FINAL ENVIRONMENTAL IMPACT STATEMENT
MAKAĪWA HILLS

ʻEwa District, Island of Oʻahu
Tax Map Keys: 9-1-15: Por. 5, 17; 9-2-03: Por. 2, Por. 5, Por. 84

TECHNICAL APPENDICES

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Appendix A
Residential Market Analysis

Makaiwa Hills:
Residential Market Study

Decision Analysts Hawai'i, Inc.

Makaiwa Hills:
Residential Market Study

Prepared for:

Makaiwa Hills, LLC

Prepared by:

Decision Analysts Hawai'i, Inc.

October 2007

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EXECUTIVE SUMMARY

1. PROPOSED DEVELOPMENT

Makaiwa Hills, LLC proposes to develop Makaiwa Hills ("the Project"), a planned residential community to be located on about 1,781 acres on the southern slopes of the Wai'anae Mountain Range, 'Ewa District, O'ahu.[1] In addition to homes, the Project will include a Neighborhood Shopping Center; a Town Center; parks and open space; an elementary school and a middle school; and associated infrastructure (e.g., roadways, utilities, a potable water system, sewers, and drainage).

As summarized in Table ES-1, about 4,100 homes are to be provided, including affordable, market-priced, and upscale multi-family and single-family homes.[2] For each type of home, this table also shows the anticipated lot sizes for single-family homes, living areas, and the number of bedrooms and bathrooms.

The more expensive upscale homes will help cover the high infrastructure costs of hillside development, thereby making it feasible for the developer to deliver the planned affordable and market-priced homes.

2. Advantages of the Projects

The residential component of Makaiwa Hills will offer the following advantages:

— A hillside location having sweeping views overlooking Ko 'Olina Resort and the ocean beyond.

— A wide selection of homes, ranging in price from affordable to market, to upscale.

— Upscale homes on comparatively large lots, a product that is rarely offered on O'ahu.

1. The 'Ewa District is commonly referred to as 'Ewa or the Kapolei region.
2. The developer may provide the affordable homes on-site, off-site, pay an in-lieu fee, or some combination of these. For the market study, it is assumed that all of the affordable homes would be provided on-site.

— Short drives to jobs, stores, services and recreation that are available or will be available within the Project or nearby in the City of Kapolei, Ko 'Olina Resort, Campbell Industrial Park, Kalaeloa / Barbers Point Harbor, etc.

From a marketing perspective, the high visibility of the Project from the City of Kapolei, Ko 'Olina Resort, and elsewhere will help attract potential buyers.

3. ANTICIPATED BUYERS AND USES OF PROJECT HOMES

a. Affordable Homes

Due to qualifying requirements, it is anticipated that the affordable homes will be sold to established O'ahu residents who will occupy their homes. Most of the buyers will probably work in the Kapolei region, while others will commute to jobs outside the region.

b. Market Homes

Most buyers of the market-priced homes are expected to be owner-occupants, while the remaining homes will be purchased by investors who will rent to residents. Most of the buyers and renters of these homes will probably work in the Kapolei region, while others will commute to jobs outside the region.

c. Upscale Homes

Most buyers of the upscale single-family homes and a plurality of the upscale multi-family homes are expected to be executives, managers and professionals who will be working in the Kapolei region. Additional upscale homes are expected to be purchased by investors who will rent to these same categories of workers. Thus, the upscale homes at Makaiwa Hills will allow these workers to become part of the Kapolei community and contribute to it instead of commuting to Kapolei from distant communities.

To a lesser extent, buyers of the upscale homes will include: (1) wealthier retirees who are new to O'ahu and who will become owner-occupants, and (2) part-time residents who desire vacation homes or second homes on O'ahu. It is anticipated that these buyers will be drawn to Makaiwa Hills as a result of the market exposure provided by its proximity to Ko 'Olina Resort, the sweeping views, large lot sizes for many of the single-family homes, and more amenities and high-quality amenities. Upscale homes for such buyers are a common product on the Neighbor Islands.

4. ANTICIPATED PROJECT HOME PRICES

Anticipated home prices at Makaiwa Hills are shown in Table ES-1 for each type of home, including the anticipated average price and the price range (low to high). The prices reflect market conditions in late 2006, while price ranges reflect variations in home models, amenities, and views.

Prices for the affordable units at Makaiwa Hills are based on U.S. Department of Housing and Urban Development (HUD) price guidelines for Honolulu. Prices for market homes and upscale home are based on comparable new homes being sold at Makakilo and in other communities in 'Ewa and Central O'ahu.

Over time, these prices will increase in response to general price inflation, higher family incomes, and the increased desirability of a mature region.

5. HOUSING NEED

a. O'ahu

Based on an in-depth housing study conducted by SMS, Inc. for the State in 2003, an estimated 76,600 homes will have to be built on O'ahu between 2006 and 2020 in order to keep pace with demand and draw down the housing deficit. However, known residential projects planned and proposed for O'ahu include less than 57,000 homes, of which about 48,500 homes or less are likely to be built by 2020. Thus, there is a shortfall of about 28,100 homes. Without the 4,100 homes provided by Makaiwa Hills, this shortfall would amount to about 32,200 homes.

b. Kapolei Region

In 2005, Decision Analysts Hawai'i, Inc. prepared economic and population growth projections for the Kapolei region based on planned private and public projects. The large amount and wide variety of development that is likely to occur, along with the related economic and population projections, indicate that a major transformation of 'Ewa is occurring from its past role as largely a suburb of Honolulu's Primary Urban Center, to its current and future role as O'ahu's second full-service urban center. As a result of this ongoing transformation, growth in the Kapolei region is likely to continue at a sustained pace.

For the 15-year period from 2006 to 2020, the projections indicate that about 23,300 homes will be built and sold in 'Ewa. This projection reflects likely development although, as indicated in the previous subsection, demand is likely to exceed the number of homes that will actually be built.

Without Makaiwa Hills, it is theoretically possible that other planned and proposed projects in 'Ewa could supply these homes. However, this would accelerate development of the remaining agricultural lands in 'Ewa that are within the City's Urban Growth Boundary. In practice, however, the State or City might deny some proposed 'Ewa Plain projects in full or in part, or developers might encounter delays in obtaining approvals, obtaining financing, building infrastructure, etc. Therefore, without Makaiwa Hills, there is a risk of a regional shortfall in housing production by 2020.

In view of the above, Makaiwa Hills will help supply needed housing on O'ahu and in 'Ewa up to about 2020.

6. ANTICIPATED ABSORPTION RATES AND DURATIONS

a. Affordable and Market-priced Homes

During the 2009-to-2020 development period for Makaiwa Hills, an annual average of more than 1,300 affordable and market-priced homes are projected for 'Ewa. Makaiwa Hills could capture about 15% or more of this market, an estimate based on the Project's locational advantages (near jobs, stores, service centers, etc.), sweeping views, and competitive pricing. It is therefore expected that sales of affordable and market-priced homes at Makaiwa Hills will average about 195 homes per year (1,300 homes per year x 15%). At this rate, the 2,332 affordable homes and market-priced homes at Makaiwa Hills could be absorbed in about 12 years.

b. Upscale Homes

During the 2009-to-2020 period, an annual average of about 240 upscale homes and resort-residential homes are projected for 'Ewa. It is estimated that Makaiwa Hills could capture about 65% or more of this market, an estimate based on the Project's locational advantages, large lots and homes, sweeping views, and anticipated home prices that will be far lower than those at Ko 'Olina Resort. Thus, sales of upscale homes at Makaiwa Hills are expected to average about 156 homes per year (240 homes per year x 65%). At this rate, the 1,768 upscale homes at Makaiwa Hills could be absorbed in about 11 years.

7. IMPACT OF THE PROJECT ON THE HOUSING MARKET

Makaiwa Hills will help house 'Ewa's growing population, and help moderate housing prices on O'ahu by supplying:

— about 1,230 homes at affordable prices that are below market prices;

— about 1,102 homes at market prices in competition with other residential projects in the Kapolei region and Central O'ahu, and in competition with existing communities throughout the island; and

— about 1,768 upscale homes in competition with the few projects in the Kapolei region and Central O'ahu that offer upscale homes, and in competition with existing communities that have upscale homes.

Table ES 1. Makaiwa Hills: Proposed Residential Development, Anticipated Prices, and Anticipated Years for Absorption

Type of Home	Anticipated Development				Approximate Prices (2006$)			Years to Absorb
	Homes	Lot Area (sq. ft.)	Living Area (sq. ft.)	Beds/ Baths	Low	Average	High	
Multi-family (MF) Homes								
Affordable, Medium-density	900	-	850	2/2	$ 267,750	$ 315,000	$ 362,250	12
Market, Medium-density	437	-	1,200	3/2	$ 374,000	$ 440,000	$ 506,000	12
Market, Low-density	320	-	1,500	3/2.5	$ 425,000	$ 500,000	$ 575,000	12
Upscale Market, Low-density	849	-	1,600	3/2.5	$ 510,000	$ 600,000	$ 690,000	11
Subtotal, Multi-family Homes	2,506				$ 388,429	$ 456,975	$ 525,522	
Single-family (SF) Homes								
Affordable, Medium-density	330	5,000	1,250	3/2	$ 357,000	$ 420,000	$ 483,000	12
Market, Medium-density	345	5,000	1,500	3/2.5	$ 595,000	$ 700,000	$ 805,000	12
Upscale Market, Medium-density	76	5,000	2,000	4/3	$ 680,000	$ 800,000	$ 920,000	11
Upscale Market, Medium-low-density	127	7,500	2,500	4/3	$ 765,000	$ 900,000	$ 1,035,000	11
Upscale Market, Low-density	594	10,000	3,200	4/3.5	$ 850,000	$ 1,000,000	$ 1,150,000	11
Upscale Market, Estate	122	20,000	3,600	5/4	$ 1,105,000	$ 1,300,000	$ 1,495,000	11
Subtotal, Single-family Homes	1,594				$ 697,384	$ 820,452	$ 943,519	
Total Homes	**4,100**			-	$ 508,545	$ 598,288	$ 688,031	
Affordable Homes	1,230				$ 291,695	$ 343,171	$ 394,646	

Source: Decision Analysts Hawaii, Inc. 2007.

MAKAIWA HILLS:
RESIDENTIAL MARKET STUDY

1. INTRODUCTION[1]

a. Content and Purpose

Makaiwa Hills, LLC proposes to develop Makaiwa Hills ("the Project"), a planned residential community to be located on 1,780.705 acres on the southern slopes of the Wai'anae Mountain Range, 'Ewa District, O'ahu.[1] The Project is within the State Urban District and is consistent with the City's 'Ewa Development Plan; however, City zoning is Agricultural. Thus, the Project will require a change in zoning from Agriculture to a mix of Residential and Business zoning.

This report addresses the market for the proposed homes within the Project, including "affordable" (see Section 5.b), market-priced, and upscale multi-family and single-family homes. Its purpose is to provide City officials with information relevant to their decisions regarding City zoning.

b. Organization of the Report

The material below provides the following information: the location of the Project, a description of the Project components and the planned housing units, anticipated buyers and uses of the homes, anticipated home prices, the need for the Makaiwa Hills homes, anticipated absorption rates, and the impact of the Project on O'ahu's housing market. Figures and tables are at the end of this report.

c. Economic Consultant

The analysis was conducted by Decision Analysts Hawai'i, Inc., a Hawai'i-based economic-consulting firm established in 1979, and specializing in economic development, land and housing economics, feasibility studies, valuations, market analysis, public policy analysis, and the economic and fiscal impacts of projects.

1. The 'Ewa District is commonly referred to as 'Ewa or the Kapolei region. Both terms are used throughout this report.

2. LOCATION OF THE PROJECT[1]

The Project Area is *mauka* of the H-1 Freeway and below Palehua Road, and between Makakilo on the east and Waimanalo Gulch on the west (Figure 1). As shown in Figure 2, the Project Area is also defined by five TMK parcels:

—TMK 9-1-015-005 (por)	59.077 acres
—TMK 9-1-015-017 (por)	95.885 acres
—TMK 9-2-003-002 (por)	849.147 acres
—TMK 9-2-003-005 (por)	200.171 acres
—TMK 9-2-003-084 (por)	576.425 acres

3. PROJECT DESCRIPTION[1,2]

a. Project Components

The Project will include multi- and single-family homes; a Neighborhood Shopping Center; a Town Center; parks and open space; an elementary school and a middle school; and associated infrastructure (e.g., roadways, a potable water system, sewers, drainage, and other utilities). Depending upon development approvals and future market conditions, development is expected to occur over a 12-year period starting in about 2008.

b. Types of Homes and Characteristics

Table 1 lists the types of homes that will be provided at Makaiwa Hills and, for each type, the approximate lot sizes (for single-family homes), anticipated living areas, and the anticipated number of bedrooms and bathrooms. With some adjustments, the home characteristics are based on similar affordable, market and upscale homes being sold as new between August and October 2006 at Makakilo, Ocean Pointe, Mililani Mauka, and Ko 'Olina Resort.[3-5] Additional information for each type of home follows:

— Affordable multi-family medium-density homes[2]

Affordable homes in six-plexes and in buildings of three to four stories will be at the lower elevations in areas designated in Project plans as A-1, AMX-1, AMX-2 and BMX-3 (see Figures 3 and 4). They will be similar to and competitive with medium-density multi-family homes offered in Makakilo, other Kapolei communities, and Central O'ahu. Most of the homes are expected

2. The developer may provide the affordable homes on-site, off-site, pay an in-lieu fee, or some combination of these. For the market study, it is assumed that all of the affordable homes would be provided on-site.

to have about 850 sq. ft. of living area, with 2 bedrooms and 2 baths Also, the affordable units will be priced for families having incomes near or below the O'ahu median income.

— Market multi-family medium-density homes

Similar to the above, market homes in six-plexes and in buildings of three to four stories will be at the at the lower elevations in areas designated as A-1, AMX-1, AMX-2 and BMX-3 (see Figures 3 and 4). They will be similar to and competitive with medium-density multi-family homes offered in Makakilo, other Kapolei communities, and Central O'ahu. Most of the homes are expected to have about 1,200 sq. ft. of living area, with 3 bedrooms and 2 baths. Homes with views overlooking Kapolei will command higher prices.

— Market multi-family low-density homes

Market homes in two- and four-plexes and in buildings of two to three stories will be at the lower elevations in areas designated as A-1, AMX-2 and AMX-3 (see Figures 3 and 4). They will be similar to and competitive with low-density multi-family homes offered in Makakilo, other Kapolei communities, and Central O'ahu. Most of the units are expected to have about 1,500 sq. ft. of living area, with 3 bedrooms and 2.5 baths. Homes with views overlooking Kapolei will command higher prices.

— Upscale market multi-family low-density homes

Upscale market homes in two- and four-plexes and in buildings of two to three stories will be located at the lower elevations in areas designated as A-1 and AMX-1, and mauka of Ko 'Olina Resort (see Figures 3 and 4). Most of the homes are expected to have about 1,600 sq. ft. of living area, with 3 bedrooms and 2.5 baths. They will offer more and higher-quality amenities than are typical of most new multi-family homes offered in Makakilo, other Kapolei communities, and Central O'ahu. Also, they will have views of Ko 'Olina Resort and the ocean beyond. They are expected to command higher prices, reflecting their views and amenities (pools, recreational areas, etc.).

— Affordable single-family medium-density homes

Affordable homes on lots of about 5,000 sq. ft. will be at the low- to mid-elevations in areas designated as R-5, but excluding the westernmost R-5 area (see Figures 3 and 4). Most of the homes are expected to have about 1,250 sq. ft. of living area, with 3 bedrooms and 2 baths. The homes will be similar to and com-

petitive with medium-density single-family homes offered in Makakilo, other Kapolei communities, and Central O'ahu. The affordable units will be priced for families having incomes near or slightly higher than the O'ahu median income.

— Market single-family medium-density homes

Market homes on lots of about 5,000 sq. ft. will be at the low- to mid-elevations in areas designated as R-5, but excluding the westernmost R-5 area (see Figures 3 and 4). Most of the homes are expected to have about 1,500 sq. ft. of living area, with 3 bedrooms and 2.5 baths. These homes will be similar to and competitive with medium-density single-family homes offered in Makakilo, other Kapolei communities, and Central O'ahu. However, homes having views overlooking Kapolei will command higher prices.

— Upscale market, single-family homes, various lot sizes[2]

Upscale homes will be offered on lots ranging in size from about 5,000 sq. ft. to over 20,000 sq. ft. The smaller lots will be in the westernmost R-5 area, while the larger lots will be located at the higher elevations in areas designated as R 7.5, R-10 and R-20 (see Figures 3 and 4). The smaller homes are expected to have about 2,000 sq. ft. of living area, with 4 bedrooms and 3 baths, while the larger homes are expected to have about 3,600 sq. ft. of living area, with 5 bedrooms and 4 baths. These upscale homes will feature more and higher-quality amenities than most of the homes offered in Makakilo, other Kapolei communities, and Central O'ahu. Also, nearly all of them will feature sweeping views of Kapolei, Ko 'Olina, and the ocean. Homes on 20,000+ sq. ft. lots are common on the Neighbor Islands, but are rarely offered on O'ahu. Prices will reflect the larger lots, amenities, and sweeping views.

The more expensive upscale homes will help cover the high infrastructure costs of hillside development, thereby making it feasible for the developer to deliver the planned affordable and market-priced homes.

c. Number of Homes by Type

The planned number of homes of each type is summarized in Table 2. As indicated, about 4,100 homes will be provided, including:[2]

— about 900 multi-family homes at affordable prices (22% of the total)

— about 757 multi-family homes at market prices (18.5%)

- — about 849 multi-family upscale homes at premium prices (20.7%)
- — about 330 single-family homes at affordable prices (8%)
- — about 345 single-family homes at market prices (8.4%)
- — about 919 single-family upscale homes at premium prices (22.4%)

d. Summary of Project Advantages

The residential component of Makaiwa Hills will offer the following advantages:

- — A hillside location having sweeping views overlooking Ko 'Olina Resort and the ocean beyond.
- — A wide selection of homes, ranging in price from affordable to market, to upscale.
- — Upscale homes on comparatively large lots, a product that is rarely offered on O'ahu.
- — Short drives to jobs, stores, services and recreation that are available or will be available within the Project or nearby in the City of Kapolei, Ko 'Olina Resort, Campbell Industrial Park, Kalaeloa / Barbers Point Harbor, etc.

From a marketing perspective, the high visibility of the Project from the City of Kapolei, Ko 'Olina Resort, and elsewhere will help attract potential buyers.

4. ANTICIPATED BUYERS AND USES OF PROJECT HOMES

Table 3 summarizes projected sales of homes at Makaiwa Hills to various types of buyers, and the associated types of residential uses. Buyers and residential uses include: (1) established residents (kama'aina residents) who purchase and occupy their homes (owner occupants), (2) investors who will rent homes to residents, (3) retirees new to O'ahu who will occupy their homes, and (4) buyers from outside Hawai'i who purchase homes for use as vacation homes or as second homes. The projected sales and the associated residential uses are based on a combination of (1) State and County housing-affordability requirements, (2) selected comparables, and (3) sales targeted to specific markets.

a. Affordable Homes[2]

Due to qualifying requirements, it is anticipated that the affordable homes will be sold to established O'ahu residents who will occupy their homes (kama'aina resident, owner-occupant). Most of the buyers will probably work in the Kapolei region, while others will commute to jobs outside the region.

b. Market Homes

For market-priced multi-family and single-family homes, it is anticipated that about 65% and 75% of the units, respectively, will be sold to established residents who will occupy their homes, while the remainder will be sold to investors who will rent them out to existing and future residents. A higher owner-occupancy rate was estimated for single-family homes because they generally are less appealing to investors due to the higher purchase prices and higher maintenance costs.

These owner-occupant rates are consistent with those of other residential communities. In 2000, 63.7% of occupied homes in 'Ewa were owner-occupied. For Makakilo, which is the closest comparable to Makaiwa Hills, the rate was 66.7%.[6] Although Makakilo is still under development, it is an older project which has lower affordability requirements than most other projects in 'Ewa. As a result, most homes are sold at market prices, which is the subject of this subsection.

Most of the buyers and renters of market-priced homes will probably work in the Kapolei region, with others commuting to jobs outside the region.

c. Upscale Homes

Most buyers of the upscale single-family homes and a plurality of the upscale multi-family homes are expected to be executives, managers and professionals who will be working in the Kapolei region. Additional upscale homes are expected to be purchased by investors who will rent to these same categories of workers. Thus, the upscale homes at Makaiwa Hills will allow these workers to become part of the Kapolei community and contribute to it instead of commuting to Kapolei from distant communities.

To a lesser extent, buyers of the upscale homes will include: (1) wealthier retirees who are new to O'ahu and who will become owner-occupants, and (2) part-time residents who desire vacation homes or second homes on O'ahu. It is anticipated that these buyers will be drawn to Makaiwa Hills as a result of the market exposure provided by its proximity to Ko 'Olina Resort, the sweeping views, large lot sizes for many of the single-family homes, and more amenities and high-quality amenities. Upscale homes for such buyers are a common product on the Neighbor Islands.

Based on discussions with Neighbor Island realtors and developers, and on a review of property-tax records for residential projects nearly Maui and Big Island resorts, the consultant's judgment for the distribution of buyers is as shown in Table 3. The percentages could vary depending upon future market conditions, the final home product, and marketing.

5. ANTICIPATED PROJECT HOME PRICES

a. Overview of Project Home Prices

Anticipated home prices at Makaiwa Hills are shown in Table 4 for each type of home, including the anticipated average price and the price range (low to high). The prices reflect market conditions for the period August to October 2006. For each type of product, home prices are expected to range from about 15% below the average price shown in the table to about 15% or more above the average. This range reflects variations in home models, amenities and views.

Over time, Makaiwa Hills home prices will increase in response to general price inflation, higher family incomes, and the increased desirability of a mature region that offers many jobs, goods, services, and recreational opportunities. Thus, home prices may appreciate somewhat faster than the inflation rate.

b. Price Guidelines and Prices of Comparables

Prices for the affordable units are based on U.S. Department of Housing and Urban Development (HUD) price guidelines for Honolulu.[7] These prices reflect an assumed family size (a family of 4), a family income that is a given percentage of the Honolulu median income for the given family size, 28% of income applied to service a mortgage, financing of 95% of the home cost (i.e., a down payment of 5%) with a 30-year mortgage, and a Hula Mae interest rate of 4.5%. Higher down payments, possibly with help from relatives, would allow new families to afford more expensive homes than the HUD guidelines would suggest.

Prices for market homes and upscale homes at Makaiwa Hills are based on similar products being sold at Makakilo, Ocean Pointe, Mililani Mauka, and Ko 'Olina. Comparisons with Makaiwa Hills follow.

— Makakilo

The newer homes at Makakilo are the closest comparables to those planned for Makaiwa Hills. Many of the market homes and upscale homes at Makakilo are similar in terms of location, lot size, home size, view and amenities.

— Ocean Pointe and Mililani Mauka

Ocean Pointe and Mililani Mauka have market homes that are similar in size to those planned for Makaiwa Hills. Also, the newer homes at these two communities command competitive or somewhat higher prices than most other residential projects in 'Ewa and Central O'ahu. However, their lot sizes are generally smaller than those at Makaiwa Hills, and the homes do not have sweeping ocean views.

— Ko 'Olina Resort

Ko 'Olina Resort offers upscale homes that are similar in size to the upscale homes planned for Makaiwa Hills. However, the Ko 'Olina homes command high prices because of their association with Ko 'Olina Resort and the related resort amenities.

In general, home prices at Makaiwa Hills are expected to be close to or slightly higher than the prices of similar homes at Makakilo, higher than similar market homes at Ocean Pointe and Mililani Mauka, but significantly less than the upscale homes at Ko 'Olina.

For multi-family and single-family homes that are sold through the Multiple Listing Service (MLS), Tables 5 and 6 summarize statistics on recent sales and listings of multi-family and single-family homes at Makakilo, Ocean Pointe, Mililani Mauka, and Ko 'Olina. The analysis covers only new homes—that is, homes built in 2005 and 2006. Sales data cover one year ending in August 2006 (Makakilo) or October 2006 (Ocean Pointe, Mililani Mauka, and Ko 'Olina). Listings are for August 2006 (Makakilo) or October 2006 (Ocean Pointe, Mililani Mauka, and Ko 'Olina). The information covers the number of sales or listings, prices, lot sizes of single-family homes, living area, the number of bedrooms, and the number of bathrooms. As appropriate, statistics for the variables include the range (lowest and highest), the median, and the average.

For these same projects, graphs of sales and listing prices versus living area are shown in Figures 5 and 6 for multi-family and single-family homes, respectively.

c. Affordable Multi-family Homes[2]

As shown in Table 4, affordable multi-family homes at Makaiwa Hills (about 850 sq. ft. with 3 bedrooms and 2 baths) are expected to sell for an average of $315,000, and range from about $267,750 to about $362,250. This average price is approximately equal to the $312,930 price that HUD considers to be affordable for a Honolulu family earning about $64,170 in 2006—that is, an income that is about 100% of the median income for a family of three, or about 90% for a family of four.[7,8]

d. Market Multi-family Homes

As shown in Table 4, prices for medium-density market-priced multi-family homes at Makaiwa Hills (about 1,200 sq. ft., with 3 bedrooms and 2 baths) are expected to average about $440,000, and range from about $374,000 to $506,000. The average price is close to that of similar homes at Makakilo, Ocean Pointe, and Mililani Mauka (see Table 5 and Figure 5).

Prices for low-density market-priced multi-family homes at Makaiwa Hills (about 1,500 sq. ft. with 3 bedrooms and 2.5 baths) are expected average about $500,000, and range from about $425,000 to $575,000). The average price is close to that of similar homes at Makakilo (Table 5 and Figure 5).

e. Upscale Multi-family Homes

Prices for upscale low-density multi-family homes (about 1,600 sq. ft. with 3 bedrooms and 2.5 baths) are expected to average about $600,000, and range from about $510,000 to about $690,000 (Table 4). Compared to similar market-priced homes, the higher prices for the upscale homes reflect an estimated premium of about $100,000 for larger sizes, more and higher-quality amenities, and better views. However, the price is expected to be at least $100,000 less than similar upscale homes at Ko 'Olina (Table 5 and Figure 5).

f. Affordable Single-family Homes[2]

Prices for affordable single-family homes at Makaiwa (5,000 sq. ft. lot, 1,250 sq. ft. living area, 3 bedrooms and 2 baths) are expected to average about $420,000, and range from about $357,000 to about $483,000 (Table 4). This average price is approximately equal to the $417,200 price that HUD considers to be affordable for a Honolulu family earning about $85,560 in 2006—that is, their income is about 120% of the median income for a family of four.

g. Market Single-family Homes

Prices for market single-family medium-density homes (5,000 sq. ft. lot, 1,500 sq. ft. living area, 3 bedrooms and 2.5 baths) are expected to average about $700,000, and range from about $595,000 to about $805,000 (Table 4). The average price is close to that of similar homes at Makakilo (Table 6 and Figure 6).

h. Upscale Single-family Homes

For the various types of upscale single-family homes (Table 1), average prices are expected to range from about $800,000 to about $1.3 million, plus or minus about 15% (Table 4). These prices are consistent with or slightly higher than the prices of similar new upscale single-family homes being sold at Makakilo in 2006 (Table 6 and Figure 6). However, the prices are well below those of upscale homes at Ko 'Olina.

6. HOUSING NEED

a. O'ahu

Demand

In 2003, SMS Research & Marketing Service (SMS) prepared an in-depth housing study for various State agencies. In this study, SMS estimated that O'ahu had a deficit of about 22,400 homes in 2002, and that this deficit would decline to about 12,100 in 2006 based on projected development averaging about 5,800 new homes per year.[9] However, the number of building permits issued between 2002 and 2006 indicate that less than 3,000 new homes per year were built during this 4-year period, resulting in a shortfall in production of about 2,800 homes a year. Thus, the 2006 housing deficit is estimated to exceed 23,000 homes (12,100 homes + 4 years x 2,800 homes / year shortfall).

To keep pace with the island-wide housing demand and draw down the estimated housing deficit, the SMS study further projected development averaging about 5,700 homes per year in 2007 and 2008. Again, building permits issued suggest that development at this pace is unlikely.

From 2009 through 2020—that is, the anticipated development period for Makaiwa Hills—the SMS study projected development averaging about 4,200 homes per year. By 2020, the housing deficit would be drawn down to about 8,200 homes.

To meet O'ahu's housing demand, an estimated 76,600 homes would have to be built between 2006 and 2020 (23,000 home deficit in 2006 + 5,700 homes / year for 2 years + 4,200 homes / year for 12 years – 8,200 home deficit in 2020).

Supply: Planned and Proposed Residential Projects

Known residential projects planned and proposed for O'ahu are listed in Table 7. As shown, the total is less than 57,000 homes. A number of these projects lack State and / or City entitlements. Thus, actual development could be less. Also, the development period for some of the major projects—such as Ho'opili (11,750 homes), UH West O'ahu (4,041 homes), Koa Ridge (5,500 homes), Waiawa by Castle & Cooke (1,350 homes), Waiawa by Gentry (5,280 homes)—could extend beyond 2020. Assuming that about 30% of the homes in these projects are built after 2020, the adjusted supply of planned and proposed homes that could be built by 2020 amounts to less than 48,500 homes (56,849 homes – 30% of 27,921 homes).

Shortfall of Homes

By 2020, a projected shortfall of 28,100 homes is indicated by a projected demand of about 76,600 homes less a supply of about 48,500 planned and proposed homes. Without the 4,100 homes provided by Makaiwa Hills, this shortfall would amount to about 32,200 homes.

b. Kapolei Region

Overview of Projected Growth

In 2005, Decision Analysts Hawai'i, Inc. (DAHI) prepared economic and population growth projections for the Kapolei region.[10] Sponsored by the Aina Nui Corporation in cooperation with other major developers in 'Ewa, this study projects likely development in 'Ewa based on the details of planned private and public projects in 'Ewa. The development plans include, but are not limited to, residential, resort, commercial, industrial, university, harbor, civic and infrastructure projects. As summarized in Table 8, the projections covered the period from 2006 to 2025, and addressed the anticipated growth in the following areas: the resident and visitor population; employment; residential, resort, commercial, and industrial development; and government projects. The figures reported in Table 8 are presented in terms of average annual growth.

The large amount and wide variety of development in the Kapolei / 'Ewa region, along with the related economic and population projections, indicate that a major transformation of 'Ewa is occurring from its past role as largely a suburb of Honolulu's Primary Urban Center, to its current and future role as O'ahu's second full-service urban center. As such, the City of Kapolei and the 'Ewa / Kapolei region will increasingly become major suppliers of (1) jobs for those who live in 'Ewa and surrounding communities, and (2) a full range of goods and services (both private and public) to residents, visitors, and businesses in Kapolei and beyond. As a result of this ongoing transformation, and as indicated by the projections in Table 8, growth in the Kapolei region is likely to continue at a sustained pace.

Residential Development

For the 15-year period from 2006 to 2020, the projection in Table 8 indicates that about 23,300 homes will be built in 'Ewa (5 years at an average rate of 1,560 homes per year + 10 years at 1,545 homes per year). This projection reflects likely development although, as indicated in the previous subsection, demand is likely to exceed the number of homes that will actually be built.

In Table 7, planned and proposed residential development for 'Ewa totals about 35,500 homes, including affordable, market, upscale, and resort-residential homes. This is a 23-year supply at the rate of development shown in Table 8. Without Makaiwa Hills, the planned and proposed homes for 'Ewa total about 31,400 homes (35,500 homes – 4,100 homes for Makaiwa Hills). This is about 8,100 more homes than projected for the 2006-to2020 period (31,400 homes planned and proposed – 23,300 new homes projected).

Without Makaiwa Hills, it is theoretically possible that other planned and proposed projects in 'Ewa could supply these homes. However, this would accelerate development of the remaining agricultural lands in 'Ewa that are within the City's Urban Growth Boundary. In practice, however, the State or City might deny some proposed 'Ewa Plain projects in full or in part, or developers might encounter delays in obtaining approvals, obtaining financing, building infrastructure, etc. Therefore, without Makaiwa Hills, there is a risk of a regional shortfall in housing production by 2020.

In view of the above, Makaiwa Hills will help supply needed housing on O'ahu and in 'Ewa up to about 2020. Furthermore, the Project will foster competition among developers, thereby providing more choices to home buyers and moderating housing prices.

7. ANTICIPATED ABSORPTION RATES AND DURATIONS

a. Affordable and Market-priced Homes

Table 8 indicates that, during the 2009-to-2020 development period for Makaiwa Hills, an annual average of more than 1,300 affordable and market-priced homes will be built and sold in 'Ewa (7 years at 640 + 690 homes + 5 years at 560 + 730 homes). It is estimated that Makaiwa Hills could capture about 15% or more of this market. This is based on the Project's locational advantages (near jobs, stores, service centers, etc.), sweeping views, and competitive pricing. It is therefore expected that sales of affordable and market-priced homes at Makaiwa Hills will average about 195 homes per year (1,300 homes per year x 15%).

As indicated in Table 2, Makaiwa Hills will provide about 2,332 affordable homes and market-priced homes (900 + 437 + 320 + 330 + 345). Assuming sales averaging 195 homes per year, this inventory could be absorbed in about 12 years.

b. Upscale Homes, All Uses

Table 8 indicates that, during the 2009-to-2020 period, an annual average of about 240 upscale homes and resort-residential homes will be built and sold in 'Ewa (7 years at 70 + 160 homes + 5 years at 85 + 170 homes). It is estimated that Makaiwa Hills could capture about 65% or more of this market. This is based on the Project's locational advantages (near jobs, stores, service centers, etc.), large lots and homes, sweeping views, and anticipated home prices that will be far lower than those at Ko 'Olina Resort. Thus, sales of upscale homes at Makaiwa Hills are expected to average about 156 homes per year (240 homes per year x 65%).

As indicated in Table 2, Makaiwa Hills will provide about 1,768 upscale homes (849 +76 +127 + 594 + 122). Assuming sales averaging 156 homes per year, this inventory could be absorbed in about 11 years.

The next two subsections provide a cross-check of this estimate based on (1) residential use of most of the upscale homes at Makaiwa Hills, and (2) vacation-home and second-home use of the remaining upscale homes.

c. Upscale Homes, Residential Use

Table 8 indicates that, during the 2009-to-2020 period, an annual average of about 1,550 homes of all types will be built and sold in 'Ewa (7 years at 1,560 homes + 5 years at 1,545 homes). Although not shown in Table 8, about 90 of these homes will be used as vacation homes and second homes, leaving about 1,455 homes for residential use.[10] Assuming a 4% vacancy rate, this number of homes provides housing for about 1,400 new families per year.

In 1999, 18.2% of the households on O'ahu had incomes that were 192.6% or more of the median family income.[6] In terms of 2006 conditions, this translates into a family income of over $137,000 per year.

Assuming that this income distribution applies to potential new buyers and renters of homes in 'Ewa, and that the higher income families comprise most of the buyers and renters of upscale homes in 'Ewa, then about 255 upscale homes per year would be sold or rented to these higher-income families (1,400 families x 18.2%).

As before, it is estimated that Makaiwa Hills could capture about 65% or more of this market. This is based on the Project's locational advantages (near jobs, stores, service centers, etc.), sweeping views, and anticipated homes prices that will be far lower than those at Ko 'Olina Resort. It is therefore expected that sales of upscale homes at Makaiwa Hills for use by residents will average about 160 homes per year (250 homes per year x 65%).

In Table 3, an estimated 1,595 upscale homes will be occupied by kama'aina residents and new retirees to O'ahu (340 + 170 + 212 + 53 + 8 + 11 + 89 + 13 + 19 + 416 + 59 +89 + 86 + 12 + 18). This use could be fulfilled in about 10 years (1,595 homes ÷ 160 homes per year).

d. Upscale Homes, Vacation-home and Second-home Use

As mentioned above, the projections for upscale homes and resort-residential homes shown in Table 8 include an average of about 90 homes per year that would be sold during the 2009-to-2020 period for use as vacation homes or second homes. Most of these homes will be located at Ko 'Olina and Kapolei West. However, some who buy upscale homes as vacation homes and second homes will be attracted to Makaiwa Hills because of the larger lots for single-family homes, better views and, compared to Ko 'Olina, much lower prices. And, as

mentioned previously, the high visibility of Makaiwa Hills from the City of Kapolei and elsewhere will help attract potential buyers.

Based on these comparative advantages, it is conservatively estimated that Makaiwa Hills will attract 20% of this market, or about 18 homes per year (90 homes per year x 20%).

As shown in Table 3, an estimated 173 upscale homes at Makaiwa Hills will be used for vacation homes or second homes. This use could be fulfilled in about 10 years (173 homes ÷ 18 homes per year).

8. IMPACT OF THE PROJECT ON THE HOUSING MARKET

Makaiwa Hills will help house 'Ewa's growing population, and help moderate housing prices on O'ahu by supplying:

— about 1,230 homes at affordable prices that are below market prices;

— about 1,102 homes at market prices in competition with other residential projects in the Kapolei region and Central O'ahu, and in competition with existing communities throughout the island; and

— about 1,768 upscale homes in competition with the few projects in the Kapolei region and Central O'ahu that offer upscale homes, and in competition with existing communities that have upscale homes.

9. REFERENCES

[1] Group 70 International, Inc. "Makaiwa Hills, Environmental Impact Statement Preparation Notice." October 2006.

[2] Group 70 International, Inc. 2006 and 2007.

[3] Hawai'i Information Services. 2006.

[4] Ocean Pointe. 2006.

[5] Castle & Cooke. 2006.

[6] U.S. Census. 2000.

[7] U.S. Department of Housing and Urban Development. "Affordable Sales Guidelines, Honolulu." 2006.

[8] U.S. Department of Housing and Urban Development. "Income Schedule by Family Size, Honolulu." 2006.

[9] SMS, Inc. *Hawai'i Housing Policy Study, 2003.* December 2003.

[10] Decision Analysts Hawai'i, Inc. "'Ewa Development, 2006 to 2025: Economic, Population and Fiscal Impacts. September 2005.

REPORT FIGURES

Figure 1. Project Location Map

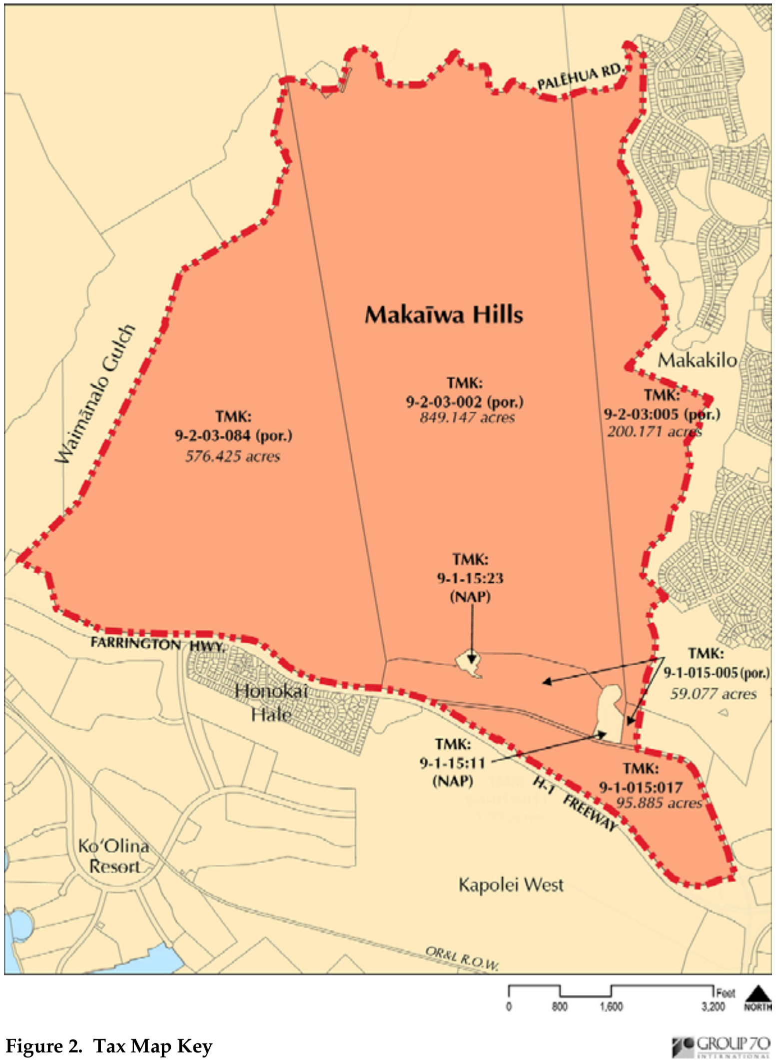

Figure 2. Tax Map Key

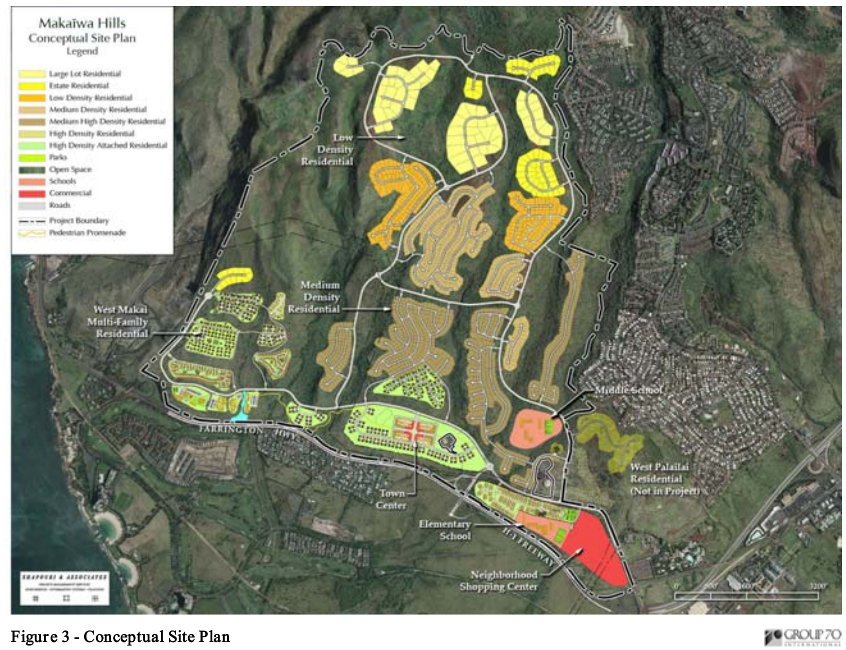

Figure 3 - Conceptual Site Plan

MAKAĪWA HILLS

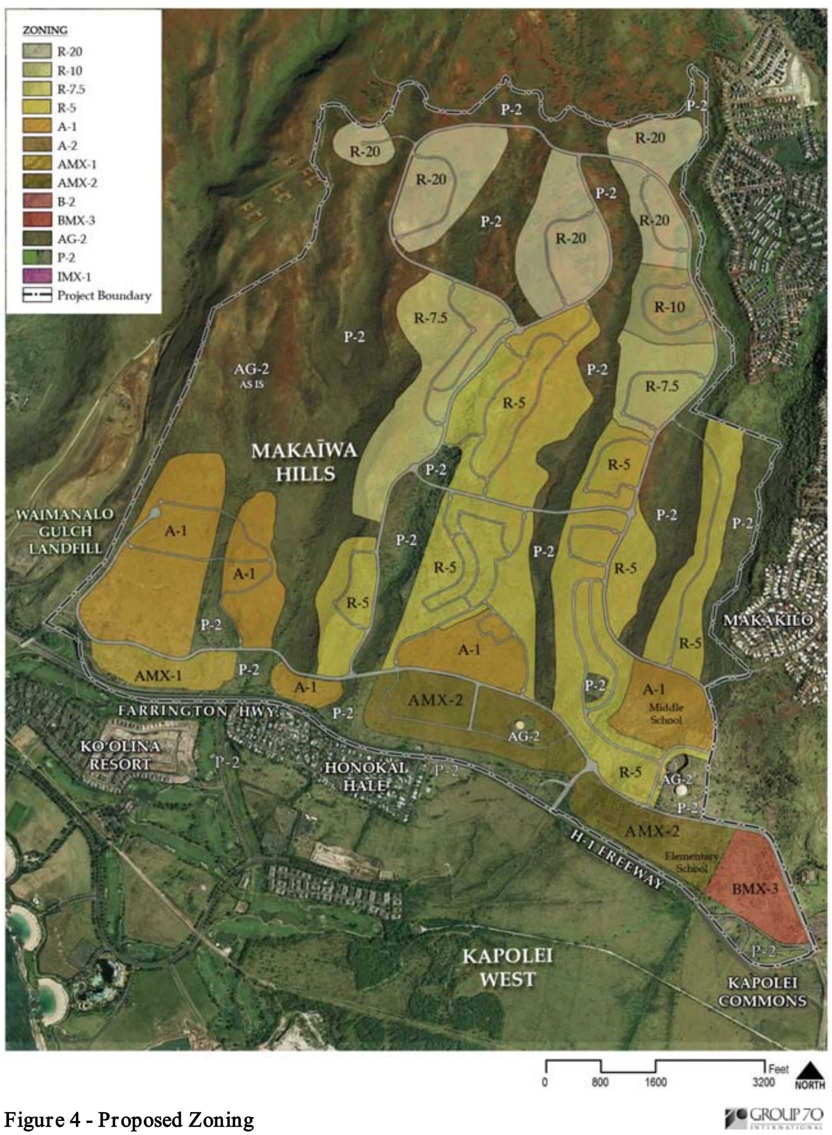

Figure 4 - Proposed Zoning

Figure 5. Prices of New Multi-family Homes, Selected Projects, 2006

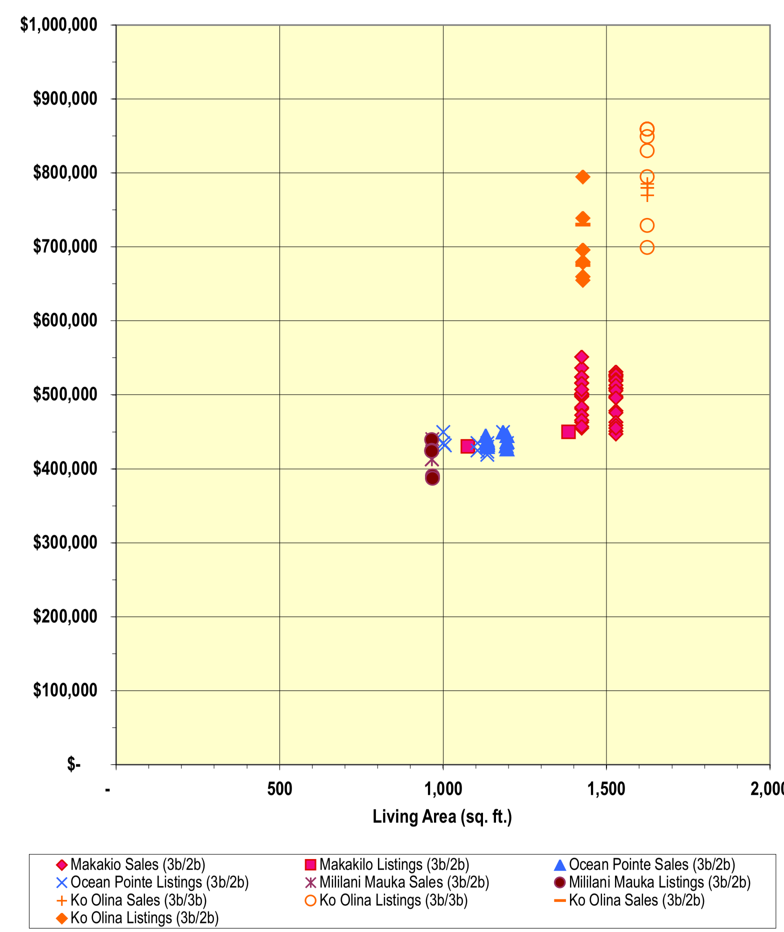

Figure 6. Prices of New Single-family Homes, Selected Projects, 2006

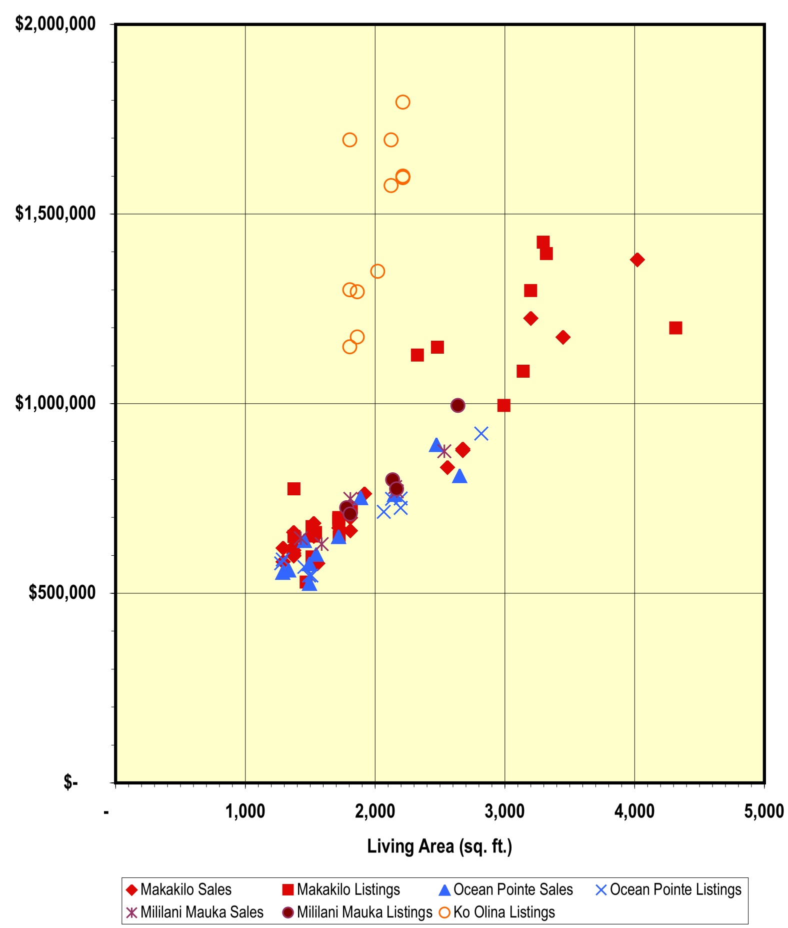

Table 1. Makaiwa Hills: Types of Homes and Anticipated Characteristics

Type of Home	Average Lot Area (sq. ft.)	Approximate Living Area (sq. ft.)	Typical Number of Bedrooms	Typical Number of Bathrooms
Multi-family (MF) Homes				
Affordable, Medium-density (A-1; AMX-1,2; BMX-3)	-	850	2	2.0
Market, Medium-density (AMX-2, BMX-3)	-	1,200	3	2.0
Market, Low-density (A-1)	-	1,500	3	2.5
Upscale Market, Low-density (A-1, AMX-1)	-	1,600	3	2.5
Single-family (SF) Homes				
Affordable, Medium-density (R-5)	5,000	1,250	3	2.0
Market, Medium-density (R-5)	5,000	1,500	3	2.5
Upscale Market, Medium-density (R-5)	5,000	2,000	4	3.0
Upscale Market, Medium-low-density (R-7.5)	7,500	2,500	4	3.0
Upscale Market, Low-density (A-1, R-10)	10,000	3,200	4	3.5
Upscale Market, Estate (R-20)	20,000	3,600	5	4.0

Source: Decision Analysts Hawaii, Inc. 2007.

Table 2. Makaiwa Hills: Proposed Residential Development

Type of Home	Approximate Number of Homes	Approximate Distribution
Multi-family (MF) Homes		
Affordable, Medium-density (A-1; AMX-1,2; BMX-3)	900	22.0%
Market, Medium-density (AMX-2, BMX-3)	437	10.7%
Market, Low-density (A-1)	320	7.8%
Upscale Market, Low-density (A-1, AMX-1)	849	20.7%
Subtotal, Multi-family Homes	2,506	61.2%
Single-family (SF) Homes		
Affordable, Medium-density (R-5)	330	8.0%
Market, Medium-density (R-5)	345	8.4%
Upscale Market, Medium-density (R-5)	76	1.9%
Upscale Market, Medium-low-density (R-7.5)	127	3.1%
Upscale Market, Low-density (A-1, R-10)	594	14.5%
Upscale Market, Estate (R-20)	122	3.0%
Subtotal, Single-family Homes	1,594	38.9%
Total Homes	**4,100**	100%
Affordable Homes	1,230	30%

Sources:
Group 70 International, Inc. 2007.
Decision Analysts Hawaii. Inc. 2007.

Table 3. Makaiwa Hills: Anticipated Buyers and Uses of Homes

Type of Home	Buyer/Use of Home: Kama'aina Resident/ Owner-Occupant	Investor/ Residential Rental	Retiree New to Oahu/ Owner-Occupant	Non-resident/ Vacation Home or Second Home	Total
NUMBER OF HOMES					
Multi-family (MF) Homes					
Affordable, Medium-density (A-1; AMX-1,2; BMX-3)	900				900
Market, Medium-density (AMX-2, BMX-3)	284	153			437
Market, Low-density (A-1)	208	112			320
Upscale Market, Low-density (A-1, AMX-1)	340	170	212	127	849
Subtotal, Multi-family Homes	1,732	435	212	127	2,506
Single-family (SF) Homes					
Affordable, Medium-density (R-5)	330				330
Market, Medium-density (R-5)	259	86			345
Upscale Market, Medium-density (R-5)	53	8	11	4	76
Upscale Market, Medium-low-density (R-7.5)	89	13	19	6	127
Upscale Market, Low-density (A-1, R-10)	416	59	89	30	594
Upscale Market, Estate (R-20)	86	12	18	6	122
Subtotal, Single-family Homes	1,233	178	137	46	1,594
Total Homes	2,965	613	349	173	**4,100**
Affordable Homes	1,230				1,230
DISTRIBUTION					
Multi-family (MF) Homes					
Affordable, Medium-density (A-1; AMX-1,2; BMX-3)	100%				100%
Market, Medium-density (AMX-2, BMX-3)	65%	35%			100%
Market, Low-density (A-1)	65%	35%			100%
Upscale Market, Low-density (A-1, AMX-1)	40%	20%	25%	15%	100%
Subtotal, Multi-family Homes	69.1%	17.4%	8.5%	5.1%	100%
Single-family (SF) Homes					
Affordable, Medium-density (R-5)	100%				100%
Market, Medium-density (R-5)	75%	25%			100%
Upscale Market, Medium-density (R-5)	70%	10%	15%	5%	100%
Upscale Market, Medium-low-density (R-7.5)	70%	10%	15%	5%	100%
Upscale Market, Low-density (A-1, R-10)	70%	10%	15%	5%	100%
Upscale Market, Estate (R-20)	70%	10%	15%	5%	100%
Subtotal, Single-family Homes	77.4%	11.2%	8.6%	2.9%	100%
Total Homes	72.3%	15.0%	8.5%	4.2%	100%
Affordable Homes	100%	0%	0%	0%	100%

Source: Decision Analysts Hawaii, Inc. 2007.

Table 4. Makaiwa Hills: Anticipated Home Prices

(Prices in 2006 dollars)

Type of Home	Prices: Low	Average	High
Multi-family (MF) Home Prices			
Affordable, Medium-density (A-1; AMX-1,2; BMX-3)	$ 267,750	$ 315,000	$ 362,250
Market, Medium-density (AMX-2, BMX-3)	$ 374,000	$ 440,000	$ 506,000
Market, Low-density (A-1)	$ 425,000	$ 500,000	$ 575,000
Upscale Market, Low-density (A-1, AMX-1)	$ 510,000	$ 600,000	$ 690,000
Average Price, Multi-family Homes	$ 391,699	$ 460,822	$ 529,946
Single-family (SF) Home Prices			
Affordable, Medium-density (R-5)	$ 357,000	$ 420,000	$ 483,000
Market, Medium-density (R-5)	$ 595,000	$ 700,000	$ 805,000
Upscale Market, Medium-density (R-5)	$ 680,000	$ 800,000	$ 920,000
Upscale Market, Medium-low-density (R-7.5)	$ 765,000	$ 900,000	$ 1,035,000
Upscale Market, Low-density (A-1, R-10)	$ 850,000	$ 1,000,000	$ 1,150,000
Upscale Market, Estate (R-20)	$ 1,105,000	$ 1,300,000	$ 1,495,000
Average Price, Single-family Homes	$ 697,326	$ 820,383	$ 943,440
Average Price, All Homes	$ 512,384	$ 602,805	$ 693,226
Average Price, Affordable Homes	$ 291,695	$ 343,171	$ 394,646

Source: Decision Analysts Hawaii, Inc. 2007.

Table 5. Selected MLS Sales and Listings, Multi-family Homes, 2006

Age: All homes were built in 2005 or 2006
Sales: Over past year, ending in August or October 2006
Listing Date: August or October 2006

Item	Number	Living Area (sq. ft.)		Price			
		Low	High	Lowest	Median	Average	Highest
Makakilo–3 bed, 2 bath							
Recent Sales	42	1,424	1,529	$ 446,983	$ 501,388	$ 497,094	$ 551,414
Listings	2	1,076	1,384	$ 430,000			$ 449,888
Ocean Pointe–3 bed, 2 bath							
Recent Sales	16	1,130	1,196	$ 427,000	$ 435,500	$ 436,250	$ 450,000
Listings	11	1,076	1,384	$ 419,000	$ 434,990	$ 433,506	$ 450,000
Mililani Mauka–3 bed, 2 bath							
Recent Sales	4	966	967	$ 412,500	$ 421,500	$ 423,875	$ 440,000
Listings	5	966	968	$ 387,000	$ 423,900	$ 412,980	$ 439,000
Ko Olina–3 bed, 2 bath							
Recent Sales	3	1,427	1,427	$ 675,000	$ 730,000	$ 711,667	$ 730,000
Listings	9			$ 655,000	$ 680,000	$ 695,556	$ 795,000
Ko Olina–3 bed, 3 bath							
Recent Sales	4	1,625	1,625	$ 770,000	$ 780,000	$ 778,750	$ 785,000
Listings	7	1,625	1,625	$ 699,000	$ 830,000	$ 802,857	$ 859,000

Source: Hawaii Information Services. 2006.

Table 6. Selected MLS Sales and Listings, Single-family Homes, 2006

Age: All homes were built in 2005 or 2006
Sales: Over past year, ending in August or October 2006
Listing Date: August or October 2006

Item	Number	Lowest	Median	Average	Highest
Makakilo					
Recent Sales	41	$ 579,000	$ 661,413	$ 746,951	$ 1,380,000
Lot (sq. ft.)		3,100	5,006	6,457	13,611
Living Area (sq. ft.)		1,291	1,528	1,906	4,022
Bedrooms		3.0	4.0	4.0	5.0
Bathrooms		2.0	2.0	2.3	4.0
Listings	20	$ 529,000	$ 712,000	$ 883,145	$ 1,425,000
Lot (sq. ft.)		3,017	5,600	6,730	14,829
Living Area (sq. ft.)		1,376	1,722	2,205	4,319
Bedrooms		3.0	4.0	3.9	5.0
Bathrooms		2.0	2.5	2.6	4.0
Ocean Pointe					
Recent Sales	11	$ 526,000	$ 638,869	$ 665,989	$ 892,048
Lot (sq. ft.)		3,120	4,138	4,209	5,368
Living Area (sq. ft.)		1,288	1,544	1,772	2,653
Bedrooms		3.0	3.0	3.5	5.0
Bathrooms		2.0	2.0	2.4	3.0
Listings	10	$ 546,900	$ 651,920	$ 669,063	$ 920,990
Lot (sq. ft.)		3,583	4,396	4,551	5,937
Living Area (sq. ft.)		1,275	1,789	1,843	2,819
Bedrooms		3.0	4.0	3.9	5.0
Bathrooms		2.0	3.0	2.6	3.0
Mililani Mauka					
Recent Sales	6	$ 630,000	$ 759,000	$ 741,167	$ 874,000
Lot (sq. ft.)		3,897	4,912	5,320	7,897
Living Area (sq. ft.)		1,428	1,983	1,947	2,532
Bedrooms		3.0	3.0	3.3	4.0
Bathrooms		2.0	2.0	2.2	3.0
Listings	5	$ 709,000	$ 775,000	$ 800,600	$ 995,000
Lot (sq. ft.)		3,634	4,680	4,687	6,064
Living Area (sq. ft.)		1,782	2,137	2,107	2,640
Bedrooms		3.0	3.0	3.6	5.0
Bathrooms		2.0	2.0	2.2	3.0
Ko Olina					
Recent Sales	-				
Listings	11	$ 1,149,000	$ 1,575,000	$ 1,474,818	$ 1,795,000
Lot (sq. ft.)		5,655	6,186	6,490	10,762
Living Area (sq. ft.)		1,806	2,020	2,006	2,216
Bedrooms		3.0	3.0	3.4	4.0
Bathrooms		2.0	2.0	2.4	3.0

Source: Hawaii Information Services. 2006.

Table 7. Planned and Proposed Housing Projects, Oahu, 2006

(2006)

Project	Location	Homes
Ewa		
East Kapolei	Kapolei	1,403
Ewa by Gentry	Ewa	1,950
Franciscan Vistas Ewa	Ewa	328
Hoopili	Ewa	11,750
Kapolei Mauka	Kapolei	750
Kapolei Mixed Use	Kapolei	300
Kapolei West	Kapolei	2,370
Ko Olina Resort & Marina	Ko Olina	1,825
Leihano Senior Living Village	Kapolei	650
Makaiwa Hills	Makakilo	4,100
Mehuna	Kapolei	1,150
Ocean Pointe	Ewa	2,750
Schuler Makakilo	Makakilo	453
UH West Oahu	Ewa	4,041
Villages of Kapolei	Kapolei	1,330
Waikoloi	Makakilo	308
Total Ewa		35,458
Central Oahu		
California Ave. Apartments	Wahiawa	42
Koa Ridge	near Waipio	5,500
Mililani Mauka	Mililani	443
Mokulola Vista	Waipahu	70
Plantation Apartments	Waipahu	330
Royal Kunia II	Kunia	2,000
Waiawa by Castle & Cooke	Waiawa	1,350
Waiawa by Gentry	Waiawa	5,280
Waipio Point	Waipio	38
Total Central Oahu		15,053
Waianae		
Nanaikeola Senior Apartments	Waianae	70
Nanaikeola Village	Waianae	132
Ohana Ola o Kahumana, Phase II	Waianae	34
Sea Country	Waianae	390
Village Pokai Bay	Waianae	125
Waianae Transitional Housing	Waianae	55
Total Waianae		806
Windward Oahu		
Bay View Estates	Kaneohe	19
Hawaii Resources, Inc.	Malaekahana	550
Ironwoods	Kailua	153
Kakaina Street	Waimanalo	50
Kumuhau	Waimanalo	60
Woods at Ahuimanu	Ahuimanu	44
Total Windward Oahu		876

Table 7. Planned and Proposed Housing Projects, Oahu, 2006

(2006)

Project	Location	Homes
Honolulu		
15 Craigside	Nuuanu	170
1700 Kalakaua	Pawaa	120
909 Kapiolani	Kakaako	225
Allure Waikiki	Waikiki	305
Capitol Place	Downtown	394
Country Club Village	Salt Lake	159
Ford Island	Pearl Harbor	430
Hale Alii	Hawaii Kai	296
Keola Lai	Kakaako	352
Koolua	Kakaako	186
Loft at Waikiki	Waikiki	36
Moana Pacific	Kakaako	706
Moana Vista	Kakaako	492
NCR Building	Kakaako	47
Palolo Chinese Home	Palolo	88
The Pinnacle	Downtown	50
Tusitala Vista	Waikiki	107
Waikiki Palms	Waikiki	116
Ward Village Shops	Kakaako	165
Watermark Waikiki	Waikiki	212
Total Honolulu		4,656
TOTAL		56,849

Sources:

Department of Planning and Permitting, City & County of Honolulu. 2005.

Honolulu Advertiser. "60,000 New Homes Planned for Oahu." September 19, 2006.

Information provided by developers.

Table 8. 'Ewa Economic and Population Growth: 2005 to 2025

(excludes Kalaeloa)

Item	Average Annual Growth 2006 to 2015	Average Annual Growth 2016 to 2025
Population		
Residents	4,505	4,397
Part-time residents	80	88
Visitors	284	155
Total Population	4,869	4,640
Employment		
Workers	1,944	1,885
Jobs (excludes infrastructure O&M, trash removal, trucking & delivery, and utilities)	2,127	1,859
Residential		
Affordable and Market Single-family Homes	640	560
Affordable and Market Multi-family Homes	690	730
Upscale and Resort-residential Single-family Homes	70	85
Upscale and Resort-residential Multi-family Homes	160	170
Total Homes	1,560	1,545
Resort		
Hotel Rooms	120	30
Time-share Units	35	40
Total Resort Units	155	70
Commercial Space (sf)		
Retail	188,500	169,000
Offices	101,500	91,000
Total Commercial Space	290,000	260,000
Industrial/Distribution (sf)		
Light	522,720	522,720
Heavy	272,250	283,140
Total Industrial Space	794,970	805,860
Government		
City Offices (sf–City Hall, Police Station, etc.)	18,000	17,000
State Offices (sf–Courts, etc.)	59,000	33,000
Public Schools, K to 12 (students)	864	838
UH West Oahu (students)	275	625

Source: Decision Analysts Hawai'i, Inc. "'Ewa Development, 2006 to 2025: Economic, Population and Fiscal Impacts." September 2005.

Appendix B
Commercial Market Analysis

Colliers Hawaii Consulting

Makaiwa Hills Commercial Development Market Assessment and Feasibility Study

Prepared for Makaiwa Hills LLC

Mike Y Hamasu
Director of Research & Consulting
8/1/05

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Executive Summary

Makaiwa Hills LLC contracted with Colliers Hawaii Consulting, a division of Colliers Monroe Friedlander, Inc. to provide a market feasibility study that would assist the with the determination of the highest and best use for their commercial development site in west Kapolei.

Feasibility
This study evaluated current commercial real estate market conditions, existing and projected rental rate levels and population growth and consumer expenditures models. It identified that a retail use would be the most feasible commercial development for this site.

Our survey of the current rental rates for retail, office and industrial properties in the West Oahu market indicates that retail net base rents for new retail developments range from $3.00 to $3.50 per square foot per month (psf/mo). These rents are significantly higher than those of office or industrial uses.

This site's location, which is central to the growing residential communities of Kapolei, Makakilo and Ewa Beach, is ideal for a retail development. The projected population growth and the forecasted growth in consumer expenditures in this area could support additional retail development of up to 3.0 million square feet by 2025.

For the Makaiwa Hills Commercial Development site we recommend a three phase build-out of a retail mixed-use development which includes an office component, a medical clinic/wellness facility and a large neighborhood shopping center/retail town center. The total development would range in size from 800,000 to 950,000 square feet and be built over a 10-15 year time period. The total development would range in size from roughly 73 to 87 acres (using a 0.25 FAR).

Our analysis of the current level of retail expenditures in the area indicates that there is tremendous retail potential for retailers that provide general merchandise, apparel, food and beverage, sports and recreation activities as well as educational services. Our study identified that residents of the primary trade area currently spend a considerable portion of their consumer dollars outside of the area.

Competition
Currently, there are three existing shopping centers and six proposed retail developments that would serve as the primary competition to the Makaiwa Hills commercial site. Pearlridge Center, Waikele Center and Pearl Highlands Center combined constitute over 3.0 million retail square feet in the area. All three are successful retail projects that benefit from the growing population that is occurring in West and Central Oahu. These shopping centers comprise the majority of the retail square footage devoted to apparel and specialty shops in the area.

Of the proposed developments, the MacNaughton Group's Kapolei Commons and the Bristol Group's Laulani Village retail developments were recently announced as proceeding with their plans with construction delivery by 2008. Both are located on 20-acre sites with the potential to add more than 800,000 square feet of new retail to this market and will likely derive retail sales from the same primary target area as that of the Makaiwa Hills site.

Several projects are planned along the proposed North-South Road, the UH West Oahu Commercial, the DHHL Regional Mall and the Estate of James Campbell commercial development site with construction plans likely to begin after 2009. Lastly, Gentry is planning a large retail development to coincide with their residential development at Waiawa. This site is slated for 2009 development.

Issues and Concerns

The primary concerns affecting the feasibility of the site is the lack of infrastructure, the increasing level of competitive retail development in the area, and this project's reliance on continued residential growth to fuel retail consumer expenditures.

Despite this site's location being adjacent to the growing neighborhoods in this market, this development site is reliant upon roadways, sewer, water, and power capacity that are currently being developed. Without these required infrastructure elements in place the project's feasibility is likely delayed. Plans are to begin selling homes for the residential component of this development by 2009. The intent is that the infrastructure will be built and in place for the new occupants of this development.

The rising popularity of Kapolei for retailers is increasingly evident with the West Oahu market's tight vacancy rates and the numerous planned retail developments. By 2009, if everything that is proposed for development was actually built, more than 1.5 million square feet of retail developments are to be constructed. The impact of all this retail square footage is likely to influence the success of each subsequent development. The Kapolei Commons and the DHHL commercial site are currently on the market looking for anchor tenants. As a result, by the time the Makaiwa Hills commercial site is available for development and lease, many retail tenants will already be committed to other projects.

We believe the levels of residential growth for the primary and secondary trade areas will be able to support more retail development than what is currently planned. We estimate that by 2015, this market will be able to support a potential maximum 1.1 million square feet of retail space with a smaller square footage allotment for office usage.

Strategies

The attractiveness of this market is evidenced by the number of successful retail shopping centers as well as the rise in the amount of planned and proposed retail projects in the area. We believe the Makaiwa Hills site has distinct advantages and disadvantages and that successful implementation of the following strategies could minimize the impact of the disadvantages. We recommend:

- Providing an active oversight over infrastructure development in the area
- Selecting an experienced master developer for both retail and residential development activities
- Begin development in phases, realizing that market penetration will improve once roadway access is constructed, utilities and power are in place, and a critical mass of residents for the Makaiwa Hills residential development have moved into their new homes
- Secure a well-respected retail/office leasing team of professionals to pre-lease project
- Aggressively market the Makaiwa Hills retail development to prospective tenants to effectively compete with Kapolei Commons, Laulani Village and the DHHL regional mall developments
- Begin efforts to solicit interest from medical users for potential clinic/well-ness facility so that State certification of need and appropriate Board of Health requirements are met.
- Fully understand the primary target consumer shopping requirements and behavior to effectively market against competing retail developments
- Target national tenants that would be unique to the primary trade area and the Oahu market
- Secure national anchor tenants by offering very attractive lease terms

Summary of Findings:

- The success of a Makaiwa Hills commercial development is contingent upon the timely completion of the many infrastructure elements required (i.e. sewer, water, storm water drainage, utilities, roadways etc…)
- Additionally, the Makaiwa Hills residential component will serve as a primary contributor to the success of the commercial development. Residential sales efforts should already be under way for Makaiwa Hills LLC prior to the pre-leasing activity of the commercial development.
- Currently retail rents exceed office rents in the primary and secondary trade areas. We believe the largest component of this proposed development should be retail use, followed by office.
- We believe that the Makaiwa Hills LLC Development site is able to support a mixed-use commercial development ranging in size from 800,000 to 950,000 square feet (roughly 73 to 87 acres).
- This development should be phased over a 10 year period with the first phase scheduled between 2011-2015.

MAKAIWA HILLS COMMERCIAL MIXED USE DEVELOPMENT ESTIMATES OF SQUARE FOOTAGE

RETAIL SQUARE FOOTAGE ESTIMATES	2005	2006-2010	2011-2015	2016-2020	2021-2025
RESIDENTIAL DEVELOPMENT MODEL ESTIMATE	442,127	316,620	1,110,627	138,677	1,546,832
CLARITAS CONSUMER EXPENDITURE MODEL (MODERATE)	1,073,587	85,792	811,745	1,741,054	2,964,373
RECOMMENDED SQUARE FOOTAGE	**606,286**	**160,965**	**768,949**	**751,892**	**1,804,482**

OFFICE SQUARE FOOTAGE ESTIMATE	2005	2006-2010	2011-2015	2016-2020	2021-2025
MODERATE ESTIMATE	19,186	(30,874)	79,369	199,603	330,732

TOTAL DEVELOPMENT SQUARE FOOTAGE ESTIMATE	2005	2006-2010	2011-2015	2016-2020	2021-2025
RECOMMENDED TOTAL DEVELOPMENT SQUARE FOOTAGE	**625,472**	**130,091**	**848,318**	**951,495**	**2,135,214**

***WE BELIEVE THE SUBJECT PROPERTY CAN SUPPORT A MIXED USE OFFICE/RETAIL DEVELOPMENT OF 800,000 TO 950,000 SQ.FT.**

****BASED ON AN 800,000 TO 950,000 SQUARE FOOT DEVELOPMENT, USING AN 0.25 FAR, THE TOTAL ACREAGE FOR THE SITE WOULD RANGE FROM 73 TO 87 ACRES**

Source: Colliers Hawaii Consulting

8/1/2005

Background and Study Purpose

Colliers Hawaii Consulting has been commissioned by Makaiwa Hills LLC to conduct a market feasibility study for a proposed commercial development site. This document focuses on the feasibility of a commercial development and quantifies the amounts and types of developments that are supportable.

The following issues are addressed in this retail market study:

- Is a major commercial development viable in the proposed location? Is the site and location characteristics appropriate for the development?
- If the project can support a commercial development, to whom should it appeal? What are the existing and projected population and demographic characteristics of the trade area residents?
- What is the magnitude and quality of supportable commercial uses for the development site? What types of businesses are appropriate tenants in the project?
- What is the level of tenant demand that could be anticipated, what level of absorption could result if this site is developed?

To evaluate the feasibility of commercial development in West Kapolei, we conducted a detailed supply/demand analysis, and qualified the results based on market observations. Our analyses evaluated the supportability of new commercial development from a retail, office and industrial demand perspective.

Below is a summary of the analysis completed for the Makaiwa Hills commercial development site:

- Overview of the various commercial real estate markets
- Economic evaluation of highest and best use for development site based on current and projected rental rates
- Demographic analysis of the trade areas
- Determine the appropriate square footage allotment potential for the development site
- Identify and review competitive environment
- Recommend commercial tenants for project development site

Colliers Hawaii Consulting Methodology and Approach

To address the feasibility and consumer supportability of a major commercial development at the Makaiwa Hills site, Colliers Hawaii Consulting conducted field evaluations for the primary, secondary, and tertiary trade areas as well as reviewed population growth, income, household formation, consumer expenditure, office inventory and job growth, and physician to population ratios.

We reviewed available commercial listings and lease comparables to identify current rental rates. Based on these current rents we projected rental rate growth using historical rental rate trends for each sector and identified the highest and best use for the site.

We identified competing commercial developments to determine current tenancy type and use. Additionally, Colliers has been compiling vacancy and absorption statistics for retail shopping centers for more than ten years, and for more than twenty years for office buildings. Based on this information we estimated the level of absorption that exists for West Oahu and projected the pace of growth among this market's planned and proposed commercial developments.

We utilized six approaches to determine the level of demand for the identified highest and best use for the target area. In our first approach, we utilized the census population growth estimates to determine the current and projected levels of commercial square footage this market can support.

For our second approach, we identified residential developments that are planned and extrapolated population growth based on the occupancy of these new homes.

Our third approach utilized the census figures for consumer expenditures for the target trade areas. Based on the current level of expenditures we measured the level of commercial trade potential in the market.

Our fourth approach used Claritas consumer expenditure data. This data is known to be more accurate than the census projections. For both consumer expenditure estimates we utilized a $331 per square foot retail sales ratio to determine the amount of retail square footage this market would support (this rate is identified based on retail sales/retail square footage).

Between these four estimates we projected what the likely amount of square footage that could be built based on current and forecasted market dynamics. In addition to providing a range of potential retail square footage for the development, we identified specific types of tenants that would be appropriate for this project.

Our fifth approach utilized proprietary Colliers data on the Oahu office market. We identified the office inventory for the Leeward/West/Central Oahu office market and the ratio of office square footage per office worker. Based on estimates of office job growth we are able to project the amount of office space demand for the future.

Our final estimation model determined the viability of a medical clinic/ wellness facility. We utilized the US West Regional estimates for the number of physicians required for a population base and applied these ratios to the primary and secondary trade areas to determine if there is a need for additional physicians for this market.

Retail Market Overview

Oahu Retail Market

Colliers Hawaii Consulting regularly surveys a large majority of the retail shopping centers throughout the state of Hawaii. Based on these surveys we are able to determine the net absorption (growth), current vacancy rate, low and high range in asking rents and check the pulse of the current retail environment.

At year-end 2004, Oahu retail shopping centers posted a strong 228,834 square feet of absorption. Much of this growth was a direct result of leasing activity among the island's regional malls. These malls faced a decline in occupancy in 2003 when both JCPenneys and McInerny's stores closed placing more than 300,000 square feet of vacant space on the market. At year-end 2003 the retail vacancy rate was 8.53%, by year-end 2004 the vacancy rate fell to 5.83%. By mid-year 2005, the Oahu retail market posted an additional 163,962 square feet of net absorption resulting in a 4.46% vacancy rate, its lowest level in more than a decade.

Asking rates among shopping center improved for the first time in nearly seven years. After falling steadily since 1997, the average asking rate rose by 8.7% over the past year from $2.35 per square foot per month (psf/mo) to $2.55 psf/mo. At mid-year 2005, the average asking rent rose an additional $0.04 psf/mo to $2.59 psf/mo.

The overall economic climate improved dramatically over the past 18 months as both businesses and retailers expressed renewed optimism. Consumer optimism appeared to translate into increased sales as the State of Hawaii posted more than $20 billion in retail sales for 2004, a 6.4% increase over last year.

Hawaii continues to be a prime retail marketplace for national as well as local retailers. Many of the top retailers covet the retail sales per square foot generated along Waikiki's prime Kalakaua Avenue. The influx of more than seven million visitors to the State added more than $10 billion to the tax base. After the terrorist attacks on September 11, 2001, the onset of the Iraqi War, and the Asian SARs epidemic wreaked havoc on the travel industry, despite this turbulence, Hawaii's resilience resulted in a full recovery in 2004 with growth anticipated for 2005. Hotel occupancy, average daily room rates and air passenger arrival counts are all surpassing previous years levels and are projected to set record levels for 2005.

West Oahu Retail Market
The location of the Makaiwa Hills commercial site in Wast Kapolei is situated in our West Oahu trade area, which encompasses Ewa Beach, Kapolei and Makakilo. For purposes of the retail survey, this area is comprised of 876,863 square feet of retail shopping center space.

The West Oahu retail trade area consistently for the past five years posted vacancy rates below 2%. Since 2001, the highest level of vacancy occurred at mid-year 2004 when it rose to 1.46%. At year-end 2004 the vacancy rate fell to 0.6% after 16,618 square feet of absorption occurred. Despite this seemingly small rate of growth, this absorption follows annual net absorption of 106,707 square feet for 2003 and 55,376 square feet for 2002. Virtually all retail space that had been built-to-date remains occupied. By mid-year 2005, the West Oahu vacancy rate fell to 0.60%

Supporting this positive retail environment has been the rapid development of new housing in the area. Throughout the Ewa Plain, which spans from Mililani to the north, Ewa Beach to the southeast and Kapolei to the southwest, the growth in population and household formation attracts retailers to the area. Among Hawaii's census tracts, this area boasts the strongest population growth in the state. Since 1990, the census estimated that this area's population grew at an annual rate of 3.6%, more than triple the population growth rate of the State of Hawaii, which was roughly 1% per year. The number of households between 1990 and 2000 grew at a robust annual rate of 3.9%. During this time period more than 11,000 new households were formed.

This strong population growth rate is anticipated to continue as many more housing developments are currently being constructed and are already planned for the future. In fact, The Estate of James Campbell will continue to divest itself of land holdings in the area in anticipation of fulfilling its master plan for continued residential and commercial development.

Office Market Overview

Oahu Office Market Overview

After nearly a decade of stagnant market conditions, the Oahu office market posted strong annual absorption of 223,207 square feet by year-end 2004. In fact, vacancy rates fell from a decade high 13.75% to 9.92% in the past two years, a more than 3.0 percentage point decline. We believe a transition is underway in the office market, whereby a tenant's market is changing into a landlord's marketplace.

Economists forecast that job growth will exceed 1.5% for 2005; this follows a 1.65% annual increase in office jobs for 2004. Should this occur, office vacancy rates are projected to fall below 9% by year-end 2006 and place upward pressure on office rental rates.

Over the course of the past year, office rental rates rose by more than 7% from $2.14 per square foot per month (psf/mo) gross to $2.29 psf/mo. This is the largest annual increase in rents in over a decade. We project that the average gross asking office rent will likely surpass $2.50 psf/mo by year-end 2006.

Four of Oahu's submarkets posted vacancy rates below 10%. The tightest market is the Airport/Mapunapuna market followed by Windward Oahu, Leeward/West Oahu and East Oahu markets.

The reduction in the amount of available office space appears to be having an impact on landlord concessions. The amount of tenant improvement allowances and free rent offered to prospective tenants has in many cases been reduced from levels seen just a few months ago. This is likely an indication that the Oahu office market is in a transition from being a tenant's market to a landlord's market.

Leeward Office Market Overview

The Leeward office is comprised of office properties from Aiea to Kapolei with 623,525 square feet of inventory that Colliers Hawaii Consulting tracks on a regular basis. Since 2002, the Leeward Office market vacancy rate fell from 10.36% to the current 3.24% after posting positive absorption for the past six months of 16,983 square feet.

Tight market conditions persist in this market despite the slight rise in vacancy rates. Currently, this market does not have any available office spaces that can accommodate a 10,000 square foot prospective tenant. This shortage of space should prompt landlords to continue to boost rental rates in this market.

The Leeward office market average gross asking rental rate ranges from an average low of $2.42 psf/mo to an average high of $2.60 psf/mo. We believe that no new office construction will be considered for this market until asking rents exceed $3.00 psf/mo.

Highest and Best Use Feasibility

Based on current market conditions, nearly all of the commercial real estate sectors are enjoying an improvement as businesses flourish under strengthening economic factors. Commercial real estate benefited from these positive dynamics resulting in a record number of commercial real estate transactions and a dramatic rise in transaction sales volume. As a result of volatility in the stock market and poor returns in alternative investments, investors capitalized on the combination of low interest rates and an abundance of capital in search of stable returns in the commercial real estate marketplace.

A record $3.55 billion in sales transactions were recorded for 2004 for Hawaii, this is quadruple the $868 million in sales transactions recorded in 2002 . This blistering sales pace is expected to continue during 2005. Property values have increased as a result of this rise in demand for commercial real estate.

A benefit to this rise in interest for commercial properties is the desire by developers to capitalize on this market. Currently, retail development and industrial development are underway. We believe it will be several years before office development becomes financially feasible.

Retail Market Feasibility
For the retail sector, rents ranged from a low of $1.17 psf/mo to a high of $6.24 psf/mo. The average net rent for retail lease comparables was $2.99 psf/mo. There are three retail projects currently marketing spaces for lease, these are Kunia Shopping Center, Mililani Mauka II, and Kapolei Parkway. The asking rents for these projects range between $3.00 and $3.50 psf/mo. We believe that construction costs for new developments as well as rising land prices will drive the increases for retail rents.

The West Oahu retail trade area benefits from the strong population and household formation growth rate. Spurred upward by the continuation in residential construction activity, this market posted the strongest population growth rate in the State.

In addition to population growth rates, the level of retail development is increasing. The retail vacancy rate of 0.6% indicates that there is strong demand for retail space in the area and that new developments receive a high level of interest from retailers. As an example, the Marketplace at Kapolei, Ewa Oceanpointe and Kapolei Shopping Center all were quickly leased upon construction completion.

RETAIL LEASE COMPARABLES FOR PRIMARY AND SECONDARY TRADE AREAS

Neighborhoo	Sq. Ft.	Rent	Op Exp	Lease Start	Lease End	Term	Comments
AIEA	720	$4.56	$0.61	01-Jun-04	31-May-09	5 YEARS	3 MONTHS FREE RENT. ONE 5 YEAR OPTION TO RENEW
AIEA	4,353	$4.50	$0.61	10-Feb-05	09-Feb-10	5 YEARS	RENT: Y1-$4.50. Y2-$6.00. YEARS 3-5 (3%). 3 MONTHS FREE. 1 MONTH TI ALLOWANCE.
AIEA	720	$3.82	$0.61	01-May-04	30-Apr-08	3 YEARS	$3K TIA FOR SIGN. RENEWAL.
AIEA	511	$6.24	$1.20	01-Jul-04	30-Jun-09	5 YEARS	PROMO EXPENSE $333.33.
KAPOLEI	1,346	$2.85	$0.42	01-Sep-04	31-Aug-09	5 YEARS	COMMISSION: 1 MONTHS STABILIZED BASE RENT.
KAPOLEI	1,200	$3.00	$0.71	01-Jan-05	31-Dec-09	5 YEARS	RENEWAL. 5% PERCENTAGE RENT. $0.05 PSF PROMO FUND PER MONTH.
KAPOLEI	960	$2.68	$0.71	01-Apr-04	31-Mar-10	6 YEARS	YEAR 6 $2.76 PSF. 2 MONTHS FREE RENT. RENEWAL. $9550 TIA, 6% PERCENTAGE RENT.
KAPOLEI	2,409	$2.28	$0.58	01-Dec-04	30-Nov-09	5 YEARS	RENEWAL. $.05 PROMO. MONTH 1-30 @ $2.25, MONTH 31-60 @ $2.33.
MILILANI	1,313	$3.80	$0.72	01-Jan-04	31-Jan-09	5 YEARS	1 MONTH FREE RENT. $15 TIA.$3.25 PSF/MO RNEWAL OPTION IF EXECUTED BEFORE 4/1/08.
MILILANI	513	$3.21	$0.87	01-Oct-04	30-Sep-09	5 YEARS	RENEWAL. NO TIA. AD/PROMO $0.07 PER MO. CAM INCLUDES TT WATER CHARGES-HIGHER THAN RETAIL SINCE THEY ARE RESTAURANT
MILILANI	1,313	$2.79	$0.87	01-Oct-04	30-Sep-09	5 YEARS	NO TIA. 7% PERCENTAGE RENT. TT TO DO STORE RENOVATION-FLOORS, WALLS, NO ANIMALS ON SIDEWALK.
MILILANI	5,341	$1.53	$0.32	01-Mar-04	28-Feb-14	10 YEARS	3 MONTHS FREE RENT. $40,000 TIA. TENANT TO REPAY LL FOR TIA. $1000/MONTH IN ADVERTISING FEES .
MILILANI	304	$3.00	$0.30	01-Apr-04	31-Mar-07	3 YEARS	AD PROMO $0.07 PSF/MO
MILILANI	573	$2.75	$0.43	01-Apr-04	31-Mar-09	5 YEARS	$40.11 PER MONTH AD/PROMO.
MILILANI	1,598	$2.75	$0.34	01-Feb-04	31-Jul-09	5 YEARS 6 MONTHS	6 MONTHS FREE GROSS RENT. PERCENTAGE RENT 8%.
MILILANI	2,800	$2.00	$0.00	01-Jan-04	01-Jan-14	10 YEARS ?	PAD SITE RENTED FOR $70,000/YR. TENANT DID OWN BUILDOUT AND CONSTRUCTION FOR 2800 SF BUILDING. ESTIMATED START DATE OF 1/1/04
MILILANI	3,000	$2.00	$0.00	01-Jul-04	01-Jul-07	3 YEARS	RENEWAL.
MILILANI	975	$3.50	$0.64	30-Sep-04	30-Sep-14	10 YEARS	jgf provided incomplete comp - actual start date unknown as site is being built out. LL provided tenant with $30 TIA.
PEARL CITY	19,675	$2.02	$0.59	15-Sep-04	31-Oct-14	10 YEARS	FIRST 5 YEARS @ $2.02 PSF RENT, NEXT 5 YEARS @ $2.22 PSF RENT. 45 DAYS FREE RENT. 2 * 5 YEAR OPTIONS. PROMO FUND $0.00412
PEARL CITY	705	$3.13	$1.36	15-Oct-04	30-Nov-09	5 YEARS	INCREASING 5% PER ANNUM. PERCENTAGE RATE: 8%.
PEARL CITY	44,174	$1.70	$1.36	15-Nov-04	14-Apr-20	15 YEARS	YRS 1-5 $1.53, 6-10 $1.69, 11-15 $1.89. 180 DAYS FREE RENT. $2,708750 TIA. 3 FIVE YEAR OPTIONS TO RENEW.
PEARL CITY	1,909	$1.17	$1.36	15-Apr-04	14-Apr-20	15 YEARS	INSTALL BAYS. YRS 1-5 $1.00, 6-10 $1.17, 11-15 $1.33. 180 DAYS FREE RENT. $ 3 FIVE YEAR OPTIONS TO RENEW.

RETAIL LEASE COMPARABLES FOR PRIMARY AND SECONDARY TRADE AREAS

Neighborhoo	Sq. Ft.	Rent	Op Exp	Lease Start	Lease End	Term	Comments
PEARL CITY	705	$3.95	$1.36	01-Sep-04	31-Aug-09	5 YEARS	BASE RENT INCREASING BY 3% PER ANNUM FOR 3RD-5TH YEAR. 1ST-2ND YEAR: 3.95. 8% PERCENTAGE RENT.
PEARL CITY	900	$2.25	$0.81	01-Feb-04	01-Feb-08	5 YEARS	2 MONTHS FREE RENT. 2-5 YEAR OPTION. 24 MONTHS ON MARKET.
PEARL CITY	2,785	$2.25	$0.81	01-Dec-03	31-Jul-09	5 YEARS 8 MONTHS	6 MONTHS FREE RENT. 2-5 YEAR OPTION. 24 MONTHS ON MARKET.
WAIPAHU	1,000	$3.00	$0.45	01-Apr-05	31-May-10	5 YEARS	5 YEAR TERM WITH ANNUAL 3% INCREASES. $20 TIA. 60 DAYS FREE RENT.
WAIPAHU	1,000	$2.50	$0.45	01-Feb-05	31-May-16	10 YEARS	3% INCREASE PER ANNUM. $0.10 PSF PER MO PROMO. 4 MONTHS FREE RENT. $25 TIA PSF.
WAIPAHU	3,000	$2.60	$0.45	01-Apr-04	30-Jul-12	5 YEARS	SPACES B109-B111. $2.60 PSF WITH 2% ANNUM INCREASE. 90 DAYS FREE RENT. $35 TIA. 2*5 YR RENEWAL OPTIONS. $200.00 PER/MO PROMO EXPENSES.
WAIPAHU	3,000	$2.65	$0.45	01-Apr-05	31-May-10	5 YEARS	SPACES C106-C108. 3% INCREASE PER ANNUM. $0.10 PSF PER MO PROMO. $20 TIA PSF. 60 DAYS FREE RENT. 1*5 YEAR RENEWAL OPTION.
WAIPAHU	600	$3.50	$0.45	01-Apr-05	31-Jul-15	10 YEARS	BASE RENT OF $3.50 WITH 3% ANNUAL INCREASES. 60 DAYS FREE RENT. $20.00 TIA.
WAIPAHU	1,286	$2.75	$0.45	01-Apr-05	30-Jun-15	10 YEARS	BASE RENT OF $2.75WITH 3% ANNUAL INCREASES. 90 DAYS FREE RENT. $30.00 TIA. 2X5 YEAR OPTIONS
WAIPAHU	1,000	$3.00	$0.45	01-Apr-05	30-Jun-15	10 YEARS	BASE RENT OF $3.00 WITH 3% ANNUAL INCREASES. 60 DAYS FREE RENT. 20.00 TIA. $0.10 PROMOTIONAL EXPENSE.
WAIPAHU	6,618	$2.54	$0.45	01-Jul-05	30-Nov-10	10 YEARS	3% INCREASE PER ANNUM. 5 MONTHS FREE RENT. $30 TIA PSF. PROMO EXPENSES $0.05
WAIPAHU	1,794	$1.05	$0.82	01-Sep-03	31-Aug-05	3 YEARS	ONE MONTH BASE RENT FREE. SITE HAD BEEN ON THE MARKET FOR FOUR MONTHS.
WAIPAHU	1,200	$5.00	$0.00	15-Apr-04	15-Apr-09	5 YEARS	5 YEAR TERM. NO OTHER INFO.
WAIPAHU	1,200	$5.58	$0.00	11-Apr-04	11-Apr-09	5 YEARS	5 YEAR TERM. NO OTHER INFO.
WAIPAHU	1,200	$4.88	$0.00	01-Oct-04	01-Oct-09	5 YEARS	5 YEAR TERM. NO OTHER INFO.
WAIPIO/GENTRY	5,000	$1.91	$0.56	18-Dec-03	30-Nov-13	10 YEARS	RENT FLAT FOR TERM OF LEASE. 2X5 OPTIONS TO RENEW. COMMISSIONS PAID ON EACH OPTION (1 MONTH)
WAIPIO/GENTRY	5,000	$1.91	$0.56	18-Dec-03	18-Dec-13	10 YEARS	RENT FLAT FOR TERM OF LEASE. 2X5 OPTIONS TO RENEW. COMMISSIONS PAID ON EACH OPTION (1 MONTH)

Office Market Feasibility

For the office sector, net rents ranged from a low of $1.35 psf/mo to a high of $2.25 psf/mo. The average net rent for office lease comparables was $1.88 psf/mo.

The West Oahu office market remains one of the tightest markets in Oahu with a mid-year 2005 vacancy rate of 3.24%. Average asking rates for this market remain higher than for most of the island. The average high full service gross rent for Leeward/West Oahu is $2.60 psf/mo. Despite the higher rents for this market area, office development is still not financially feasible. Office rents would need to exceed $3.25 psf/mo to justify additional office building construction.

Based on the current level of demand and the potential growth in office use in Leeward and West Oahu, we believe that office rents have the potential to post double-digit growth over the next few years, should this occur office construction would likely be justified in roughly four to six years.

OFFICE LEASE COMPARABLES FOR PRIMARY AND SECONDARY TRADE AREA

NEIGHBORHOOD	SQUARE FEET	RENTAL RATE	OP. EXP	LEASE START	LEASE END	TERM	COMMENTS:
EWA BEACH	595	$1.35	$0.58	03-Jan-04	03-Jan-07	3 YEARS	1 X 3 YEAR OPTION TO RENEW. NO LL CONCESSIONS.
EWA BEACH	2,226	$1.85	$0.72	01-Mar-04	01-Mar-09	5 YEARS	NEW 2 STORY W/ELEVATOR COMPLEX TO BE BUILT LATE 2003. NO LL CONCESSION INFORMATION. YR 1 - $1.23, 2-5 $1.85.
EWA BEACH	1,000	$1.85	$0.72	01-Mar-04	01-Mar-09	NEGOTIABLE	NEW 2 STORY W/ELEVATOR COMPLEX TO BE BUILT LATE 2003. NO LL CONCESSION INFORMATION. YR-1 $1.23, 2-5 $1.85.
EWA BEACH	2,000	$1.92	$0.72	01-Mar-04	01-Mar-14	10 YEARS	NEW 2 STORY W/ELEVATOR COMPLEX TO BE BUILT LATE 2003. YR 1-5 $1.85, 6-10 $2.00. NO LL CONCESSION INFORMATION PROVIDED.
EWA BEACH	7,160	$2.25	$0.72	01-Mar-04	01-Mar-09	5 YEARS	NEW 2 STORY W/ELEVATOR COMPLEX TO BE BUILT LATE 2003. YR 1-5 $2.25
KAPOLEI	2,980	$1.72	$1.00	01-Mar-04	31-Mar-06	2 YEARS 1 MONTH	1 MONTH FREE RENT
KAPOLEI	709	$2.00	$0.87	01-Jan-04	31-Dec-08	5 YEARS	FIRST 3 YEARS @ $2.00, YEARS 4-5 $2.05.
KAPOLEI	775	$1.96	$1.01	25-Feb-05	31-Jan-10	4 YEARS 11 MO	FREE RENT: 2 MONTHS 4 DAYS.
KAPOLEI	2,500	$1.70	$0.87	15-Apr-04	30-Apr-09	5 YEARS	3 MONTH FREE RENT. $30 SF TIA.
KAPOLEI	423	$2.06	$0.88	01-Oct-04	30-Sep-07	3 YEARS	ONE MONTH FREE RENT. NO OTHER LL CONCESSIONS. THREE YEAR TERM - RENT FLAT FOR TERM
KAPOLEI	2,381	$2.09	$0.92	14-Aug-04	31-Jul-09	5 YEARS	SUITES 314+315. 2 MONTHS FREE RENT. $40 TIA.
KAPOLEI	2,314	$1.96	$0.92	01-Nov-04	31-Oct-09	5 YEARS	$2/SF ON 877SF AND $4.72/SF ON 1,437. FREE RENT: 2 MONTHS. TI ALLOWANCE: $19,050.
KAPOLEI	1,072	$1.96	$0.00	01-Oct-04	30-Sep-09	5 YEARS	BASE RENT: $0/SF/MO FROM 10/1/04-11/30/04; $1.78/RSF/MO FROM 12/1/04-9/30/07; $1.94/RSF/MO FROM 10/1/07-9/30/09.
KAPOLEI	3,241	$1.70	$0.92	01-Dec-04	15-Aug-06	20 MONTHS	PHARMACY SCHOOL. SPACE HAS TO BE RECONFIG. LL INCURRED $11.55 PSF TO BUILD OUT SPACE. BASE RENT AT $1.70 FLAT FOR TERM OF LEASE.
KAPOLEI	12,514	$1.50	$0.92	01-Dec-04	31-Jul-06	1 YEAR	1- $1.55, 2- $1.61, 3- $1.68, 4- $1.74, 5- $1.81, 6- $1.89, 7- $1.96, 8- $2.04, 9- $2.12, 10 - $2.21. TWO 5 YEAR OPTIONS TO RENEW.
KAPOLEI	3,310	$2.15	$0.65	01-Dec-02	30-Nov-12	10 YEARS	RENT FIXED FOR 1ST FIVE YEARS
	Average:	**$1.88**	**$0.78**				

Source: Colliers Hawaii Consulting

Prepared for PBR Hawaii in conjunction with DHHL

Hospital Market Feasibility

The hospital market differs from the office and retail sectors due to the requirement for a certificate of need from the Department of Health. There is a formal process that is required to be followed prior to the issuance of permits to build medical facilities. In addition to these State of Hawaii requirements, a thorough feasibility study should be conducted to determine the types of services the medical facility should offer.

For our purposes, we desired a general rule of thumb to determine if there would be demand for additional physicians in the primary and secondary trade areas. In our research efforts we identified the U.S. National estimate and the U.S. Western Region estimates for the average ratio of physicians for a population of 100,000. Utilizing these figures, we are able to determine if there is a current shortfall of physicians in the primary and secondary trade areas. The national average for a population of 100,000 is 134.69 full-time equivalent (FTE) physicians. For the U.S. West, it is 132.36 FTE per 100,000. We used the U.S. West ratio as a benchmark for this study.

We believe that there is good potential for the development of a medical clinic/wellness facility to be a part of this commercial development. We recommend additional research be conducted to better understand the market potential for additional medical facilities in the area (we have included two Solucient LLC studies in the appendix for your review).

FTE PHYSICIANS MARKET ASSESSMENT FOR PRIMARY AND SECONDARY TRADE AREAS

MEDICAL CLINIC/WELLNESS FACILITY MARKET ASSESSMENT

TRADE AREA	NUMBER OF PHYSICIANS	POPULATION BASE	U.S. WEST RATIO	LOCAL MARKET RATIO	PHYSICIAN OVERAGE/SHORTFALL
PRIMARY - KAPOLEI	26				
PRIMARY - EWA BEACH	46				
PRIMARY TRADE AREA TOTALS	**72**	**38,991**	**0.1324%**	**0.1847%**	**0.0523%**
SECONDARY-WAIANAE	44				
SECONDARY - WAIPAHU	72				
SECONDARY - PEARL CITY	19				
SECONDARY TRADE AREA	**135**	**176,562**	**0.1324%**	**0.0765%**	**-0.0559%**
PRIMARY AND SECONDARY TOTALS	**207**	**215,554**	**0.1324%**	**0.0960%**	**-0.0363%**

* There is a shortfall of roughly 36 full time physicians for the primary and secondary trade areas

Source: Solucient LLC, Colliers Hawaii Consulting

8/1/2005

Highest and Best Use

Among the potential uses for this site, retail appears to be the most feasible, followed by hospital/medical clinic and general office use. Current retail rental rates provide for adequate support for development. Office rents will have to increase by at least 10% to15% per year over the next three to six years before office development becomes a viable option. Medical clinic rents are very similar to general office rents and usually follow office market trends. For medical offices the tenant build out is more costly as well as water usage is needed for most examination rooms.

Currently, the target development plan for the completion of infrastructure and phase one of the residential component is 2009. The proposed plan is to have the commercial construction coincide with the residential. Should construction start in 2009, completion of phase I would likely be in 2011.

We believe that this project can support a mixed-use development with the majority portion devoted to retail, and two smaller components for office and a medical clinic. Phase I should be anchored by grocery, drug, and retail tenants. Phase II should expand the retail component of the development as well as include second story office and a medical clinic/ wellness facility. Phase III should allow for the expansion of these three components.

Property Description

The Makaiwa Hills LLC development will occupy 1,915 acres on the slopes of the Waianae mountain range west of Makakilo (TMK 1-9-1-15:5,11,17 and 1-9-1 16, portion of 9, 1-9-2-3: portion of 2 and portion of 5). The project is bordered on the south by Farrington Highway, to the west by Waimanalo Gulch, to the north by Palehua Road, and by Makakilo City to the east.

Entitlements

The majority of the project site (approximately 1,875 acres) is currently designated as an Agricultural District by the State. The remaining 4-+ acres are designated Urban. The City and County Department of Planning and Permitting has zoned the majority of the project site (approximately 1,779 acres) as AG-2 (General Agriculture). Approximately 96 acres are zoned AG-1 (Restricted Agriculture) and the remaining 55+ acres are zoned R-5 (Residential). Of the 1,915 acres, the City & County allocated 78.0 acres for commercial use.

Access

The project will generate additional traffic on the roadways in the vicinity of the project sites. Planed regional traffic improvements such as the Kapolei Interchange, expansion of the Palailai Interchange, and the addition of a proposed Makaiwa Interchange have taken the development into account. Old Farrington Highway is planned to be improved as an arterial and will be utilized and extended in a manner similar to a frontage road to minimize connections to Farrington Highway and the freeway. Connections to Farrington Highway are proposed across from existing intersections, again to minimize new connections. Farrington Highway may need to be widened from the end of the H-1 Freeway to the intersection with Old Farrington Highway. Improvements to existing intersections will also be required.

As planning for the project progresses, additional detailed traffic studies will be required.

Infrastructure

Water

With the exception of the currently zoned R-5 parcel, initial development of the site will require the construction of at least one reservoir and pump station. At a minimum, a 440' system reservoir will need to be constructed along with a pump station connecting to the 215' reservoirs. The BWS has indicated that there should be sufficient interim capacity in the existing reservoirs to accommodate initial development, as long as the ultimate reservoirs are constructed in a timely manner.

A portion of the 55-acre, R-5 site within the 670' service zone could possibly connect to the existing water line in Nohona Street, which abuts the site. The BWS has indicated that pressure-regulating valves are not accepted within the system as a means of replacing reservoirs. When the 440'reservoirs for the rest of Makaiwa Hills are installed, the 440' system could be converted away from the pressure regulating valves. More detailed conceptual designs will be needed along with development plans for the 55-acres in order to approach the Board on this concept.

Wastewater

Wastewater from the project site will be conveyed to the Honouliuli WWTP for treatment. Implementation of the proposed collection system capacity expansion projects may be required prior to sewer connection application approval. Specifically, construction of a relief sewer parallel to the Ko Olina interceptor will be necessary to accommodate wastewater generated by the proposed Makaiwa Hills and West Kalaeloa developments. In addition, construction of a third relief interceptor, from Fort Barrette Road to the treatment plant, is required to convey wastewater from Makaiwa Hills to Honouliuli WWTP.

Solid Waste

It is anticipated that refuse generated by Makaiwa Hills residential development will be collected by the City and County refuse collection service. A private refuse collection company will service refuse from the proposed commercial area. It is estimated that municipal refuse collection from the site will necessitate 46 truck trips per week.

Electrical Power

It is anticipated that HECO and Hawaiian Telephone Company (HTCO) will provide the necessary electrical and telephone service to the project site. The total diversified demand for the entire development is estimated to be 16.8 MVA. Power is to be supplied to the sites via existing substation at Kahe Point and Makakilo, and the future Kapolei B Substation.

Discussions are ongoing wit HECO to coordinate alignments for additional HECO power lines through the West Kalaeloa area from H-Power plant to the substation at the railroad right of way.

Trade Area Overview

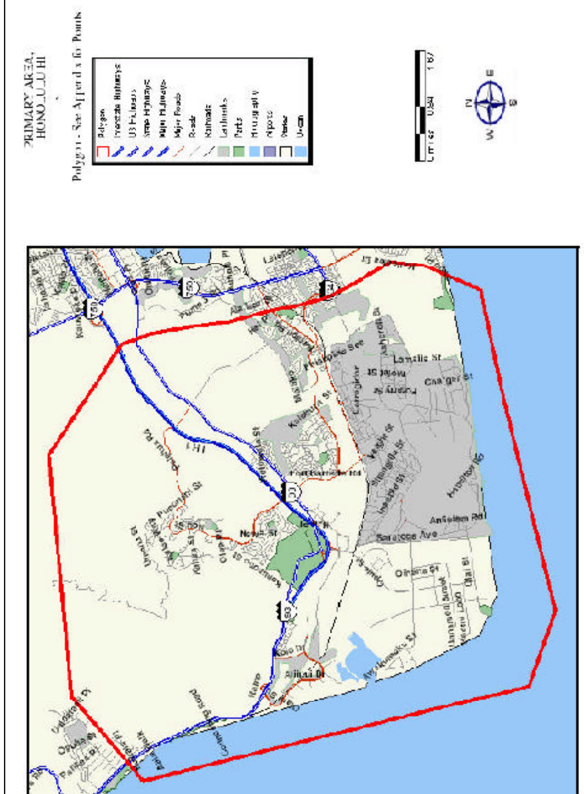
Introduction
Based on the size, location and configuration of the Makaiwa Hills project site, as a rule of thumb, a 40,000 square foot parcel could support a 10,000 square foot retail building, with the remaining land to be used as parking. As a result, this 100-acre parcel could actually support roughly 950,000 to 1.1 million square feet of retail development. An objective of this study is to determine if the population base and the amount of projected consumer expenditures in the area would support a large-scale retail development. Subsequently, should this market does support additional retail; we would want to determine the size of the recommended size of the development.

In order to accomplish this task we identified a primary, secondary and tertiary trade areas from which the shopping center would draw customers to shop at this new retail development.

Trade Areas Delineated (Primary, Secondary and Tertiary)
Identifying the primary, secondary and tertiary trade areas for a retail development is vitally important as it dictates the market demographic characteristics, retail market potential, and ultimately the market feasibility of a project.

We have utilized drive-time estimates to identify the likely trade areas for this commercial development site. The primary trade area corresponds to a 5-minute drive time; this is where the majority of the project's shoppers would come from. Urban Land Institute, a non-profit real estate association, estimates that roughly 75% to 85% of a regional mall's shoppers reside within the primary trade area. The secondary trade area is based on a 10-minute drive time, and the tertiary trade area is represented by a 15-minute drive (see trade area maps).

Primary Trade Area

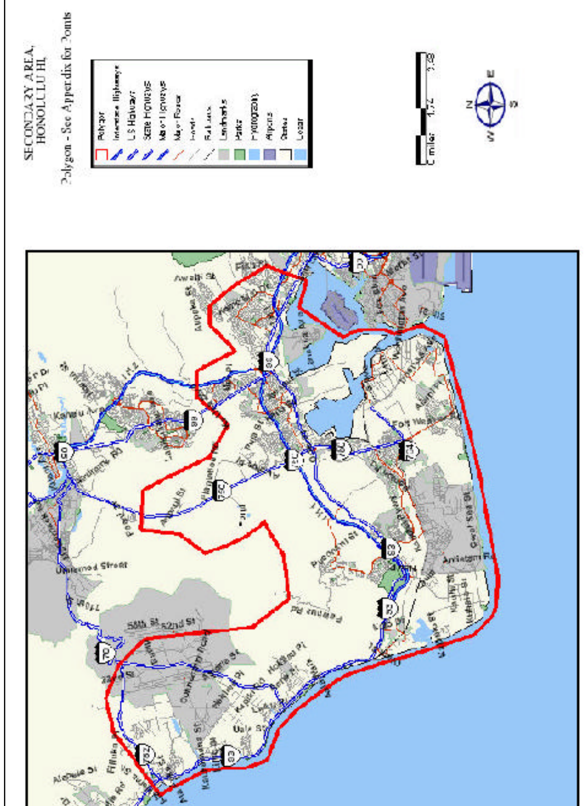


Primary Trade Area

The primary trade area boundaries include the neighborhoods of Kapolei, Makakilo, Ko Olina, and Nanakuli. This trade area is comprised of many new housing developments, the burgeoning "second city" of Kapolei, and the growing resort region of Ko Olina.

The 2000 census data estimates that the 2004 population for the primary trade area is 38,991 residents with 11,493 households. During the time period of 1990-2000, the population grew at an annual 8.5% rate and the number of households increased by a 8.7% annual rate. Per capita income during this time period grew at a 5.2% rate, far exceeding the inflation rate. Similarly, the median household income grew at a 4.5% rate. Total retail expenditures for this trade area exceed $596 million. This figure equates to a monthly household retail expenditure of $4,327.

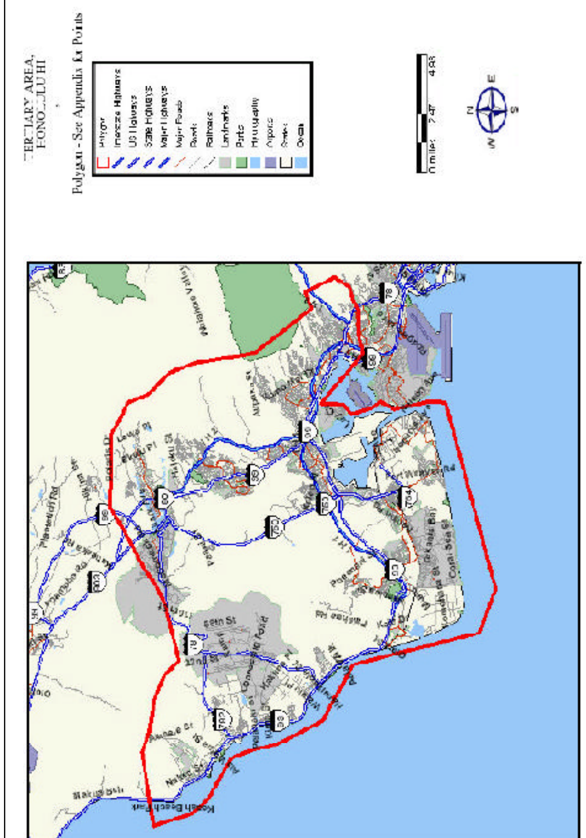
Secondary Trade Area



Secondary Trade Area
The secondary trade area boundaries include the neighborhoods of the primary trade area and Waianae, Ewa Beach, Waipahu and Waipio. Most of these neighborhoods in the secondary trade area are older and well established, with few new residential developments this market is unlikely to face the explosive population growth anticipated for the primary trade area.

The 2000 census estimates the 2004 secondary trade area population (inclusive of the primary trade area) to be 215,554 residents with 60,138 households. The annual population growth averaged 2.6% between 1990 and 2000. Similarly the number of households increased by 2.8% during this time period. Per capita income grew by an annual rate of 3.8% between the 1990 and 2000 census years. Median household income grew by 3.0% per year during the same time period. Total retail expenditures for this trade area excluding that of the primary trade area totaled $3.11 billion for a monthly household expenditure of $4,310.

Tertiary Trade Area



Tertiary Trade Area

For many, the ingress and egress at a shopping center, its access from the freeway and length of travel time will dictate where a customer would likely shop. For Hawaii this is no different. Drive times throughout Oahu increased as more cars are added to our roadways and traffic congestion occurs more frequently. The boundaries of the tertiary trade area are dictated by shopper's access to the island's freeways, for instance the neighborhoods of Pearl City, Aiea and Halawa located along Kamehameha Highway and H-1 could access the Makaiwa Hills site within a 15 minute drive.

The tertiary trade area is the broadest area from which customers may be drawn. A number of factors can dictate the success of a project's appeal to customers that live outside of the immediate area. If the center offers better accessibility or parking, more stores, better value, higher quality goods or a wider variety of merchandise, customers may be willing travel further distances.

The 2000 census estimates that the 2004 tertiary trade area population of 343.959 households (excluding the primary and secondary trade area counts). The annual population growth for this market averaged 1.5% for the years 1990 to 2000. Household formation grew at an annual rate of 1.8%. Per capita income increased at an annual rate of 3.8% per year from 1990 to 2000. Median household income grew at a 3.1% annual rate during the same time period. Total retail expenditures totaled $5.15 billion with a monthly household retail expenditure of $4,293.

Trade Area Demographics

For the purposes of this study we have evaluated many of the trade area demographic characteristics .We have attached a comprehensive demographic report (see appendix) that covers a host of vital statistics on the primary, secondary and tertiary trade areas.

The demographic data for the primary trade area when compared to the island of Oahu and the State of Hawaii revealed several interesting facts:

- The primary trade area posted one of the strongest population and household growth rates in the state.
- The average household income growth indicates that this market will likely continue to attract retailers to the area.
- More than 54.5% of the primary trade area's households have children and the average household size is 3.38 and is significantly higher than that statewide average household size of 2.92.
- Most of the homes in the primary trade area were built after 1990, while most of the homes in the State of Hawaii were built prior to 1980.
- Nearly 63% of the primary trade area population commute time is longer than 30 minutes. More than 14% higher than those numbers posted for the State of Hawaii.

The three principal areas of concern for a retail development would be the growth in population and households, consumer expenditure levels and household and personal income levels for the area. These are the factors that we analyzed to assist us in determining the market feasibility of the Makaiwa Hills project.

Retail Square Footage - Quantitative Analysis

Introduction

The objectives of the retail feasibility analysis is to provide the developer with quantitative information that either confirms or refutes the supposition that the project's market can support a major retail development. The primary focus of this section is to identify those factors that are likely to indicate the retail potential for the site. We derive our conclusions of market feasibility from two primary indicators – population growth and consumer retail expenditures.

Population Growth

Population growth for the primary trade area is driven principally by the development of new residential housing in the area. As the fastest population growth area on Oahu, the primary trade area is projected to add more than 10,000 new households over the next decade. Since 1990, the population for the area has grown by more than 8% per year and is forecasted to continue at this high level for the next ten years. As a result of all this new household formation, retail developments are attracting new tenants to this market and vacant space is quickly absorbed. Should every retail project planned for construction for this market occur, by 2009 nearly 1.5 million square feet of new retail will have been built.

In all likelihood, not every proposed project will be built, as retail development continues, many proposed projects will be scaled back or shelved. For the Makaiwa Hills commercial site, a thorough knowledge of the existing retail inventory, what is being constructed and what is being proposed is vital to understanding if a large-scale retail development is feasible for this market.

Colliers Hawaii Consulting has compiled the major retail shopping centers for the primary, secondary and tertiary trade areas, as well as those projects currently being constructed or proposed for the foreseeable future. We apply an average retail square footage per resident ratio to the market area to determine if this market is under-served or over-served by the current retail square footage. Based on this ratio we can also determine the additional amount of retail square footage that could feasibly be added to the market as the population grows in the area.

We utilized two population estimates and two consumer expenditure models to determine retail square footage demand. For the population estimates, our first method used the census data and projections of annual growth. We can surmise that fluctuations in the annual population growth percentages would occur over the next twenty-years, as a result we incorporated in our census estimates a 3% annual population growth estimate for the primary trade area, a 1.2% growth rate for the secondary trade area, and a 1% population growth rate for the tertiary trade area. These growth percentages are based on the historical average for the various trade areas. We are confident that the primary trade area will continue to post stronger than average population growth percentages (3% is three times higher than the statewide average annual growth rate).

The second method of population growth takes into account the numerous residential developments that are being built in the area. We believe that these developments would generate significantly higher population growth rates than the census projections.

CENSUS POPULATION MODEL - RETAIL SQUARE FOOTAGE ESTIMATE

CENSUS POPULATION MODEL

POPULATION ESTIMATE

MARKET	POPULATION 2004	GROWTH RATE	%	2005	2006-2010	2011-2015	2016-2020	2021-2025
PRIMARY	38,991	Conservative	1.00%	39,381	41,390	43,501	45,720	48,052
		Moderate	2.50%	39,966	45,218	51,160	57,882	65,489
		Aggressive	4.00%	40,551	49,336	60,025	73,029	88,851
SECONDARY	176,563	Conservative	1.50%	179,211	193,062	207,982	224,056	241,372
		Moderate	1.75%	179,653	195,932	213,687	233,051	254,169
		Aggressive	2.10%	180,271	200,011	221,913	246,213	273,175
TERTIARY	128,405	Conservative	1.00%	129,689	136,304	143,257	150,565	158,245
		Moderate	1.50%	130,331	140,403	151,254	162,944	175,537
		Aggressive	2.00%	130,973	144,605	159,655	176,272	194,619

RETAIL MARKET POTENTIAL

RETAIL SQUARE FOOTAGE PER RESIDENT		2005	2006-2010	2011-2015	2016-2020	2021-2025
		20.78	21.30	21.83	22.38	22.94
PRIMARY	Conservative	818,295	881,536	949,665	1,023,059	1,102,125
	Moderate	830,448	963,064	1,116,857	1,295,211	1,502,045
	Aggressive	842,601	1,050,780	1,310,394	1,634,150	2,037,896
SECONDARY	Conservative	3,723,830	4,111,909	4,540,430	5,013,610	5,536,102
	Moderate	3,733,002	4,173,051	4,664,973	5,214,883	5,829,617
	Aggressive	3,745,843	4,259,922	4,844,553	5,509,418	6,265,530
TERTIARY	Conservative	2,694,803	2,903,068	3,127,429	3,369,129	3,629,509
	Moderate	2,708,144	2,990,372	3,302,013	3,646,132	4,026,113
	Aggressive	2,721,484	3,079,854	3,485,413	3,944,377	4,463,779

INVENTORY ESTIMATE

		2005	2006-2010	2011-2015	2016-2020	2021-2025
PRIMARY	EXISTING AND NEW INVENTORY	506,407	1,723,657	1,881,157	1,976,157	2,038,657
	Conservative	311,888	(842,121)	(931,492)	(953,098)	(936,532)
	Moderate	324,041	(760,593)	(764,300)	(680,946)	(536,612)
	Aggressive	336,194	(672,877)	(570,763)	(342,007)	(761)
SECONDARY	EXISTING AND NEW INVENTORY	3,394,001	3,822,751	3,947,751	3,947,751	3,947,751
	Conservative	329,829	289,158	592,679	1,065,859	1,588,351
	Moderate	339,001	350,300	717,222	1,267,132	1,881,866
	Aggressive	351,842	437,171	896,802	1,561,667	2,317,779
TERTIARY	EXISTING AND NEW INVENTORY	2,596,159	2,671,159	2,671,159	2,671,159	2,671,159
	Conservative	98,644	(919,683)	456,270	697,970	958,350
	Moderate	111,985	(832,379)	630,854	974,973	1,354,954
	Aggressive	125,325	(742,897)	814,254	1,273,218	1,792,620

CAPTURE RATE

	CAPTURE RATE		2005	2006-2010	2011-2015	2016-2020	2021-2025
PRIMARY	85.00%	Conservative	265,105	(715,803)	(791,768)	(810,134)	(796,052)
		Moderate	275,435	(646,504)	(649,655)	(578,804)	(456,120)
		Aggressive	285,765	(571,945)	(485,148)	(290,706)	(647)
SECONDARY	15.00%	Conservative	49,474	43,374	88,902	159,879	238,253
		Moderate	50,850	52,545	107,583	190,070	282,280
		Aggressive	52,776	65,576	134,520	234,250	347,667
TERTIARY	5.00%	Conservative	4,932	(45,984)	22,814	34,899	47,918
		Moderate	5,599	(41,619)	31,543	48,749	67,748
		Aggressive	6,266	(37,145)	40,713	63,661	89,631

RETAIL MARKET POTENTIAL - CENSUS MODEL

	2005	2006-2010	2011-2015	2016-2020	2021-2025
Conservative	319,511	(718,413)	(680,053)	(615,356)	(509,882)
Moderate	331,884	(635,578)	(510,529)	(339,986)	(106,092)
Aggressive	344,807	(543,514)	(309,915)	7,205	436,651

Source: Census, Colliers Hawaii Consulting

8/1/2005

PLANNED AND PROPOSED RESIDENTIAL DEVELOPMENTS

PRIMARY AND SECONDARY TRADE AREA RESIDENTIAL DEVELOPMENTS

Name of Development	Developer or Owner	Trade Area	2004-2005	2006-2010	2011-2015	2016-2020	2021-2025	Total
Makaiwa Hills I & II	Aina Nui Corporation	primary	0	500	1,250	1,250	66	3,066
Kapolei West	Aina Nui Corporation	primary	0	2,370	0	0	0	2,370
City of Kapolei	Campbell Estate	primary	0	300	700	0	0	1,000
Palehua East B	Castle & Cooke	primary	60	210	0	0	0	270
Makakilo Build-out 2/3	Finance Realty	primary	200	50	0	0	0	250
Palehua East C&D	Finance Realty	primary	0	80	400	220	0	700
UH West Oahu	State of Hawaii (DLNR)	primary	0	500	1,250	1,250	1,000	4,000
Villages of Kapolei	State of Hawaii (HCDCH/DHHL)	primary	0	327	0	0	0	327
Unnamed	State of Hawaii (DHHL)	primary	0	500	0	0	0	500
Unnamed	State of Hawaii (DHHL)	primary	0	0	240	0	0	240
Ewa by Gentry	Gentry Homes	secondary	600	700	0	0	0	1,300
Gentry Ewa Makai	Gentry Homes	secondary	0	800	1,065	0	0	1,865
Ocean Pointe	HASEKO(Ewa) Inc.	secondary	500	1,250	1,250	650	0	3,650
Mehana	Schuler Homes	secondary	0	450	698	0	0	1,148
Ewa Villages	City & County of Honolulu	secondary	100	567	0	0	0	667
	TOTALS		**1,460**	**8,604**	**6,853**	**3,370**	**1,066**	**21,353**

NON-RESIDENT/SECOND HOME DEVELOPMENTS			2004-2005	2006-2010	2011-2015	2016-2020	2021-2025	Total
Ko Olina Resort & Marina	Ko Olina Development LLC	primary	100	600	185	0	0	885
Ko Olina Timeshare		primary	210	175	175	0	0	560
Ko Olina SFH		primary	40	12	12	480		544
			350	**787**	**372**	**480**	**0**	**1,989**

HOTEL DEVELOPMENTS								
Oceanpoint Hotel		secondary	0	0	950	0	0	950
Ko Olina Hotel		primary	387	250	0	0	0	637
		annual totals	**387**	**250**	**950**	**0**	**0**	**1587**
TOTAL HOTEL ROOMS			**387**	**637**	**1587**	**1587**	**1587**	**1587**

Source: DPP, Makiko Feasibility Report,Bruce Plasch

8/1/2005

Consumer Expenditures

The next two methods took into account consumer expenditures for this market. For the first consumer expenditure method we used the census estimates of consumer expenditures for the primary, secondary and tertiary trade areas. We determined that for 2004, the average sales per square foot for retail shopping centers on the island was $331 per square foot. By taking the totals for consumer expenditures and dividing this figure by the retail sales per square foot figure, we can determine the amount of retail square footage that this market can support.

The census estimates are likely to underreport the amount of consumer expenditures for this market due to the dramatic growth in household formation that will occur over the next decade. As a result, Colliers Hawaii Consulting sourced additional consumer expenditure data from Claritas, a reputable consumer economic forecasting firm. The Claritas data provides an alternative opinion of the retail market potential for this development site.

All four methods of retail square footage estimations incorporated a capture rate for the primary, secondary and tertiary trade areas. The capture rate indicates the percentage likelihood that a resident of that trade area would shop at the Makaiwa Hills retail development. The Urban Land Institute, a real estate research consortium, estimates that the primary trade area provides 75%-85% of a shopping center's retail expenditures. Similarly, we believe that 85% of the primary area's shoppers would frequent the Makaiwa Hills site. We also believe we would capture 15% of the secondary market, and 5% of the tertiary market's shoppers.

Based on census and the residential development population growth models, used in conjunction with the estimated capture rates, we believe that by 2025 the amount of retail space that could be developed would range between an overbuilt situation of –157,720 square feet to more than 1.2 million square feet.

The consumer expenditure models estimates ranged from a conservative 727,845 square feet to an aggressive estimate of 4.07 million square feet.

CENSUS CONSUMER EXPENDITURE MODEL - RESIDENT RETAIL SQ.FT. ESTIMATE

CENSUS CONSUMER EXPENDITURE MODEL

MARKET	RETAIL SALES GROWTH RATE	ESTIMATE	BASE YEAR	2005	2006-2010	2011-2015	2016-2020	2021-2025
PRIMARY	4.00%	Conservative	$229,342,745	$238,516,455	$290,191,737	$353,062,620	$429,554,661	$522,618,925
	5.00%	Moderate	$229,342,745	$240,809,883	$307,341,213	$392,253,924	$500,626,451	$638,940,309
	6.00%	Aggressive	$229,342,745	$243,103,310	$325,327,068	$435,361,003	$582,611,230	$779,665,249
SECONDARY	2.00%	Conservative	$1,197,578,911	$1,221,530,490	$1,348,668,364	$1,489,038,851	$1,644,019,210	$1,815,130,050
	3.00%	Moderate	$1,197,578,911	$1,233,506,279	$1,429,971,850	$1,657,729,292	$1,921,762,591	$2,227,849,548
	4.00%	Aggressive	$1,197,578,911	$1,245,482,068	$1,515,319,373	$1,843,617,713	$2,243,042,841	$2,729,004,583
TERTIARY	1.50%	Conservative	$1,983,000,188	$2,012,745,190	$2,168,298,198	$2,335,872,964	$2,516,398,579	$2,710,875,937
	2.00%	Moderate	$1,983,000,188	$2,022,660,191	$2,233,180,289	$2,465,611,487	$2,722,234,311	$3,005,566,644
	3.00%	Aggressive	$1,983,000,188	$2,042,490,193	$2,367,805,928	$2,744,936,025	$3,182,133,170	$3,688,964,485

RETAIL SQUARE FOOTAGE POTENTIAL

	RETAIL SALES PER SQ. FT.	ESTIMATE	BASE YEAR	2005	2006-2010	2011-2015	2016-2020	2021-2025
PRIMARY	$331	Conservative	692,878	720,594	876,712	1,066,654	1,297,748	1,578,909
	$331	Moderate	692,878	727,522	928,523	1,185,057	1,512,467	1,930,333
	$331	Aggressive	692,878	734,451	982,861	1,315,290	1,760,155	2,355,484
SECONDARY	$331	Conservative	3,618,063	3,690,424	4,074,527	4,498,607	4,966,825	5,483,777
	$331	Moderate	3,618,063	3,726,605	4,320,157	5,008,246	5,805,929	6,730,663
	$331	Aggressive	3,618,063	3,762,786	4,578,004	5,569,842	6,776,564	8,244,727
TERTIARY	$331	Conservative	5,990,937	6,080,801	6,550,750	7,057,018	7,602,413	8,189,958
	$331	Moderate	5,990,937	6,110,756	6,746,768	7,448,977	8,224,273	9,080,262
	$331	Aggressive	5,990,937	6,170,665	7,153,492	8,292,858	9,613,695	11,144,908

CAPTURE RATE ANALYSIS

	CAPTURE RATE		BASE YEAR	2005	2006-2010	2011-2015	2016-2020	2021-2025
PRIMARY	85.00%	Conservative	588,947	612,504	745,205	906,656	1,103,086	1,342,073
		Moderate	588,947	618,394	789,245	1,007,299	1,285,597	1,640,783
		Aggressive	588,947	624,283	835,432	1,117,997	1,496,132	2,002,162
SECONDARY	15.00%	Conservative	542,709	553,564	611,179	674,791	745,024	822,566
		Moderate	542,709	558,991	648,023	751,237	870,889	1,009,599
		Aggressive	542,709	564,418	686,701	835,476	1,016,485	1,236,709
TERTIARY	5.00%	Conservative	299,547	304,040	327,537	352,851	380,121	409,498
		Moderate	299,547	305,538	337,338	372,449	411,214	454,013
		Aggressive	299,547	308,533	357,675	414,643	480,685	557,245

RESIDENT RETAIL ESTIMATE OF SQUARE FOOTAGE

(CAPTURE RATE FIGURES LESS CURRENT AND PLANNED INVENTORY)		2005	2006-2010	2011-2015	2016-2020	2021-2025
	Conservative	(353,684)	(383,370)	(69,494)	349,438	727,845
	Moderate	(340,870)	(292,685)	127,192	688,907	1,258,104
	Aggressive	(326,558)	(187,485)	364,324	1,114,509	1,949,824

Source: Census, Colliers Hawaii Consulting

8/1/2005

CLARITAS CONSUMER EXPENDITURE MODEL - RETAIL SQUARE FOOTAGE ESTIMATES

CLARITAS CONSUMER EXPENDITURE MODEL

MARKET	RETAIL SALES GROWTH RATE	ESTIMATE	BASE YEAR	2005	2006-2010	2011-2015	2016-2020	2021-2025
PRIMARY	4.00%	Conservative	$704,433,000	$732,610,320	$891,332,472	$1,084,442,239	$1,372,165,390	$1,605,239,427
	5.00%	Moderate	$704,433,000	$739,654,650	$944,007,592	$1,204,819,485	$1,537,688,895	$1,962,523,985
	6.00%	Aggressive	$704,433,000	$746,698,980	$999,251,674	$1,337,224,148	$1,789,507,558	$2,394,764,786
SECONDARY	2.00%	Conservative	$1,396,565,000	$1,424,496,300	$1,572,759,019	$1,736,453,041	$1,917,184,468	$2,116,726,568
	3.00%	Moderate	$1,396,565,000	$1,438,461,950	$1,667,571,646	$1,933,172,576	$2,241,076,848	$2,598,022,289
	4.00%	Aggressive	$1,396,565,000	$1,452,427,600	$1,767,100,255	$2,149,947,654	$2,615,740,053	$3,182,447,728
TERTIARY	1.50%	Conservative	$1,533,362,000	$1,556,362,430	$1,676,644,350	$1,806,222,139	$1,945,814,217	$2,096,194,531
	2.00%	Moderate	$1,533,362,000	$1,564,029,240	$1,726,814,660	$1,906,542,916	$2,147,076,983	$2,324,065,176
	3.00%	Aggressive	$1,533,362,000	$1,579,362,860	$1,830,914,418	$2,122,531,616	$2,460,595,875	$2,852,505,005

RETAIL SQUARE FOOTAGE POTENTIAL

	RETAIL SALES PER SQ. FT.	ESTIMATE	BASE YEAR	2005	2006-2010	2011-2015	2016-2020	2021-2025
PRIMARY	$331	Conservative	2,128,196	2,213,324	2,692,847	3,276,261	4,145,515	4,849,666
	$331	Moderate	2,128,196	2,234,606	2,851,987	3,639,938	4,645,586	5,929,075
	$331	Aggressive	2,128,196	2,255,888	3,018,887	4,039,952	5,406,367	7,234,939
SECONDARY	$331	Conservative	4,219,230	4,303,614	4,751,538	5,246,082	5,792,098	6,394,944
	$331	Moderate	4,219,230	4,345,806	5,037,981	5,840,401	6,770,625	7,849,010
	$331	Aggressive	4,219,230	4,387,999	5,338,671	6,495,310	7,902,538	9,614,646
TERTIARY	$331	Conservative	4,632,514	4,702,001	5,065,391	5,456,864	5,878,593	6,332,914
	$331	Moderate	4,632,514	4,725,164	5,216,963	5,759,948	6,486,637	7,021,345
	$331	Aggressive	4,632,514	4,771,489	5,531,463	6,412,482	7,433,824	8,617,840

CAPTURE RATE ANALYSIS

	CAPTURE RATE		BASE YEAR	2005	2006-2010	2011-2015	2016-2020	2021-2025
PRIMARY	85.00%	Conservative	1,808,967	1,881,326	2,288,920	2,784,821	3,523,688	4,122,216
		Moderate	1,808,967	1,899,415	2,424,189	3,093,947	3,948,748	5,039,714
		Aggressive	1,808,967	1,917,505	2,566,054	3,433,959	4,595,412	6,149,698
SECONDARY	15.00%	Conservative	632,884	645,542	712,731	786,912	868,815	959,242
		Moderate	632,884	651,871	755,697	876,060	1,015,594	1,177,351
		Aggressive	632,884	658,200	800,801	974,297	1,185,381	1,442,197
TERTIARY	5.00%	Conservative	231,626	235,100	253,270	272,843	293,930	316,646
		Moderate	231,626	236,258	260,848	287,997	324,332	351,067
		Aggressive	231,626	238,574	276,573	320,624	371,691	430,892

RESIDENT RETAIL ESTIMATE OF SQUARE FOOTAGE
(CAPTURE RATE FIGURES LESS CURRENT AND PROJECTED INVENTORY)

	2005	2006-2010	2011-2015	2016-2020	2021-2025
Conservative	938,176	(289,872)	17,285	148,508	1,413,311
Moderate	963,752	(104,058)	430,713	617,452	2,583,341
Aggressive	990,487	98,636	901,588	1,156,216	4,037,995

Source: Claritas, Colliers Hawaii Consulting

8/1/2005

NON-RESIDENT CONSUMER EXPENDITURE PROJECTIONS 2005-2025

RESORT-NON-RESIDENT CONSUMER EXPENDITURE PROJECTIONS

	2006-2015	2016-2025	2006-2025
HOTEL ROOMS	1,200	300	1,500
OCCUPIED AT 75%	900	225	1,125
NUMBER OF VISITORS 2.1 PER ROOM	1,890	473	2,363
CONSUMPTION EXPENDITURES @ $130 PER DAY	$89,680,500	$22,420,125	$112,100,625
TIMESHARE UNITS	350	400	750
OCCUPIED 90%	315	360	675
NUMBER OF VISITORS PER UNIT 3.0	945	1,080	2,025
CONSUMPTION EXPENDITURES @ $110 PER DAY	$37,941,750	$43,362,000	$81,303,750
TOTAL CONSUMPTION EXPENDITURES (RESORT)	$127,622,250	$65,782,125	$193,404,375

Source: Bluce Plasch

Source: Bruce Plasch

8/1/2005

MAKAIWA HILLS COMMERCIAL MIXED USE DEVELOPMENT ESTIMATES OF SQUARE FOOTAGE

RETAIL SQUARE FOOTAGE ESTIMATES	2005	2006-2010	2011-2015	2016-2020	2021-2025
RESIDENTIAL DEVELOPMENT MODEL ESTIMATE	442,127	316,620	1,110,627	138,677	1,546,832
CLARITAS CONSUMER EXPENDITURE MODEL (MODERATE)	1,073,587	85,792	811,745	1,741,054	2,964,373
RECOMMENDED SQUARE FOOTAGE	**606,286**	**160,965**	**768,949**	**751,892**	**1,804,482**

OFFICE SQUARE FOOTAGE ESTIMATE	2005	2006-2010	2011-2015	2016-2020	2021-2025
MODERATE ESTIMATE	19,186	(30,874)	79,369	199,603	330,732

TOTAL DEVELOPMENT SQUARE FOOTAGE ESTIMATE	2005	2006-2010	2011-2015	2016-2020	2021-2025
RECOMMENDED TOTAL DEVELOPMENT SQUARE FOOTAGE	**625,472**	**130,091**	**848,318**	**951,495**	**2,135,214**

*WE BELIEVE THE SUBJECT PROPERTY CAN SUPPORT A MIXED USE OFFICE/RETAIL DEVELOPMENT OF 800,000 TO 950,000 SQ.FT.

**BASED ON AN 800,000 TO 950,000 SQUARE FOOT DEVELOPMENT, USING AN 0.25 FAR, THE TOTAL ACREAGE FOR THE SITE WOULD RANGE FROM 73 TO 87 ACRES

Source: Colliers Hawaii Consulting

8/1/2005

Estimation of Retail Square Footage Demand

The commercial component of this development is planned to begin construction in 2009. We believe occupancy will likely occur in 2011. Using this timeline, we believe that our retail square footage estimation models indicate a range from an overbuilt situation of a negative 461,766 square feet to an aggressive estimate of 929,838 square feet.

We believe that the census estimates have significantly under-represented the level of growth in this area and as a result we would discount the lower estimates for both the census population and the census consumer expenditure models. Additionally, the residential development model assumes that whatever is built will be occupied. Despite the current hot residential market conditions, over a twenty-year period it is unlikely that interest rates and housing demand will continue at its current pace. As a result, the residential development model provides a very aggressive projection.

For our estimations, we believe that a phased development plan will allow the most flexibility should market dynamics change. For Phase I, we estimate that the amount of retail square footage allocated for this site should range between 350,000 to 450,000 square feet. For Phase II, the additional development of 250,000 to 350,000 square feet should be considered by 2020. For Phase III, an additional 200,000 to 250,000 square feet should be planned for completion by 2025.

The total retail square footage supported by the population and consumer expenditures by 2025 would range in size from 800,000 square feet to 1,050,000 square feet.

Retail Trade Potential Analysis

Overview

Once we determined that the market areas surrounding the Makaiwa Hills commercial development site could support a certain level of additional retail square footage, our next objective is to identify those categories of retailers that would likely succeed in this trade area.

Based on the census of retail trade, supporting demographic, consumer expenditures and retail sales information we are able to estimate the retail trade potential for various categories of retail merchandise and services.

Consumer Spending Patterns Report

The consumer spending patterns report is utilized to identify those categories of retail expenditures for the primary, secondary and tertiary trade areas that exceed the national average. Based on these estimations we are better able to select major retail categories for inclusion in a proposed retail development. The consumer spending patterns report provides estimation of what a trade area's residents are actually spending on goods and services (see appendix). The Market Index to USA compares the national average to the identified market area, an index greater than 1.0 indicates that for this retail category the area's residents have a higher than average propensity to purchase a specific good or service.

For the identified trade areas, the following broad retail categories show where residents currently spend the majority of their money on:

- Womens apparel
- Mens apparel
- Girls Apparel
- Boys Apparel
- Infant Apparel
- Sports and Recreation
- Produce-Fresh Fruits and Vegetables
- Furniture and appliances
- Day Care

Consumer Spending Patterns Report

Prepared For: COLLIERS MONROE FRIEDLANDER — **Order #: 963561918**
Project Code: 2006735 - PRIMARY AREA — **Site: 01**

PRIMARY AREA, Polygon (see appendix), Total

Annual Expenditures	Aggregate (in 000's) 2005	Aggregate 2010	Per Capita 2005	Per Capita 2010	Average Household 2005	Average Household 2010	Market Index to USA 2005	Market Index to USA 2010
Apparel:								
Total Apparel	59,122	79,364	1,589	1,826	5,543	6,456	133	137
Women's Apparel	16,917	22,772	455	524	1,586	1,852	135	138
Men's Apparel	11,838	15,164	318	349	1,110	1,234	131	134
Girl's Apparel	4,293	5,835	115	134	402	475	155	160
Boy's Apparel	4,108	5,552	110	128	385	452	155	161
Infant's Apparel	1,716	2,142	46	49	161	174	153	151
Footwear (excl. Infants)	7,495	9,763	201	225	703	794	143	146
Other Apparel Prods/Services	12,755	18,136	343	417	1,196	1,475	115	120
Entertainment:								
Sports and Recreation	19,491	28,662	524	659	1,827	2,332	141	144
TV, Radio and Sound Equipment	23,184	32,412	623	746	2,173	2,637	126	127
Reading Materials	5,750	7,065	155	163	539	575	106	109
Travel	18,639	27,579	501	634	1,747	2,243	131	135
Photographic Equipment	1,758	2,204	47	51	165	179	129	132
Food at Home:								
Total Food at Home	71,427	89,569	1,920	2,061	6,696	7,286	122	123
Cereal Products	4,398	5,377	118	124	412	437	137	141
Bakery Products	7,105	8,641	191	199	666	703	117	119
Fish and Seafood	1,404	1,894	38	44	132	154	109	111
Meats (All)	13,716	17,232	369	396	1,286	1,402	117	118
Dairy Products	6,674	8,061	179	185	626	656	110	112
Fresh Milk and Cream	1,836	2,116	49	49	172	172	119	120
Eggs	947	1,268	25	29	89	103	141	141
Other Dairy Products	3,891	4,677	105	108	365	380	102	103
Fruits and Vegetables	9,879	12,674	266	292	926	1,031	138	139
Juices	2,221	2,755	60	63	208	224	127	127
Sugar and Other Sweets	4,803	5,988	129	138	450	487	125	127
Fats and Oils	571	753	15	17	54	61	108	109
Nonalcoholic Beverages	6,634	7,357	178	169	622	598	114	115
Prepared Foods	14,022	18,838	377	433	1,314	1,532	126	126

Consumer Spending Patterns Report

Prepared For: COLLIERS MONROE FRIEDLANDER — **Order #: 963561918**
Project Code: 2006735 - PRIMARY AREA — **Site: 01**

PRIMARY AREA, Polygon (see appendix), Total

Annual Expenditures	Aggregate (in 000's) 2005	Aggregate 2010	Per Capita 2005	Per Capita 2010	Average Household 2005	Average Household 2010	Market Index to USA 2005	Market Index to USA 2010
Health Care:								
Total Health Care	37,052	62,985	996	1,449	3,473	5,124	94	94
Medical Services	18,242	26,110	490	601	1,710	2,124	114	117
Prescription Drugs	17,095	34,360	460	790	1,603	2,795	78	81
Medical Supplies	1,714	2,515	46	58	161	205	116	120
Household Equipment:								
Total Household Textiles	6,900	9,717	185	224	647	790	122	127
Domestic Textiles	2,795	4,036	75	93	262	328	123	125
Window and Furniture Covers	4,104	5,682	110	131	385	462	122	128
Total Furniture	10,760	14,378	289	331	1,009	1,170	129	133
Bedroom Furniture	2,913	3,881	78	89	273	316	129	132
Living/Dining Room Furniture	4,727	6,078	127	140	443	494	128	133
Other Furniture	3,119	4,420	84	102	292	360	131	135
Major Appliances	4,176	5,071	112	117	392	412	124	126
Small Appliance/Houseware	8,943	11,671	240	269	838	949	135	138
Misc Household Equipment	6,965	9,277	187	213	653	755	123	125
Misc Personal Items:								
Personal Care Products and Services	10,999	15,081	296	347	1,031	1,227	117	118
Personal Expenses and Services	17,392	25,023	467	576	1,630	2,036	110	114
Smoking Prods/Supplies	7,067	8,815	190	203	662	717	82	80
Miscellaneous Items:								
Total Education	19,316	29,274	519	673	1,811	2,381	151	158
Room and Board	948	1,190	25	27	89	97	108	118
Tuition/School Supplies	18,368	28,085	494	646	1,722	2,285	154	160
Pet Expenses	6,109	8,794	164	202	573	715	122	123
Day Care	5,567	7,648	150	176	522	622	160	162
Contributions (All)	22,633	30,681	608	706	2,122	2,496	113	117

Consumer Spending Patterns Report

Prepared For: COLLIERS MONROE FRIEDLANDER — **Order #: 963561918**

Project Code: 2006735 - PRIMARY AREA — **Site: 01**

PRIMARY AREA, Polygon (see appendix), Total

	Aggregate (in 000's)		Per Capita		Average Household		Market Index to USA	
Annual Expenditures	**2005**	**2010**	**2005**	**2010**	**2005**	**2010**	**2005**	**2010**
Other Misc. Expenses:								
Housekeeping Supplies	3,924	5,645	105	130	368	459	112	112
Total Food away from Home	57,416	75,496	1,543	1,737	5,383	6,141	114	115
Breakfast and Brunch	4,359	6,340	117	146	409	516	109	109
Dinner	16,527	20,590	444	474	1,549	1,675	109	111
Lunch	18,590	25,586	500	589	1,743	2,081	126	127
Snacks and Non Alcoholic Beverage	5,023	7,304	135	168	471	594	108	108
Catered Affairs	1,084	1,408	29	32	102	115	98	104
Food and Nonalcoholic Bevgs on Trips	11,833	14,268	318	328	1,109	1,161	108	111
Total Alcoholic Beverages	11,912	15,350	320	353	1,117	1,249	92	94
Alcoholic Beverages at Home	8,778	10,995	236	253	823	894	99	100
Alcoholic Beverages away from Home	3,134	4,355	84	100	294	354	78	81
Shelter and Related Expenses:								
Household Services	5,746	8,614	154	198	539	701	105	112
Household Repairs	16,311	21,932	438	505	1,529	1,784	129	132
Total Housing Expenses	13,987	18,180	376	418	1,311	1,479	103	107
Fuels and Utilities	1,285	1,344	35	31	121	109	62	67
Telephone Service	12,702	16,836	341	387	1,191	1,370	111	112
Transportation Expenses:								
Total Transportation Expenses	92,159	125,707	2,477	2,892	8,640	10,226	121	121
New Autos/Trucks/Vans	39,072	48,489	1,050	1,116	3,663	3,944	123	125
Used Vehicles	29,590	42,450	795	977	2,774	3,453	120	120
Boats and Outboard Motor, Etc	4,591	5,907	123	136	430	481	154	155
Towing Charges	75	104	2	2	7	8	120	123
Gasoline	16,022	24,952	431	574	1,502	2,030	109	108
Diesel Fuel	261	314	7	7	24	26	200	195
Rented Vehicles	2,548	3,491	68	80	239	284	133	136
Automotive Maintenace/Repair/Other	20,127	27,767	541	639	1,887	2,259	115	117
Total Specified Consumer Expenditures	584,829	803,963	15,720	18,496	54,826	65,400	119	120

Consumer Spending Patterns Report

Prepared For: COLLIERS MONROE FRIEDLANDER — **Order #: 963561988**

Project Code: 2006736 - HONOLULU, HI — **Site: 01**

SECONDARY AREA, Polygon (see appendix), Total

	Aggregate (in 000's)		Per Capita		Average Household		Market Index to USA	
Annual Expenditures	**2005**	**2010**	**2005**	**2010**	**2005**	**2010**	**2005**	**2010**
Apparel:								
Total Apparel	321,808	402,929	1,448	1,662	5,257	6,014	126	127
Women's Apparel	93,799	117,028	422	483	1,532	1,747	130	130
Men's Apparel	65,676	78,470	295	324	1,073	1,171	126	127
Girl's Apparel	22,146	28,547	100	118	362	426	140	143
Boy's Apparel	21,239	26,907	96	111	347	402	139	143
Infant's Apparel	9,131	10,820	41	45	149	162	142	140
Footwear (excl. Infants)	40,808	49,630	184	205	667	741	136	136
Other Apparel Prods/Services	69,008	91,527	310	378	1,127	1,366	108	111
Entertainment:								
Sports and Recreation	102,285	141,913	460	586	1,671	2,118	129	130
TV, Radio and Sound Equipment	124,987	164,714	562	680	2,042	2,459	119	118
Reading Materials	30,681	35,717	138	147	501	533	99	101
Travel	102,588	141,353	461	583	1,676	2,110	126	127
Photographic Equipment	9,075	10,757	41	44	148	161	116	118
Food at Home:								
Total Food at Home	406,059	477,505	1,827	1,970	6,633	7,128	121	121
Cereal Products	25,413	29,196	114	120	415	436	138	141
Bakery Products	40,432	46,032	182	190	660	687	116	116
Fish and Seafood	8,071	10,141	36	42	132	151	109	109
Meats (All)	79,772	93,474	359	386	1,303	1,395	118	118
Dairy Products	36,747	41,865	165	173	600	625	106	106
Fresh Milk and Cream	10,360	11,221	47	46	169	167	117	116
Eggs	5,685	7,086	26	29	93	106	147	145
Other Dairy Products	20,702	23,558	93	97	338	352	94	95
Fruits and Vegetables	58,655	70,188	264	290	958	1,048	143	141
Juices	12,756	14,795	57	61	208	221	127	126
Sugar and Other Sweets	26,874	31,504	121	130	439	470	122	123
Fats and Oils	3,240	4,014	15	17	53	60	107	107
Nonalcoholic Beverages	36,672	38,298	165	158	599	572	110	110
Prepared Foods	77,426	97,999	348	404	1,265	1,463	121	121

Consumer Spending Patterns Report

Prepared For: COLLIERS MONROE FRIEDLANDER — **Order #: 963561988**

Project Code: 2006736 - HONOLULU, HI — **Site: 01**

SECONDARY AREA, Polygon (see appendix), Total

Annual Expenditures	Aggregate (in 000's) 2005	Aggregate (in 000's) 2010	Per Capita 2005	Per Capita 2010	Average Household 2005	Average Household 2010	Market Index to USA 2005	Market Index to USA 2010
Health Care:								
Total Health Care	229,812	362,856	1,034	1,497	3,754	5,416	101	100
Medical Services	104,115	138,414	468	571	1,701	2,066	113	114
Prescription Drugs	115,719	210,945	521	870	1,890	3,149	92	91
Medical Supplies	9,978	13,497	45	56	163	201	118	118
Household Equipment:								
Total Household Textiles	37,160	49,038	167	202	607	732	115	117
Domestic Textiles	15,085	20,497	68	85	246	306	115	117
Window and Furniture Covers	22,074	28,541	99	118	361	426	114	118
Total Furniture	57,599	72,065	259	297	941	1,076	120	123
Bedroom Furniture	15,594	19,490	70	80	255	291	120	122
Living/Dining Room Furniture	25,390	30,505	114	126	415	455	120	122
Other Furniture	16,614	22,070	75	91	271	329	122	124
Major Appliances	22,514	25,736	101	106	368	384	117	117
Small Appliance/Houseware	48,693	59,629	219	246	795	890	128	129
Misc Household Equipment	37,444	47,003	168	194	612	702	115	116
Misc Personal Items:								
Personal Care Products and Services	60,819	78,180	274	323	994	1,167	112	112
Personal Expenses and Services	98,161	131,689	442	543	1,604	1,966	108	110
Smoking Prods/Supplies	38,543	46,332	173	191	630	692	78	77
Miscellaneous Items:								
Total Education	107,715	150,770	485	622	1,760	2,251	147	149
Room and Board	5,136	5,869	23	24	84	88	102	107
Tuition/School Supplies	102,580	144,901	461	598	1,676	2,163	150	152
Pet Expenses	32,482	44,411	146	183	531	663	113	114
Day Care	30,026	38,547	135	159	490	575	150	149
Contributions (All)	124,597	158,053	561	652	2,035	2,359	109	111

Consumer Spending Patterns Report

Prepared For: COLLIERS MONROE FRIEDLANDER — **Order #: 963561988**

Project Code: 2006736 - HONOLULU, HI — **Site: 01**

SECONDARY AREA, Polygon (see appendix), Total

Annual Expenditures	Aggregate (in 000's) 2005	Aggregate (in 000's) 2010	Per Capita 2005	Per Capita 2010	Average Household 2005	Average Household 2010	Market Index to USA 2005	Market Index to USA 2010
Other Misc. Expenses:								
Housekeeping Supplies	21,490	29,131	97	120	351	435	107	106
Total Food away from Home	314,121	389,928	1,413	1,609	5,131	5,820	108	109
Breakfast and Brunch	23,882	32,919	107	136	390	491	104	104
Dinner	89,087	104,838	401	433	1,455	1,565	102	104
Lunch	104,049	134,843	468	556	1,700	2,013	123	123
Snacks and Non Alcoholic Beverage	26,878	37,160	121	153	439	555	101	101
Catered Affairs	6,051	7,245	27	30	99	108	96	98
Food and Nonalcoholic Bevgs on Trips	64,174	72,923	289	301	1,048	1,089	102	104
Total Alcoholic Beverages	63,861	77,936	287	322	1,043	1,163	86	87
Alcoholic Beverages at Home	47,453	56,286	213	232	775	840	93	94
Alcoholic Beverages away from Home	16,408	21,650	74	89	268	323	71	74
Shelter and Related Expenses:								
Household Services	32,059	44,716	144	184	524	667	103	107
Household Repairs	87,975	110,585	396	456	1,437	1,651	121	122
Total Housing Expenses	76,796	93,847	345	387	1,255	1,401	99	101
Fuels and Utilities	7,352	7,149	33	29	120	107	62	66
Telephone Service	69,444	86,698	312	358	1,134	1,294	105	106
Transportation Expenses:								
Total Transportation Expenses	501,677	650,235	2,257	2,683	8,195	9,706	115	115
New Autos/Trucks/Vans	208,058	243,358	936	1,004	3,399	3,633	114	115
Used Vehicles	163,311	224,226	735	925	2,668	3,347	116	117
Boats and Outboard Motor, Etc	26,771	32,471	120	134	437	485	156	156
Towing Charges	421	547	2	2	7	8	117	119
Gasoline	87,731	130,169	395	537	1,433	1,943	104	103
Diesel Fuel	1,564	1,762	7	7	26	26	209	201
Rented Vehicles	13,822	17,702	62	73	226	264	126	127
Automotive Maintenace/Repair/Other	111,253	144,488	500	596	1,817	2,157	111	111
Total Specified Consumer Expenditures	3,232,282	4,180,063	14,541	17,247	52,801	62,396	114	115

Consumer Spending Patterns Report

Prepared For: COLLIERS MONROE FRIEDLANDER — **Order #: 963562156**

Project Code: 2006737 - TERTIARY AREA — **Site: 01**

TERTIARY AREA, Polygon (see appendix), Total

Annual Expenditures	Aggregate (in 000's) 2005	Aggregate (in 000's) 2010	Per Capita 2005	Per Capita 2010	Average Household 2005	Average Household 2010	Market Index to USA 2005	Market Index to USA 2010
Apparel:								
Total Apparel	550,228	676,980	1,479	1,696	5,103	5,817	122	123
Women's Apparel	159,768	195,977	429	491	1,482	1,684	126	126
Men's Apparel	112,237	131,808	302	330	1,041	1,133	123	123
Girl's Apparel	37,084	46,930	100	118	344	403	133	136
Boy's Apparel	35,191	43,897	95	110	326	377	131	134
Infant's Apparel	15,589	18,116	42	45	145	156	137	135
Footwear (excl. Infants)	68,657	82,137	184	206	637	706	130	130
Other Apparel Prods/Services	121,702	158,115	327	396	1,129	1,359	108	111
Entertainment:								
Sports and Recreation	176,539	240,745	474	603	1,637	2,069	126	127
TV, Radio and Sound Equipment	217,574	281,803	585	706	2,018	2,422	117	117
Reading Materials	55,123	62,875	148	157	511	540	101	102
Travel	179,975	243,309	484	609	1,669	2,091	125	126
Photographic Equipment	15,794	18,336	42	46	146	158	114	116
Food at Home:								
Total Food at Home	691,645	800,470	1,859	2,005	6,414	6,878	117	117
Cereal Products	42,829	48,394	115	121	397	416	132	134
Bakery Products	68,865	77,139	185	193	639	663	113	112
Fish and Seafood	13,766	17,030	37	43	128	146	106	106
Meats (All)	134,625	155,372	362	389	1,249	1,335	113	113
Dairy Products	63,027	70,598	169	177	585	607	103	103
Fresh Milk and Cream	17,599	18,755	47	47	163	161	113	112
Eggs	9,609	11,810	26	30	89	101	141	139
Other Dairy Products	35,819	40,033	96	100	332	344	93	93
Fruits and Vegetables	99,745	117,649	268	295	925	1,011	138	136
Juices	21,805	24,896	59	62	202	214	123	122
Sugar and Other Sweets	45,928	52,968	123	133	426	455	119	119
Fats and Oils	5,524	6,735	15	17	51	58	104	103
Nonalcoholic Beverages	62,807	64,516	169	162	582	554	107	106
Prepared Foods	132,724	165,173	357	414	1,231	1,419	118	117

Consumer Spending Patterns Report

Prepared For: COLLIERS MONROE FRIEDLANDER — **Order #: 963562156**

Project Code: 2006737 - TERTIARY AREA — **Site: 01**

TERTIARY AREA, Polygon (see appendix), Total

Annual Expenditures	Aggregate (in 000's) 2005	Aggregate (in 000's) 2010	Per Capita 2005	Per Capita 2010	Average Household 2005	Average Household 2010	Market Index to USA 2005	Market Index to USA 2010
Health Care:								
Total Health Care	399,567	621,489	1,074	1,557	3,706	5,340	100	98
Medical Services	182,278	238,529	490	598	1,690	2,050	113	113
Prescription Drugs	200,129	360,104	538	902	1,856	3,094	90	89
Medical Supplies	17,161	22,856	46	57	159	196	115	115
Household Equipment:								
Total Household Textiles	64,719	83,944	174	210	600	721	113	116
Domestic Textiles	26,367	35,185	71	88	245	302	114	115
Window and Furniture Covers	38,352	48,759	103	122	356	419	113	116
Total Furniture	100,531	123,474	270	309	932	1,061	119	121
Bedroom Furniture	27,229	33,402	73	84	253	287	119	120
Living/Dining Room Furniture	44,383	52,358	119	131	412	450	119	121
Other Furniture	28,919	37,713	78	94	268	324	120	122
Major Appliances	38,742	43,525	104	109	359	374	114	114
Small Appliance/Houseware	85,116	102,463	229	257	789	880	127	128
Misc Household Equipment	64,418	79,542	173	199	597	684	112	113
Misc Personal Items:								
Personal Care Products and Services	105,710	133,674	284	335	980	1,149	111	110
Personal Expenses and Services	174,027	229,452	468	575	1,614	1,972	109	111
Smoking Prods/Supplies	65,728	77,725	177	195	610	668	75	74
Miscellaneous Items:								
Total Education	187,883	257,283	505	644	1,742	2,211	146	147
Room and Board	9,024	10,030	24	25	84	86	102	105
Tuition/School Supplies	178,859	247,253	481	619	1,659	2,125	149	149
Pet Expenses	56,274	75,885	151	190	522	652	111	113
Day Care	50,478	63,675	136	160	468	547	143	142
Contributions (All)	221,831	276,344	596	692	2,057	2,375	110	112

Consumer Spending Patterns Report

Prepared For: COLLIERS MONROE FRIEDLANDER — **Order #: 963562156**
Project Code: 2006737 - TERTIARY AREA — **Site: 01**

TERTIARY AREA, Polygon (see appendix), Total

Annual Expenditures	Aggregate (in 000's) 2005	Aggregate (in 000's) 2010	Per Capita 2005	Per Capita 2010	Average Household 2005	Average Household 2010	Market Index to USA 2005	Market Index to USA 2010
Other Misc. Expenses:								
Housekeeping Supplies	37,024	49,389	99	124	343	424	104	104
Total Food away from Home	547,181	667,102	1,470	1,671	5,075	5,732	107	108
Breakfast and Brunch	41,652	56,483	112	141	386	485	103	103
Dinner	155,957	180,138	419	451	1,446	1,548	102	102
Lunch	179,799	229,150	483	574	1,667	1,969	121	120
Snacks and Non Alcoholic Beverage	46,764	63,512	126	159	434	546	99	100
Catered Affairs	10,585	12,381	28	31	98	106	95	97
Food and Nonalcoholic Bevgs on Trips	112,424	125,439	302	314	1,043	1,078	102	103
Total Alcoholic Beverages	113,220	135,629	304	340	1,050	1,165	87	88
Alcoholic Beverages at Home	83,873	97,733	225	245	778	840	93	94
Alcoholic Beverages away from Home	29,347	37,896	79	95	272	326	72	75
Shelter and Related Expenses:								
Household Services	55,830	76,524	150	192	518	658	101	105
Household Repairs	150,164	185,206	404	464	1,393	1,591	117	118
Total Housing Expenses	133,587	161,012	359	403	1,239	1,384	97	100
Fuels and Utilities	12,158	11,696	33	29	113	101	58	62
Telephone Service	121,429	149,316	326	374	1,126	1,283	105	105
Transportation Expenses:								
Total Transportation Expenses	875,260	1,118,338	2,352	2,801	8,117	9,610	114	114
New Autos/Trucks/Vans	363,907	418,027	978	1,047	3,375	3,592	113	113
Used Vehicles	284,807	386,566	765	968	2,641	3,322	115	116
Boats and Outboard Motor, Etc	45,104	54,381	121	136	418	467	150	150
Towing Charges	723	921	2	2	7	8	114	115
Gasoline	153,648	224,917	413	563	1,425	1,933	103	103
Diesel Fuel	2,636	2,928	7	7	24	25	200	192
Rented Vehicles	24,434	30,599	66	77	227	263	126	126
Automotive Maintenace/Repair/Other	193,376	247,227	520	619	1,793	2,124	109	110
Total Specified Consumer Expenditures	5,607,542	7,133,419	15,068	17,869	52,005	61,298	113	113

Retail SIC Summary Report

Retail SIC Summary Report

The Retail SIC Summary Report quantifies the number of retailers and their NAIC category in an identified trade area (see appendix). Additionally, this report provides the number of employees per retail establishment and their expected retail sales. This report allows you to identify the number of competitive retailers in an area and what their aggregated sales are.

Business-Facts: Retail SIC Summary 2004 Report

Prepared For: COLLIERS MONROE FRIEDLANDER — **Order #: 963561918**
Project Code: 2006735 - PRIMARY AREA — **Site: 02**

PRIMARY AREA, Polygon (see appendix), Total

SIC Code	Business Description	Total Establishments	Total Employees	Sales (in Millions)	Establishments 20+ Employees
RET	All Retailing	120	2,129	231.2	24
52	Building Materials, Garden Supply and Mobile Homes	11	271	49.5	4
521	Lumber and Other Building Materials	5	143	18.1	3
523	Paint, Glass and Wallpaper	3	5	1.0	0
525	Hardware Stores	3	123	30.4	1
526	Retail Nurseries and Garden	0	0	.0	0
527	Mobile Home Dealers	0	0	.0	0
53	General Merchandise Stores	1	4	.2	0
531	Department Stores	0	0	.0	0
54	Food Stores	6	134	22.5	1
541	Grocery Stores	5	130	22.3	1
542	Meat and Fish Markets	0	0	.0	0
543	Fruit and Vegetable Markets	0	0	.0	0
544	Candy, Nut and Confection Store	1	4	.2	0
545	Dairy Products Stores	0	0	.0	0
546	Retail Bakeries	0	0	.0	0
549	Miscellaneous Food Stores	0	0	.0	0
55	Automobile Dealers and Gas Service Stations	11	346	68.4	2
551	New and Used Car Dealers	1	25	10.1	1
552	Used Car Dealers	0	0	.0	0
553	Auto and Home Supply Stores	5	42	7.6	0
554	Gasoline Service Stations	4	275	49.5	1
555	Boat Dealers	1	4	1.2	0
556	Recreational Vehicle Dealer	0	0	.0	0
557	Motorcycle Dealers	0	0	.0	0
559	Automotive Dealers, NEC	0	0	.0	0
56	Apparel and Accessory Stores	3	14	1.1	0
561	Mens and Boys Clothing Stores	0	0	.0	0
562	Womens Clothing Stores	0	0	.0	0
563	Womens Accessory and Specialty Stores	0	0	.0	0
564	Childrens and Infants Wear	0	0	.0	0
565	Family Clothing Stores	1	8	.4	0
566	Shoe Stores	1	5	.6	0
569	Miscellaneous Apparel and Accessory Stores	1	1	.1	0
57	Home Furniture,Furnishings and Equipment	10	52	8.6	0
571	Home Furniture and Furnishing	6	32	5.1	0
5712	Furniture and Kitchen Design Stores	3	15	2.4	0

Business-Facts: Retail SIC Summary 2004 Report

Prepared For: COLLIERS MONROE FRIEDLANDER — **Order #: 963561918**
Project Code: 2006735 - PRIMARY AREA — **Site: 02**

PRIMARY AREA, Polygon (see appendix), Total

SIC Code	Business Description	Total Establishments	Total Employees	Sales (in Millions)	Establishments 20+ Employees
5713	Floor Covering Stores	1	12	2.4	0
5719	Miscellaneous Home Furnishing Stores	0	0	.0	0
572	Household Appliance Stores	0	0	.0	0
573	Radio, TV and Computer Store	4	20	3.5	0
5731	Radio, TV, Electronic Stores	1	3	.5	0
5734	Computer Hardware and Software Stores	2	12	2.2	0
5735	Music, Video CD's and Tape Stores	1	5	.8	0
58	Eating and Drinking Places	41	1,107	53.8	15
5812	Eating Places	40	1,103	53.6	15
5813	Drinking Places	1	4	.2	0
59	Miscellaneous Retail	37	201	27.1	2
591	Drug Stores and Proprietary	2	64	8.2	1
592	Liquor Stores	0	0	.0	0
593	Used Merchandise Stores	0	0	.0	0
5932A	Antique Stores	0	0	.0	0
594	Miscellaneous Shopping Goods Stores	14	44	2.9	0
5941	Sporting Goods, Bicycle and Gun Stores	3	6	.4	0
5942	Book Stores	0	0	.0	0
5943	Stationery Stores	0	0	.0	0
5944	Jewelry Stores	5	12	.7	0
5945	Hobby, Toy and Game Shops	3	16	1.1	0
5946	Camera and Photography Supply Stores	0	0	.0	0
5947	Gift, Novelty and Souvenir Shops	3	10	.7	0
5948	Luggage and Leather Goods Stores	0	0	.0	0
5949	Sewing, Needlework and Craft Stores	0	0	.0	0
596	NonStore Retailers	3	32	6.2	1
5961	Catalog and Mail Order Houses	1	27	5.4	1
598	Fuel and Ice Dealers	0	0	.0	0
599	Retail Stores, NEC	18	61	9.8	0
5992	Florists	1	2	.1	0
5993	Tobacco Stores and Stands	1	6	.3	0
5994	News Dealers and Newsstands	0	0	.0	0
5995	Optical Goods Stores	0	0	.0	0
5999	Miscellaneous Retail Stores NEC	16	53	9.4	0
5999M	Pet Shops	0	0	.0	0

Prepared from Claritas Business-Facts which includes data from infoUSA.

Business-Facts: Retail SIC Summary 2004 Report

Prepared For: COLLIERS MONROE FRIEDLANDER **Order #: 963561988**
Project Code: 2006736 - HONOLULU, HI **Site: 02**

SECONDARY AREA, Polygon (see appendix), Total

SIC Code	Business Description	Total Establishments	Total Employees	Sales (in Millions)	Establishments 20+ Employees
RET	All Retailing	974	14,994	1,821.2	160
52	Building Materials, Garden Supply and Mobile Homes	52	1,044	153.4	11
521	Lumber and Other Building Materials	23	542	68.8	7
523	Paint, Glass and Wallpaper	15	53	9.5	0
525	Hardware Stores	7	409	67.9	3
526	Retail Nurseries and Garden	7	40	7.2	1
527	Mobile Home Dealers	0	0	.0	0
53	General Merchandise Stores	19	1,857	206.6	9
531	Department Stores	12	1,829	203.2	9
54	Food Stores	105	1,718	265.7	19
541	Grocery Stores	60	1,243	212.9	13
542	Meat and Fish Markets	5	97	15.6	1
543	Fruit and Vegetable Markets	1	28	5.6	1
544	Candy, Nut and Confection Store	4	19	1.0	0
545	Dairy Products Stores	2	30	1.2	1
546	Retail Bakeries	9	169	5.8	1
549	Miscellaneous Food Stores	24	132	23.6	2
55	Automobile Dealers and Gas Service Stations	121	1,955	561.0	17
551	New and Used Car Dealers	14	896	362.0	11
552	Used Car Dealers	16	77	18.2	1
553	Auto and Home Supply Stores	54	444	80.4	3
554	Gasoline Service Stations	26	469	84.3	1
555	Boat Dealers	1	4	1.2	0
556	Recreational Vehicle Dealer	3	23	6.5	0
557	Motorcycle Dealers	7	42	8.4	1
559	Automotive Dealers, NEC	0	0	.0	0
56	Apparel and Accessory Stores	60	367	25.6	1
561	Mens and Boys Clothing Stores	0	0	.0	0
562	Womens Clothing Stores	12	77	4.1	0
563	Womens Accessory and Specialty Stores	0	0	.0	0
564	Childrens and Infants Wear	4	19	1.1	0
565	Family Clothing Stores	21	157	8.5	1
566	Shoe Stores	11	77	9.7	0
569	Miscellaneous Apparel and Accessory Stores	12	37	2.2	0
57	Home Furniture,Furnishings and Equipment	90	738	131.5	7
571	Home Furniture and Furnishing	40	347	56.9	5
5712	Furniture and Kitchen Design Stores	22	200	32.2	3

Business-Facts: Retail SIC Summary 2004 Report

Prepared For: COLLIERS MONROE FRIEDLANDER **Order #: 963561988**
Project Code: 2006736 - HONOLULU, HI **Site: 02**

SECONDARY AREA, Polygon (see appendix), Total

SIC Code	Business Description	Total Establishments	Total Employees	Sales (in Millions)	Establishments 20+ Employees
5713	Floor Covering Stores	7	111	22.2	2
5719	Miscellaneous Home Furnishing Stores	4	19	1.5	0
572	Household Appliance Stores	11	87	15.5	0
573	Radio, TV and Computer Store	39	304	59.1	2
5731	Radio, TV, Electronic Stores	11	102	15.6	1
5734	Computer Hardware and Software Stores	10	126	31.6	1
5735	Music, Video CD's and Tape Stores	13	59	9.2	0
58	Eating and Drinking Places	288	5,512	268.5	79
5812	Eating Places	268	5,425	264.5	79
5813	Drinking Places	20	87	4.0	0
59	Miscellaneous Retail	239	1,803	208.9	17
591	Drug Stores and Proprietary	18	486	62.6	7
592	Liquor Stores	7	15	1.4	0
593	Used Merchandise Stores	14	80	5.4	2
5932A	Antique Stores	0	0	.0	0
594	Miscellaneous Shopping Goods Stores	106	810	74.8	6
5941	Sporting Goods, Bicycle and Gun Stores	28	234	12.5	2
5942	Book Stores	4	65	3.3	1
5943	Stationery Stores	5	225	40.6	2
5944	Jewelry Stores	20	53	3.2	0
5945	Hobby, Toy and Game Shops	21	103	6.8	0
5946	Camera and Photography Supply Stores	0	0	.0	0
5947	Gift, Novelty and Souvenir Shops	23	101	6.8	1
5948	Luggage and Leather Goods Stores	2	9	.5	0
5949	Sewing, Needlework and Craft Stores	3	20	1.1	0
596	NonStore Retailers	7	58	10.0	1
5961	Catalog and Mail Order Houses	1	27	5.4	1
598	Fuel and Ice Dealers	0	0	.0	0
599	Retail Stores, NEC	87	354	54.7	1
5992	Florists	14	54	3.1	0
5993	Tobacco Stores and Stands	1	6	.3	0
5994	News Dealers and Newsstands	1	1	.1	0
5995	Optical Goods Stores	2	9	.7	0
5999	Miscellaneous Retail Stores NEC	69	284	50.5	1
5999M	Pet Shops	10	61	10.8	0

Prepared from Claritas Business-Facts which includes data from infoUSA.

TERTIARY AREA, Polygon (see appendix), Total

SIC Code	Business Description	Total Establishments	Total Employees	Sales (in Millions)	Establishments 20+ Employees
RET	All Retailing	1,551	23,059	2,568.3	260
52	Building Materials, Garden Supply and Mobile Homes	75	1,403	205.8	16
521	Lumber and Other Building Materials	33	728	92.5	9
523	Paint, Glass and Wallpaper	21	71	12.8	0
525	Hardware Stores	10	524	86.3	5
526	Retail Nurseries and Garden	11	80	14.2	2
527	Mobile Home Dealers	0	0	.0	0
53	General Merchandise Stores	30	3,055	339.5	17
531	Department Stores	22	3,022	335.7	17
54	Food Stores	158	2,406	375.7	26
541	Grocery Stores	87	1,735	296.5	19
542	Meat and Fish Markets	6	98	15.8	1
543	Fruit and Vegetable Markets	1	28	5.6	1
544	Candy, Nut and Confection Store	6	30	1.6	0
545	Dairy Products Stores	2	30	1.2	1
546	Retail Bakeries	13	219	7.7	1
549	Miscellaneous Food Stores	43	266	47.3	3
55	Automobile Dealers and Gas Service Stations	164	2,286	630.4	21
551	New and Used Car Dealers	15	930	375.7	12
552	Used Car Dealers	24	102	24.2	1
553	Auto and Home Supply Stores	74	587	106.4	4
554	Gasoline Service Stations	37	591	106.2	3
555	Boat Dealers	2	8	2.4	0
556	Recreational Vehicle Dealer	3	23	6.5	0
557	Motorcycle Dealers	9	45	9.0	1
559	Automotive Dealers, NEC	0	0	.0	0
56	Apparel and Accessory Stores	104	917	58.6	6
561	Mens and Boys Clothing Stores	0	0	.0	0
562	Womens Clothing Stores	25	192	10.1	0
563	Womens Accessory and Specialty Stores	1	8	.4	0
564	Childrens and Infants Wear	6	30	1.7	0
565	Family Clothing Stores	27	250	13.4	3
566	Shoe Stores	18	130	16.5	0
569	Miscellaneous Apparel and Accessory Stores	27	307	16.5	3
57	Home Furniture,Furnishings and Equipment	139	1,034	184.5	11
571	Home Furniture and Furnishing	55	430	68.1	7
5712	Furniture and Kitchen Design Stores	28	242	38.9	4

TERTIARY AREA, Polygon (see appendix), Total

SIC Code	Business Description	Total Establishments	Total Employees	Sales (in Millions)	Establishments 20+ Employees
5713	Floor Covering Stores	11	122	24.4	2
5719	Miscellaneous Home Furnishing Stores	8	48	3.7	1
572	Household Appliance Stores	16	103	18.3	0
573	Radio, TV and Computer Store	68	501	98.1	4
5731	Radio, TV, Electronic Stores	20	126	19.5	1
5734	Computer Hardware and Software Stores	21	224	55.2	2
5735	Music, Video CD's and Tape Stores	20	114	17.7	1
58	Eating and Drinking Places	473	8,810	428.9	129
5812	Eating Places	444	8,666	422.5	129
5813	Drinking Places	29	144	6.4	0
59	Miscellaneous Retail	408	3,148	344.9	34
591	Drug Stores and Proprietary	28	827	106.4	13
592	Liquor Stores	12	26	2.3	0
593	Used Merchandise Stores	26	121	8.0	2
5932A	Antique Stores	1	2	.1	0
594	Miscellaneous Shopping Goods Stores	183	1,431	118.9	15
5941	Sporting Goods, Bicycle and Gun Stores	48	362	19.3	5
5942	Book Stores	10	103	5.4	1
5943	Stationery Stores	8	280	50.5	3
5944	Jewelry Stores	40	156	8.8	0
5945	Hobby, Toy and Game Shops	33	280	18.7	3
5946	Camera and Photography Supply Stores	0	0	.0	0
5947	Gift, Novelty and Souvenir Shops	38	220	14.5	3
5948	Luggage and Leather Goods Stores	3	10	.6	0
5949	Sewing, Needlework and Craft Stores	3	20	1.1	0
596	NonStore Retailers	15	97	16.1	1
5961	Catalog and Mail Order Houses	1	27	5.4	1
598	Fuel and Ice Dealers	0	0	.0	0
599	Retail Stores, NEC	144	646	93.2	3
5992	Florists	20	83	4.8	0
5993	Tobacco Stores and Stands	1	6	.3	0
5994	News Dealers and Newsstands	1	1	.1	0
5995	Optical Goods Stores	9	118	10.6	2
5999	Miscellaneous Retail Stores NEC	113	438	77.4	1
5999M	Pet Shops	19	94	16.6	0

Prepared from Claritas Business-Facts which includes data from infoUSA.

Retail Trade Potential Report
The Retail Trade Potential Report extrapolates data from the census of retail trade and incorporates demographics and sales forecasts to determine the level of consumer expenditures that could be expected from a specified geographic area. Used in conjunction with the Retail SIC Summary Report and the Consumer Spending Patterns Report we can identify those retail categories with the greatest market potential (see appendix).

RETAIL TRADE POTENTIAL SUMMARY REPORT - PRIMARY AND SECONDARY TRADE AREAS

Retail Trade Potential Summary Report
Prepared For: Makaiwa Hills LLC

	Primary Trade Area			Secondary Trade Area		
Description	$ Potential	$ Actual	Shortfall	$ Potential	$ Actual	Shortfall
Apparel and Accessory Stores	$38,762,093	$1,100,000	$37,662,093	$223,406,166	$59,200,000	$164,206,166
Automotive Dealers	$79,223,643	$10,100,000	$69,123,643	$462,185,123	$380,200,000	$81,985,123
Automotive and Home Supply Stores	$4,707,240	$7,600,000	-$2,892,760	$27,696,236	$80,400,000	-$52,703,764
Drug and Proprietary Stores	$31,748,827	$8,200,000	$23,548,827	$192,111,868	$62,600,000	$129,511,868
Eating and Drinking Places	$88,874,826	$53,800,000	$35,074,826	$515,396,173	$268,500,000	$246,896,173
Food Stores	$60,116,173	$22,500,000	$37,616,173	$358,194,120	$265,700,000	$92,494,120
Furniture and Home Furnishings Stores	$8,413,252	$9,900,000	-$1,486,748	$49,198,816	$112,800,000	-$63,601,184
Home Appliance, Radio, and T.V. Stores	$13,982,936	$7,000,000	$6,982,936	$79,638,590	$131,000,000	-$51,361,410
Gasoline Service Stations	$19,439,873	$49,500,000	-$30,060,127	$115,178,433	$84,300,000	$30,878,433
General Merchandise	$108,558,706	$200,000	$108,358,706	$633,949,104	$206,600,000	$427,349,104
Department Stores (Including Leased Depts.)	$67,526,796	$0	$67,526,796	$395,591,113	$203,200,000	$192,391,113
Hardware, Lumber and Garden Stores	$14,234,941	$49,500,000	-$35,265,059	$84,746,474	$153,400,000	-$68,653,526
Total Retail Sales	$2,039,119,429	$219,400,000	$1,819,719,429	$3,137,292,216	$2,007,900,000	$1,129,392,216

Source: Claritas, Colliers Hawaii Consulting

7/25/2005

Retail Tenancy Recommendations

For this market area, we believe that a retail shopping center with several major department store anchors would be justified. Those retail categories with the greatest potential fall into the following categories:

General Merchandise/Department Stores
This category of retailer appears to be in short supply with a retail market potential of $164 million for the primary and secondary trade areas. Less than 30% of the retail expenditures for general merchandise/department stores are spent within the trade area. Target, Kohl's, Macy's, Burlington Coat Factory, Sears and Nordstrom stores would fit into this category of potential anchor department stores.

Eating and Drinking Establishments
The retail trade potential for additional eating and drinking establishments in the secondary trade area is enormous with an estimated $247 million in sales. Of the $515 million in restaurant expenditures, only $268 million is being spent within the primary and secondary trade areas. This is an indication that a large amount of restaurant sales are being spent outside of the primary trade area. Outback Steakhouse, Chili's and Assaggio have either been recently built or are under construction in Kapolei. Additional restaurants that could be considered are Red Robin's, Cheesecake Factory, Big City Diner, Bubba Gumps, Jackie Chan's, IHOP, and Denny's. Among competitive shopping centers there is a preponderance of fast food and plate-lunch type restaurants, very few sit-down mid-priced family and upscale luxury restaurants for this market.

Apparel & Accessory Stores
There was a significant $161 million shortfall of apparel and accessory stores in the primary trade area. Currently, only $59 million in retail sales are spent in the primary and secondary trade area for this category of retail goods, we believe that the lack of retail stores in the area is a major factor. Based on the demographics of the area we believe this market can support additional apparel store such as Abercrombie & Fitch, Banana Republic, Ann Klein, Eddie Bauer, Gap and Gap Kids, The Limited, bebe, T&C, Billabong, and HIC.

Drug and Proprietary Stores
In addition to apparel and merchandise stores, there appears to be a potential for $130 million in additional drug store sales in the area. As a result, consideration should be made for tenants such as Longs Drug, Walgreens and Rite Aid for this market area.

Food Stores
Although major grocery food chains such as Safeway, Times and Star Markets have a presence in Kapolei and Ewa Beach, it appears that there is a shortfall in grocery stores in the area. Roughly $92 million in food store sales are being spent outside of the primary trade area. An ideal candidate to fill this void would be a tenant such as Trader Joe's.

Competitive Retail Shopping Centers

Introduction
In addition to the current economic environment, a major factor impacting the success of a new retail development is the level of competition. As a part of this study, we identified those existing retail shopping centers that currently generate sales from shoppers within our primary trade area. We also labeled each shopping center by location, shopping center type, tenant list and site plan, asking rental rate range, and recent lease comparables (see appendix).

Additionally, we categorized each tenant list by major product/service offering. This will help us to identify the type of retail categories that are underrepresented in this market.

Principle Competition
<u>Pearlridge Center</u>
We believe that the major competitors to the Makaiwa Hills development site would be from Pearlridge Center, located in Pearl City along Kamehameha Highway. This site benefited from the tremendous residential and military growth in the area to post double-digit increases to its annual retail sales over the past few years with the latest year average retail sales for in-line space at $340 per square foot. As the only regional mall in the project site's secondary trade area, this shopping center is a formidable competitor with nationally known anchor tenants. The closure of JCPenneys in 2004 resulted in roughly 130,000 square feet of vacancy for this 1.2 million square foot center. This site is being redeveloped into smaller stores and is being actively marketed for lease.

<u>Waikele Center</u>
Waikele Premium Outlet Mall would be another major competitor. As the only outlet mall on the island, its tenant list is filled primarily with national chains and high credit tenants. Similarly, big box chains such as Lowe's, Sports Authority, Borders Books and Old Navy anchor this 700,000 square foot center. Among one of this center's strengths is its depth of high quality upscale apparel outlet stores. This tenant mix attracts tourists from Waikiki (primarily Japanese) to shop here. American Assets Inc., a retail real estate investment trust, recently purchased this center in 2004.

<u>Pearl Highlands Center</u>
Although Pearl Highlands is not a regional mall, it can be categorized as a power center. Anchored by Sams Club, Signature Theaters, Pier One Imports and Comp USA, this center will be adjacent to a new WalMart being developed on the mauka side and Home Depot on the makai side.

Primary and SecondaryTrade Area Neighborhood Center Competition
In the primary trade area there are eight grocery-anchored neighborhood shopping centers. Most of these centers are smaller than 200,000 square feet in gross leasable area and garner most of their customers from within a 3-mile radius of their locations. We have included a shopping center description, site plan, tenant list and available asking rents.

Neighborhood grocery anchored shopping centers in the primary and secondary trade area are:

- Ewa Beach Towne Center
- Ewa Beach Shopping Center
- Kapolei Shopping Center
- Marketplace at Kapolei
- Waipahu Town Center
- Waipahu Daiei Center
- Royal Kunia Shopping Center
- Waipio Gentry Shopping Center

Proposed Retail Developments
Lastly, we noted the many proposed retail developments that are scheduled for construction in the area. In particular, there are six development sites that will likely serve as primary competition for tenants.

- Kapolei Commons
- Laulani Village
- UH West Oahu Commercial Development Site
- DHHL Commercial Regional Mall Site
- Estate of James Campbell Development Site
- Waiawa Development

In addition to those above mentioned project sites, there are several retail developments that are not direct competition to a regional mall development but provide insight into asking rents for new developments.

- Kunia Shopping Center - Waipahu
- Kapolei Parkway - Kapolei
- Manana Development Site – Pearl City

Large Retail Development Competitors

<u>Kapolei Commons</u>

The MacNaughton Group's Kapolei Commons project located on a 20-acre site at the intersection of Kapolei Parkway and H-I Freeway. This site is proposed to be Hawaii's first lifestyle center with pedestrian thoroughfares. Estimated planned construction for its first phase is likely to be 325,000 to 350,000 square feet. Construction delivery planned for 2007-2008.

<u>Laulani Village</u>

Laulani Village 20-acre site in Ewa Beach, recently announced plans to begin development earlier this year. This development is located along Fort Weaver Road, the major traffic corridor through Ewa Beach. As a result, it is ideally situated to provide retail merchandise to the rapidly growing Ewa Beach community. This site could add 250,000 to 350,000 square feet of additional retail to the market. Target completion of first phase is 2007, with full build out planned by the end of 2008.

<u>University of Hawaii West Campus Commercial Development Site</u>

University of Hawaii commercial development site adjacent to the North – South Road is undergoing feasibility studies and is dependent upon the completion of needed infrastructure of roads, sewers and utilities. Likely completion of infrastructure is 2008, with retail development to coincide with U.H. West Campus development.

<u>Gentry Properties Waiawa Commercial Development</u>

Gentry Properties in a joint venture with Madison Marquette are considering the development of a large regional mall in excess of 500,000 square feet to be built in conjunction with their Waiawa residential development. Preliminary plans require building several bridges over large ravines as part of the infrastructure. This will provide access from H-2 Freeway to the site. Expectations are for construction to begin in 2009 or later. Rumors indicate that Target may be considering the site as their anchor tenant.

<u>Estate of James Campbell Development Site</u>

The Estate of James Campbell has a development site at the intersection of Farrington Highway and the North-South Road. At this time this large parcel has received it commercial zoning entitlements but a sale or development has not been announced.

Small Retail Developments

<u>Kunia Shopping Center</u>

A&B Properties Inc. plans on developing this 4.5-acre site into a 66,000 square foot mixed-use retail and office complex. This site is located along busy Kunia Road and is near the Kunia WalMart. This retail development is more than 80% pre-leased and achieving retail rents in the $3.00-$3.25 psf/mo range.

<u>Kapolei Parkway</u>

The MacNaughton Group is planning to develop this site along Kapolei's Kamokila Boulevard. Sitting between Outback Steakhouse and Ace Center, this 1.7-acre site will be developed into a 26,000 square foot mix-use building with ground floor retail and second floor office/service usage. Asking rents for retail are at $3.25 psf/mo.

<u>Manana Development Site</u>

Located along Kuala Road in Pearl City, this 13.55-acre site will likely be built into a retail shopping center. Estimated square footage is 150,000 square feet with asking rents in excess of $3.50 psf/mo.

Office Market Assessment

Colliers Hawaii Consulting determines the level of office demand for a trade area by identifying the average amount of office space allocated for each office employee, then estimating the level of office job growth for that market.

The current office market inventory for the island of Oahu is estimated at 15.3 million square feet with 89,500 office workers (State DLIR estimate). Based on these figures, there is roughly 154 square feet of office space per office worker on Oahu.

The inventory of buildings located in Leeward, Central and West Oahu totaled 1.13 million square feet. Based on our estimates and taking into account the Leeward office market vacancy rate, there are roughly 6,955 office workers that currently work in these trade areas. Using this figure as the baseline, we forecast the conservative (1.25%), moderate (1.75%) and aggressive (2.25%) job growth percentages from 2005-2025.

Our estimates for office demand for 2011-2015 range from a conservative 5,687 square feet to an aggressive 145,875 square feet. By year 2020, the office market demand should range from 84,373 square feet to 306,689 square feet.

Despite the increase in office space demand, current rents are not at a level to support additional construction of office space. Currently available space in the Leeward, Central and West Oahu markets range in full service gross rent of $2.42 to $2.60 psf/mo. AT a current mid-year 2005 vacancy rate of 3.24%, price increases are anticipated over the next few years. By 2009, we believe that office development will likely be financially feasible and could augment the Makaiwa Hills commercial development site.

WEST, CENTRAL AND LEEWARD OAHU OFFICE INVENTORY (MULTI-TENANT OFFICE BUILDINGS)

OFFICE INVENTORY - WEST, CENTRAL AND LEEWARD OAHU

Office/Service Usage Primary Trade Area	Address	City	Trade Area	Year Built	Office RBA
Ewa Beach Professional	91-902 Fort Weaver Road	Ewa Beach	Primary Trade Area	1963	14,126
Former ASB Bank Building	94-230 Farrington Highway	Waipahu	Primary Trade Area	1990	31,032
Government Offices	94-275 Mokuola Street	Waipahu	Primary Trade Area	1993	42,248
Campbell Square	1001 Kamokila Boulevard	Kapolei	Primary Trade Area	1993	136,868
Bank of Hawaii Building	1001 Kamokila Boulevard	Kapolei	Primary Trade Area	1995	208,406
State Gov't Offices	601 Kamokila Blvd	Kapolei	Primary Trade Area	1998	222,228
Police Station	1100 Kamokila Boulevard	Kapolei	Primary Trade Area	1999	50,689
Filipino Community Center	94-428 Mokuola Street	Waipahu	Primary Trade Area	2002	33,051
Ewa Oceanpointe	91-831 Fort Weaver Road	Ewa Beach	Primary Trade Area	2004	16,639
Primary Trade Area Totals					**755,287**

Office/Service Usage Secondary Trade Area	Address	City	Trade Area	Year Built	Office RBA
Aiea Commercial Center	99-079 Kauhale Street	Aiea	Secondary Trade Area	1963	20,616
Newtown Square	98-1247 Kaahumanu Street	Aiea	Secondary Trade Area	1975	61,000
Pearlridge Office Building	98-211 Pali Momi Street	Aiea	Secondary Trade Area	1976	89,461
Pearl City Business Plaza	803 Kamehameha Highway	Pearl City	Secondary Trade Area	1981	53,400
Pearl City Plaza	917 Kamehameha Highway	Pearl City	Secondary Trade Area	1988	38,658
Leilehua Building	300 Kahelu Drive	Mililani	Secondary Trade Area	1988	21,563
Castle & Cooke Building	100 Kahelu Drive	Mililani	Secondary Trade Area	1989	40,000
Intellect Building	200 Kahelu Drive	Mililani	Secondary Trade Area	1990	32,000
Mililani Professional Center	95-750 Lanikuhana Drive	Mililani	Secondary Trade Area	1993	21,000
Secondary Trade Area Totals					**377,698**
Combined Trade Area Totals					**1,132,985**

New Office Projects Planned or Proposed	Square Footage	Occupancy Date
Laulani Village	81,000	2008
Kapolei Commons	30,000	2008
Kapolei Parkway	10,144	2006
Pearlridge Office Building	30,000	2008

Source: Colliers Hawaii Consulting

8/1/2005

WEST, CENTRAL AND LEEWARD OAHU OFFICE INVENTORY (MULTI-TENANT OFFICE BUILDINGS)

WEST, CENTRAL, LEEWARD OAHU OFFICE DEMAND ESTIMATES						
ANNUAL TOTAL OFFICE WORKER JOB COUNTS						
BASE YEAR	JOB GROWTH ESTIMATE	2005	2006-2010	2011-2015	2016-2020	2021-2025
Conservative	1.25%	7,208	7,670	8,161	8,684	9,241
Moderate	1.75%	7,244	7,900	8,616	9,397	10,248
Aggressive	2.25%	7,279	8,136	9,093	10,163	11,359
ANNUAL INCREASE IN JOBS						
		2005	2006-2010	2011-2015	2016-2020	2021-2025
Conservative		89	95	101	107	114
Moderate		125	136	148	162	176
Aggressive		160	179	200	224	250
CUMULATIVE INCREASE IN OFFICE SQUARE FOOTAGE DEMAND						
		2005	2006-2010	2011-2015	2016-2020	2021-2025
Conservative		13,704	84,837	160,529	241,071	326,774
Moderate		19,186	120,270	230,513	350,747	481,876
Aggressive		24,667	156,583	304,023	468,813	652,994
PROJECTED OFFICE SQUARE FOOTAGE ESTIMATE						
		2005	2006-2010	2011-2015	2016-2020	2021-2025
New Supply		0	151,144	0	0	0
OFFICE SPACE DEMAND ESTIMATES						
Conservative		13,704	(66,307)	9,385	89,927	175,630
Moderate		19,186	(30,874)	79,369	199,603	330,732
Aggressive		24,667	5,439	152,879	317,669	501,850

Source: Colliers Hawaii Consulting

8/1/2005

Medical Clinic Market Assessment

We identified the U.S. National estimate and the U.S. Western Region estimates for the average ratio of physicians for a population of 100,000. Utilizing these figures, we are able to determine if there is a current shortfall of physicians in the primary and secondary trade areas. The national average for a population of 100,000 is 134.69 full-time equivalent (FTE) physicians. For the U.S. West, it is 132.36 FTE per 100,000. We used the U.S. West ratio as a benchmark for this study.

In the primary trade area, there are 26 physicians for a population of 38,991, or a ratio of 67 physicians per population of 100,000. This market has a shortfall of roughly 66 FTE physicians. For the combined primary and secondary trade area, there are 207 FTE physicians for a population of 215,554 or a ratio of 96 FTE physicians per 100,000. There appears to be a shortfall of roughly 78 FTE physicians for the primary and secondary trade areas.

We believe there is an opportunity to capitalize on the apparent shortfall of physicians in this market. Additional specialized research needs to be conducted to identify those medical specialties that would be appropriate for this market. We have attached two studies conducted by Solucient LLC as reference materials that will highlight the FTE Physician ratio that we used as well as potential high growth medical specialties that may be appropriate for consideration. See the appendix for ***Physicians Community Requirements in the 21st Century,*** and ***Top Growth Areas in the Outpatient Market***.

FTE PHYSICIANS MARKET ASSESSMENT FOR PRIMARY AND SECONDARY TRADE AREAS

MEDICAL CLINIC/WELLNESS FACILITY MARKET ASSESSMENT

TRADE AREA	NUMBER OF PHYSICIANS	POPULATION BASE	U.S. WEST RATIO	LOCAL MARKET RATIO	PHYSICIAN OVERAGE/SHORTFALL
PRIMARY - KAPOLEI	26				
PRIMARY - EWA BEACH	46				
PRIMARY TRADE AREA TOTALS	**72**	**38,991**	**0.1324%**	**0.1847%**	**0.0523%**
SECONDARY-WAIANAE	44				
SECONDARY - WAIPAHU	72				
SECONDARY - PEARL CITY	19				
SECONDARY TRADE AREA	**135**	**176,562**	**0.1324%**	**0.0765%**	**-0.0559%**
PRIMARY AND SECONDARY TOTALS	**207**	**215,554**	**0.1324%**	**0.0960%**	**-0.0363%**

* There is a shortfall of roughly 36 full time physicians for the primary and secondary trade areas

Source: Solucient LLC, Colliers Hawaii Consulting

8/1/2005

Proposed Phased Development Plan

Based on current and projected population and consumer expenditures for the area, the market could support a development of roughly 800,000 to 950,000 square feet. With infrastructure of roadways, sewers and utilities will likely be completed by late 2009, we believe that Phase I of the retail development could be built to coincide with the completion of the initial phase of the residential development and could be completed by 2011. We estimate that 350,000 square feet should be the allotment for Phase I and include the grocery and drug store anchors.

Phase II construction could be slated for 2013-2015. Depending on the level of retail space absorption and consumer expenditure growth we believe that an additional 250,000 to 350,000 square feet could be built. In addition to expansion of the retail component for this phase, we recommend a low-rise office building and a medical clinic/wellness facility to be built.

Phase III would complete the center's construction with the addition of 200,000 to 250,000 square feet.

RETAIL MARKET ASSESSMENT - RESIDENT AND NON-RESIDENT MARKET TOTALS

RESIDENT MARKET

CENSUS POPULATION MODEL	ANNUAL GROWTH %	2005	2006-2010	2011-2015	2016-2020	2021-2025
CONSERVATIVE	1.0% TO 1.5%	319,511	(660,834)	(527,428)	(381,981)	(223,382)
MODERATE	1.5% TO 2.5%	331,884	(577,999)	(357,904)	(106,611)	180,408
AGGRESSIVE	2.0% TO 4.0%	344,807	(485,935)	(157,290)	240,580	723,151

RESIDENTIAL PLANNED DEVELOPMENT MODEL	2005	2006-2010	2011-2015	2016-2020	2021-2025
RESIDENTIAL SF DEMAND TOTALS	**332,293**	**126,770**	**729,595**	**1,000,645**	**1,165,799**

CENSUS CONSUMER EXPENDITURE MODEL	ANNUAL GROWTH %	2005	2006-2010	2011-2015	2016-2020	2021-2025
CONSERVATIVE	1.5% TO 3%	(353,684)	(383,370)	(69,494)	349,438	727,845
MODERATE	2% TO 4%	(340,870)	(292,685)	127,192	688,907	1,258,104
AGGRESSIVE	3% TO 6%	(326,558)	(187,485)	364,324	1,114,509	1,949,824

CLARITAS CONSUMER EXPENDITURE MODEL	ANNUAL GROWTH %	2005	2006-2010	2011-2015	2016-2020	2021-2025
CONSERVATIVE	1.5% TO 3%	938,176	(289,872)	17,285	628,613	1,413,311
MODERATE	2% TO 4%	963,752	(104,058)	430,713	1,360,022	2,583,341
AGGRESSIVE	4% TO 6%	990,487	98,636	901,588	2,230,192	4,037,995

RESORT MARKET

RESORT MARKET CONSUMER EXPENDITURE MODEL	CAPTURE RATE	2005	2006-2010	2011-2015	2016-2020	2021-2025
HOTEL MARKET	85.00%	61,459	101,161	252,030	252,030	252,030
TIMESHARE MARKET	85.00%	48,376	88,689	129,002	129,002	129,002
RESORT SF DEMAND TOTALS		**109,835**	**189,850**	**381,032**	**381,032**	**381,032**

RESIDENT AND RESORT RETAIL MARKET ESTIMATES

RESIDENTIAL AND RESORT SF DEMAND TOTALS	2005	2006-2010	2011-2015	2016-2020	2021-2025
CENSUS POPULATION (MODERATE ESTIMATE)	441,719	(388,148)	23,129	274,421	561,440
CENSUS CONSUMER EXPENDITURE (MODERATE)	(231,035)	(102,835)	508,224	1,069,940	1,639,136
RESIDENTIAL DEVELOPMENT	442,127	316,620	1,110,627	1,381,677	1,546,832
CLARITAS CONSUMER EXPENDITURE (MODERATE ESTIMATE)	1,073,587	85,792	811,745	1,741,054	2,964,373

OFFICE MARKET

OFFICE DEMAND MODEL (154 SF PER OFFICE WORKER)	ANNUAL JOB GROWTH	2005	2006-2010	2011-2015	2016-2020	2021-2025
CONSERVATIVE	1.25%	13,704	(66,307)	9,385	89,927	175,630
MODERATE	1.75%	19,186	(30,874)	79,369	199,603	330,732
AGGRESSIVE	2.25%	24,667	5,439	152,879	317,669	501,850

HOSPITAL MARKET

HOSPITAL DEMAND MODEL (BY FULL TIME PHYSICIANS)	# OF PHYSICIANS	POPULATION	AREA MARKET RATIO	US WEST RATIO	% DIFF
PRIMARY TRADE AREA	26	38,991	0.067%	0.133%	0.066%
SECONDARY TRADE AREA	181	176,562	0.103%	0.133%	0.030%
TOTALS	**207**	**215,554**	**0.096%**	**0.133%**	**0.037%**

For the Total Secondary Trade Area, there is a shortage of roughly 37 FTE Physicians

Source: Colliers Hawaii Consulting, Census, Claritas, Bruce Plasche

8/1/2005

Successful Mainland Town Center Developments

Successful Mainland Town Center Developments

We have provided several examples of successful mainland town centers. As an alternative to the lifestyle center or regional mall concepts currently being marketed by the MacNaughton Group and DHHL, we believe a town center development might be appropriate for the Makaiwa Hills development. We have attached project descriptions for successful Mainland town center developments for your review.

- **DC Ranch, Scottsdale, Arizona** – this mixed use development on 2,600 acres is located on the western foothills of the McDowell Mountains in Scottsdale. Upon completion this development will include 5,500 dwelling units on 2000 acres and 110 acres of commercial mixed use. On Market Street, the Town Center is comprised of 300,000 square feet of commercial uses.
- **Bay Meadows, San Mateo California** – situated on a former horse racetrack, this 75 acre site is being developed into a mixed use residential/commercial project of 740 units, 500,000 square feet of office space (Franklin Resources is the primary office tenant), and 300,000 of commercial retail space.
- **Issaquah Highlands, Issaquah Washington** – this 2,000 acre "new town" project is located in the hills above Issaquah and will comprise 2 million square feet of office use (Microsoft is major tenant), 3,250 dwelling units and a 400,000 high density town center on 800 acres of developable land.

We have also provided additional webpage addresses for other successful town center mixed-use developments.

- www.celebrationfl.com
- www.postaddisoncircle.com
- www.santanarow.com
- www.abacoatowncenter.com
- www.miznerpark.org
- www.mashpeecommons.com

Appendix

Appendix

- **Trade Area Demographics Report**
- **Retail Square Footage Estimation Models**
  - **Population Growth Model**
    - **Retail Inventory**
    - **Population Growth Projections**
    - **Census Projections**
    - **Residential Growth Projections**
  - **Consumer Expenditure Model**
    - **Census Consumer Expenditure Projections**
    - **Claritas Consumer Expenditure Projections**
    - **Retail Square Footage Estimates**
- **Retail Shopping Center Competition**
  - **Primary and Secondary Trade Area Shopping Center Competitors**
  - **Successful Mainland Town Center Developments**
- **Hospital FTE Physicians Demand Model**
  - **Physicians Community Requirements in the 21st Century by Solucient LLC**
  - **Top Growth Areas in the Outpatient Market by Solucient LLC**

Trade Area Demographics Reports

DEMOGRAPHIC PROFILE COMPLETE

1990 - 2000 Census, 2004 Estimates & 2009 Projections

Calculated using Proportional Block Groups

Prepared For Makaiwa Hills LLC

Lat/Lon: 21.346059/-158.0890495

RF9

Primary Trade Area Makaiwa Hills - 5 Minute Drivetime	PRIMARY	
Population		
Estimated Population (2004)	38,991	
Census Population (1990)	18,904	
Census Population (2000)	35,011	
Projected Population (2009)	43,320	
Forecasted Population (2014)	47,929	
Historical Annual Change (1990-2000)	16,107	8.5%
Historical Annual Change (2000-2004)	3,980	2.8%
Projected Annual Change (2004-2009)	4,328	2.2%
Est. Population Density (2004)	1,064.85	*psm*
Trade Area Size	36.62	*sq mi*
Households		
Estimated Households (2004)	11,493	
Census Households (1990)	5,453	
Census Households (2000)	10,171	
Projected Households (2009)	12,893	
Forecasted Households (2014)	14,401	
Historical Annual Change (1990-2000)	4,718	8.7%
Projected Annual Change (2000-2009)	2,722	3.0%
Average Household Income		
Est. Average Household Income (2004)	$71,506	
Census Average Hhld Income (1990)	$45,025	
Census Average Hhld Income (2000)	$67,813	
Proj. Average Household Income (2009)	$69,834	
Historical Annual Change (1990-2000)	$22,788	5.1%
Projected Annual Change (2000-2009)	$2,021	0.3%
Median Household Income		
Est. Median Household Income (2004)	$68,141	
Census Median Hhld Income (1990)	$43,329	
Census Median Hhld Income (2000)	$62,714	
Proj. Median Household Income (2009)	$76,973	
Historical Annual Change (1990-2000)	$19,385	4.5%
Projected Annual Change (2000-2009)	$14,260	2.5%
Per Capita Income		
Est. Per Capita Income (2004)	$21,147	
Census Per Capita Income (1990)	$12,988	
Census Per Capita Income (2000)	$19,792	
Proj. Per Capita Income (2009)	$20,855	
Historical Annual Change (1990-2000)	$6,804	5.2%
Projected Annual Change (2000-2009)	$1,063	0.6%
Other Income		
Est. Median Disposable Income (2004)	$55,645	
Proj. Median Disposable Income (2009)	$61,682	
Est. Median Household Net Worth (2004)	$44,796	
Household Income Distribution (2004)		
HH Income $200,000 or More	184	1.6%
HH Income $150,000 to 199,999	300	2.6%
HH Income $125,000 to 149,999	549	4.8%
HH Income $100,000 to 124,999	1,324	11.5%
HH Income $75,000 to 99,999	2,545	22.1%

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Primary Trade Area Makaiwa Hills - 5 Minute Drivetime	PRIMARY	
HH Income $50,000 to 74,999	3,089	26.9%
HH Income $35,000 to 49,999	1,599	13.9%
HH Income $25,000 to 34,999	874	7.6%
HH Income $15,000 to 24,999	593	5.2%
HH Income $10,000 to 14,999	166	1.4%
HH Income $0 to 9,999	272	2.4%
HH Income $35,000+	9,589	83.4%
HH Income $50,000+	7,990	69.5%
HH Income $75,000+	4,902	42.6%
Race & Ethnicity (2004)		
Total Population	38,991	
White	7,226	18.5%
Black or African American	919	2.4%
American Indian & Alaska Native	83	0.2%
Asian	17,039	43.7%
Hawiian & Pacific Islander	3,316	8.5%
Other Race	473	1.2%
Two or More Races	9,935	25.5%
Not Hispanic or Latino Population	35,338	90.6%
Non Hispanic: White	*6,506*	*18.4%*
Non Hispanic: Black or African American	*825*	*2.3%*
Non Hispanic: Amer Indian & AK Native	*77*	*0.2%*
Non Hispanic: Asian	*15,367*	*43.5%*
Non Hispanic: Hawiian & Pacific Islander	*2,986*	*8.4%*
Non Hispanic: Other Race	*473*	*1.3%*
Non Hispanic: Two or More Races	*9,104*	*25.8%*
Hispanic or Latino Population	3,653	9.4%
Hispanic: White	*720*	*19.7%*
Hispanic: Black or African American	*94*	*2.6%*
Hispanic: American Indian & Alaska Native	*5*	*0.1%*
Hispanic: Asian	*1,672*	*45.8%*
Hispanic: Hawiian & Pacific Islander	*330*	*9.0%*
Hispanic: Other Race	*1*	*0.0%*
Hispanic: Two or More Races	*831*	*22.7%*
Not of Hispanic Origin Population (1990)	17,230	91.1%
Hispanic Origin Population (1990)	1,674	8.9%
Not Hispanic or Latino Population (2000)	31,760	90.7%
Hispanic or Latino Population (2000)	3,251	9.3%
Not Hispanic or Latino Population 5yr (2009)	38,962	89.9%
Hispanic or Latino Population 5yr (2009)	4,357	10.1%
Historical Annual Change (1990-2000)	1,577	9.4%
Projected Annual Change (2000-2009)	1,106	3.8%
Age Distribution (2004)		
Total Population	38,991	
Age 0 to 4 yrs	3,809	9.8%
Age 5 to 9 yrs	3,550	9.1%
Age 10 to 14 yrs	3,215	8.2%
Age 15 to 19 yrs	2,485	6.4%
Age 20 to 24 yrs	2,106	5.4%
Age 25 to 29 yrs	2,777	7.1%
Age 30 to 34 yrs	3,660	9.4%
Age 35 to 39 yrs	3,819	9.8%
Age 40 to 44 yrs	3,270	8.4%
Age 45 to 49 yrs	2,567	6.6%

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Primary Trade Area Makaiwa Hills - 5 Minute Drivetime	PRIMARY	
Age 50 to 54 yrs	2,217	5.7%
Age 55 to 59 yrs	1,760	4.5%
Age 60 to 64 yrs	1,344	3.4%
Age 65 to 69 yrs	849	2.2%
Age 70 to 74 yrs	593	1.5%
Age 75 to 79 yrs	437	1.1%
Age 80 to 84 yrs	296	0.8%
Age 85 yrs plus	238	0.6%
Median Age	31.5	yrs
Age 19 yrs or less	13,060	33.5%
Age 20 to 64 years	23,520	60.3%
Age 65 years Plus	2,412	6.2%
Female Age Distribution (2004)		
Female Population	19,480	50.0%
Age 0 to 4 yrs	*1,801*	*9.2%*
Age 5 to 9 yrs	*1,734*	*8.9%*
Age 10 to 14 yrs	*1,601*	*8.2%*
Age 15 to 19 yrs	*1,224*	*6.3%*
Age 20 to 24 yrs	*1,050*	*5.4%*
Age 25 to 29 yrs	*1,382*	*7.1%*
Age 30 to 34 yrs	*1,814*	*9.3%*
Age 35 to 39 yrs	*1,903*	*9.8%*
Age 40 to 44 yrs	*1,606*	*8.2%*
Age 45 to 49 yrs	*1,312*	*6.7%*
Age 50 to 54 yrs	*1,123*	*5.8%*
Age 55 to 59 yrs	*891*	*4.6%*
Age 60 to 64 yrs	*693*	*3.6%*
Age 65 to 69 yrs	*449*	*2.3%*
Age 70 to 74 yrs	*344*	*1.8%*
Age 75 to 79 yrs	*247*	*1.3%*
Age 80 to 84 yrs	*176*	*0.9%*
Age 85 yrs plus	*129*	*0.7%*
Female Median Age	*32.0*	*yrs*
Age 19 yrs or less	*6,360*	*32.6%*
Age 20 to 64 years	*11,775*	*60.4%*
Age 65 years Plus	*1,346*	*6.9%*
Male Age Distribution (2004)		
Male Population	19,511	50.0%
Age 0 to 4 yrs	*2,008*	*10.3%*
Age 5 to 9 yrs	*1,817*	*9.3%*
Age 10 to 14 yrs	*1,614*	*8.3%*
Age 15 to 19 yrs	*1,261*	*6.5%*
Age 20 to 24 yrs	*1,056*	*5.4%*
Age 25 to 29 yrs	*1,395*	*7.1%*
Age 30 to 34 yrs	*1,846*	*9.5%*
Age 35 to 39 yrs	*1,916*	*9.8%*
Age 40 to 44 yrs	*1,664*	*8.5%*
Age 45 to 49 yrs	*1,255*	*6.4%*
Age 50 to 54 yrs	*1,094*	*5.6%*
Age 55 to 59 yrs	*869*	*4.5%*
Age 60 to 64 yrs	*650*	*3.3%*
Age 65 to 69 yrs	*399*	*2.0%*
Age 70 to 74 yrs	*249*	*1.3%*
Age 75 to 79 yrs	*190*	*1.0%*

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RF9

Primary Trade Area Makaiwa Hills - 5 Minute Drivetime	PRIMARY	
Age 80 to 84 yrs	*119*	*0.6%*
Age 85 yrs plus	*109*	*0.6%*
Male Median Age	*30.9*	*yrs*
Age 19 yrs or less	*6,700*	*34.3%*
Age 20 to 64 years	*11,745*	*60.2%*
Age 65 years Plus	*1,066*	*5.5%*
Males per 100 Females, Male % Pop (2004)		
Overall Comparison	100	
Age 0 to 4 yrs	*112*	*52.7%*
Age 5 to 9 yrs	*105*	*51.2%*
Age 10 to 14 yrs	*101*	*50.2%*
Age 15 to 19 yrs	*103*	*50.7%*
Age 20 to 24 yrs	*101*	*50.1%*
Age 25 to 29 yrs	*101*	*50.2%*
Age 30 to 34 yrs	*102*	*50.4%*
Age 35 to 39 yrs	*101*	*50.2%*
Age 40 to 44 yrs	*104*	*50.9%*
Age 45 to 49 yrs	*96*	*48.9%*
Age 50 to 54 yrs	*97*	*49.3%*
Age 55 to 59 yrs	*98*	*49.4%*
Age 60 to 64 yrs	*94*	*48.4%*
Age 65 to 69 yrs	*89*	*47.0%*
Age 70 to 74 yrs	*72*	*42.0%*
Age 75 to 79 yrs	*77*	*43.5%*
Age 80 to 84 yrs	*68*	*40.3%*
Age 85 yrs plus	*84*	*45.7%*
Age 19 yrs or less	*105*	*51.3%*
Age 20 to 39 yrs	*101*	*50.3%*
Age 40 to 64 yrs	*98*	*49.6%*
Age 65 years Plus	*79*	*44.2%*
Household Type (2004)		
Total Households	11,493	
Households with Children	6,266	54.5%
Average Household Size	3.38	
Est. Household Density	313.87	psm
Population Family	34,300	88.0%
Population Non-Family	4,544	11.7%
Population Group Qtrs	148	0.4%
Family Households	9,445	82.2%
Married Couple Hhlds	*7,695*	*81.5%*
Other Family Hhlds	*1,750*	*18.5%*
Family Households With Children	6,206	65.7%
Married Couple With Children	*5,010*	*80.7%*
Other Family Hhlds With Children	*1,196*	*19.3%*
Family Households No Children	3,239	34.3%
Married Couple No Children	*2,685*	*82.9%*
Other Family Households No Children	*554*	*17.1%*
Average Family Household Size	3.63	
Average Family Income	$73,744	
Median Family Income	$71,338	
Non-Family Households	2,048	17.8%
Non-Family Hhlds With Children	60	2.9%
Non-Family Hhld No Children	1,988	97.1%
N-F Hhld Lone Person No Children	*1,423*	*69.5%*

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Primary Trade Area Makaiwa Hills - 5 Minute Drivetime	PRIMARY	
Lone Male Householder	799	56.1%
Lone Female Householder	624	43.9%
N-F Hhld 2+ Persons No Children	*564*	*27.6%*
Average Non-Family Hhld Size	2.22	
Marital Status (2004)		
(15 Years or Older)	28,417	
Never Married	7,512	26.4%
Now Married	16,416	57.8%
Previously Married	4,489	15.8%
Separated	*1,341*	*29.9%*
Widowed	*1,922*	*42.8%*
Divorced	*1,226*	*27.3%*
Educational Attainment (2004)		
Adult Population (25 Years or Older)	23,825	
Elementary (0 to 8)	1,176	4.9%
Some High School (9 to 11)	1,816	7.6%
High School Graduate (12)	6,369	26.7%
Some College (13 to 16)	5,901	24.8%
Associate Degree Only	2,545	10.7%
Bachelor Degree Only	4,566	19.2%
Graduate Degree	1,452	6.1%
Any College + (Some College or higher)	14,465	60.7%
College Degree + (Bachelor Degree or higher)	6,018	25.3%
Housing (2004)		
Total Housing Units	12,522	
Housing Units, Occupied	11,493	91.8%
Housing Units, Owner-Occupied	*8,484*	*73.8%*
Housing Units, Renter-Occupied	*3,009*	*26.2%*
Housing Units, Vacant	1,029	8.2%
Total Housing Units (2000)	11,083	
Historical Annual Change (2000-2004)	1,440	3.2%
Household Size (2004)		
Total Households	11,493	
1 Person Household	1,423	12.4%
2 Person Households	2,731	23.8%
3 Person Households	2,307	20.1%
4 Person Households	2,473	21.5%
5 Person Households	1,346	11.7%
6 Person Households	642	5.6%
7+ Person Households	569	4.9%
Household Stability (2004)		
Total Households	11,493	
In current residence < 1 year	5,233	45.5%
In current residence 1-2 years	2,955	25.7%
In current residence 3-5 years	1,463	12.7%
In current residence 6-10 years	1,047	9.1%
In current residence > 10 years	794	6.9%
Turnover (% Annual Residential Turnover)	45.5%	
Stability (% In Current Residence 5+ Years)		16.0%
Median Years in Residence	1.9	yrs
Household Vehicles (2004)		
Total Vehicles Available	21,791	

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RF9

Primary Trade Area Makaiwa Hills - 5 Minute Drivetime	PRIMARY	
Household: 0 Vehicles Available	476	4.1%
Household: 1 Vehicles Available	3,374	29.4%
Household: 2 Vehicles Available	5,422	47.2%
Household: 3+ Vehicles Available	2,221	19.3%
Average Per Household	1.9	*Vehicles*
Owner Occupied Hhlds Vehicles	17,274	79.3%
Average Per Owner Household	*2.0*	*Vehicles*
Renter Occupied Hhlds Vehicles	4,517	20.7%
Average Per Renter Household	*1.5*	*Vehicles*
Travel Time (2000)		
Worker Base (16 Years or Older)	17,243	
Travel to Work in 14 Minutes or Less	1,852	10.7%
Travel to Work in 15 to 29 Minutes	4,449	25.8%
Travel to Work in 30 to 59 Minutes	7,746	44.9%
Travel to Work in 60 Minutes or More	2,850	16.5%
Work at Home	346	2.0%
Average Travel Time to Work	34.4	mins
Transportation To Work (2000)		
Work Base	17,243	
Drive to Work Alone	11,344	65.8%
Drive to Work in Carpool	4,064	23.6%
Travel to Work - Public Transportation	1,116	6.5%
Drive to Work on Motorcycle	62	0.4%
Bicycle to Work	46	0.3%
Walk to Work	188	1.1%
Other Means	77	0.4%
Work at Home	346	2.0%
Daytime Demos (2004)		
Total Number of Businesses	650	
Total Number of Employees	11,250	
Company Headqtrs: Businesses	4	0.6%
Company Headqtrs: Employees	89	0.8%
Employee Population per Business	17.3 to 1	
Residential Population per Business	60.0 to 1	
Potential Combined Area Demographics	19,752	
Labor Force (2004)		
Labor: Population Age 16+	27,896	
Unemployment Rate		3.4%
Labor Force Total: Males	13,811	49.5%
Male civilian employed	*9,140*	*66.2%*
Male civilian unemployed	*471*	*3.4%*
Males in Armed Forces	*1,155*	*8.4%*
Males not in labor force	*3,045*	*22.0%*
Labor Force Total: Females	14,084	50.5%
Female civilian employed	*8,908*	*63.2%*
Female civilian unemployed	*468*	*3.3%*
Females in Armed Forces	*191*	*1.4%*
Females not in labor force	*4,518*	*32.1%*
Labor Force Change (2000-2004)	11,970	18.8%
Male Change (2000-2004)	5,788	18.0%
Female Change (2000-2004)	6,182	19.6%
Occupation (2000)		

DEMOGRAPHIC PROFILE COMPLETE

1990 - 2000 Census, 2004 Estimates & 2009 Projections

Calculated using Proportional Block Groups

Prepared For Makaiwa Hills LLC

Lat/Lon: 21.346059/-158.0890495

RF9

Primary Trade Area Makaiwa Hills - 5 Minute Drivetime	PRIMARY	
Occupation: Population Age 16+	15,926	
Occupation Total: Males	*8,023*	*50.4%*
Occupation Total: Females	*7,902*	*49.6%*
Mgmt, Business, & Financial Operations	2,296	14.4%
Professional and Related	2,606	16.4%
Service	2,889	18.1%
Sales and Office	4,859	30.5%
Farming, Fishing, and Forestry	39	0.2%
Construction, Extraction, & Maintenance	1,725	10.8%
Production, Transport, & Material Moving	1,512	9.5%
White Collar		*61.3%*
Blue Collar		*38.7%*
Units In Structure (2000)		
Total Units	11,083	
1 Detached Unit	6,248	56.4%
1 Attached Unit	1,283	11.6%
2 Units	70	0.6%
3 to 4 Units	647	5.8%
5 to 9 Units	1,921	17.3%
10 to 19 Units	766	6.9%
20 to 49 Units	41	0.4%
50 or more Units	81	0.7%
Mobile Home or Trailer	26	0.2%
Other Structure	0	-
Homes Built By Year (2000)		
Homes Built 1999 to 2000	448	4.0%
Homes Built 1995 to 1998	2,165	19.5%
Homes Built 1990 to 1994	3,822	34.5%
Homes Built 1980 to 1989	1,541	13.9%
Homes Built 1970 to 1979	1,753	15.8%
Homes Built 1960 to 1969	902	8.1%
Homes Built 1950 to 1959	260	2.3%
Homes Built 1940 to 1949	67	0.6%
Homes Built Before 1939	125	1.1%
Median Age of Homes	12.9	yrs
Home Values (2000)		
Owner Specified Housing Units	5,478	
Home Values $1,000,000 or More	0	-
Home Values $750,000 or $999,999	27	0.5%
Home Values $500,000 or $749,999	11	0.2%
Home Values $400,000 to $499,999	154	2.8%
Home Values $300,000 to $399,999	704	12.9%
Home Values $250,000 to $299,999	1,413	25.8%
Home Values $200,000 to $249,999	1,516	27.7%
Home Values $175,000 to $199,999	601	11.0%
Home Values $150,000 to $174,999	418	7.6%
Home Values $125,000 to $149,999	200	3.7%
Home Values $100,000 to $124,999	247	4.5%
Home Values $90,000 to $99,999	60	1.1%
Home Values $80,000 to $89,999	10	0.2%
Home Values $70,000 to $79,999	18	0.3%
Home Values $60,000 to $69,999	11	0.2%
Home Values $50,000 to $59,999	2	0.0%
Home Values $35,000 to $49,999	11	0.2%

DEMOGRAPHIC PROFILE COMPLETE

1990 - 2000 Census, 2004 Estimates & 2009 Projections

Calculated using Proportional Block Groups

Prepared For Makaiwa Hills LLC

Lat/Lon: 21.346059/-158.0890495

RF9

Primary Trade Area Makaiwa Hills - 5 Minute Drivetime	PRIMARY	
Home Values $25,000 to $34,999	40	0.7%
Home Values $10,000 to $24,999	32	0.6%
Home Values $0 to $9,999	1	0.0%
Owner Occupied Median Home Value	$235,871	
Renter Occupied Median Rent	$873	
Consumer Expenditure *(Annual Total)*		
Total Household Expenditure (2004)	$596,773,221	
Total Non-Retail Expenditures (2004)	*$349,601,175*	
Total Retail Expenditures (2004)	*$247,172,045*	
Apparel (2004)	$32,533,935	
Contributions (2004)	$17,363,079	
Education (2004)	$10,380,669	
Entertainment (2004)	$31,051,186	
Food And Beverages (2004)	$100,329,289	
Furnishings And Equipment (2004)	$23,075,247	
Gifts (2004)	$16,833,456	
Health Care (2004)	$40,145,561	
Household Operations (2004)	$18,859,526	
Miscellaneous Expenses (2004)	$7,009,361	
Personal Care (2004)	$9,838,013	
Personal Insurance (2004)	$6,911,014	
Reading (2004)	$3,186,167	
Shelter (2004)	$99,457,653	
Tobacco (2004)	$5,486,092	
Transportation (2004)	$127,985,513	
Utilities (2004)	$46,327,458	
Consumer Expenditure *(per Household per Month)*		
Total Household Expenditure (2004)	$4,327	
Total Non-Retail Expenditures (2004)	*$2,535*	*58.6%*
Total Retail Expenditures (2004)	*$1,792*	*41.4%*
Apparel (2004)	$236	*5.5%*
Contributions (2004)	$126	*2.9%*
Education (2004)	$75	*1.7%*
Entertainment (2004)	$225	*5.2%*
Food And Beverages (2004)	$727	*16.8%*
Furnishings And Equipment (2004)	$167	*3.9%*
Gifts (2004)	$122	*2.8%*
Health Care (2004)	$291	*6.7%*
Household Operations (2004)	$137	*3.2%*
Miscellaneous Expenses (2004)	$51	*1.2%*
Personal Care (2004)	$71	*1.6%*
Personal Insurance (2004)	$50	*1.2%*
Reading (2004)	$23	*0.5%*
Shelter (2004)	$721	*16.7%*
Tobacco (2004)	$40	*0.9%*
Transportation (2004)	$928	*21.4%*
Utilities (2004)	$336	*7.8%*

DEMOGRAPHIC PROFILE COMPLETE

1990 - 2000 Census, 2004 Estimates & 2009 Projections

Calculated using Proportional Block Groups

Prepared For Makaiwa Hills LLC

Lat/Lon: 21.3824935/-158.0715575

COLLIERS MONROE FRIEDLANDER

RF9

Secondary Trade Area Makaiwa Hills	SECONDARY	
Population		
Estimated Population (2004)	215,554	
Census Population (1990)	160,348	
Census Population (2000)	202,602	
Projected Population (2009)	230,895	
Forecasted Population (2014)	246,575	
Historical Annual Change (1990-2000)	42,254	2.6%
Historical Annual Change (2000-2004)	12,952	1.6%
Projected Annual Change (2004-2009)	15,341	1.4%
Est. Population Density (2004)	2,100.24	*psm*
Trade Area Size	102.63	*sq mi*
Households		
Estimated Households (2004)	60,138	
Census Households (1990)	43,496	
Census Households (2000)	55,808	
Projected Households (2009)	65,039	
Forecasted Households (2014)	70,133	
Historical Annual Change (1990-2000)	12,312	2.8%
Projected Annual Change (2000-2009)	9,231	1.8%
Average Household Income		
Est. Average Household Income (2004)	$68,841	
Census Average Hhld Income (1990)	$48,113	
Census Average Hhld Income (2000)	$65,664	
Proj. Average Household Income (2009)	$67,685	
Historical Annual Change (1990-2000)	$17,550	3.6%
Projected Annual Change (2000-2009)	$2,021	0.3%
Median Household Income		
Est. Median Household Income (2004)	$63,070	
Census Median Hhld Income (1990)	$44,834	
Census Median Hhld Income (2000)	$58,334	
Proj. Median Household Income (2009)	$70,970	
Historical Annual Change (1990-2000)	$13,499	3.0%
Projected Annual Change (2000-2009)	$12,637	2.4%
Per Capita Income		
Est. Per Capita Income (2004)	$19,426	
Census Per Capita Income (1990)	$13,051	
Census Per Capita Income (2000)	$18,056	
Proj. Per Capita Income (2009)	$19,295	
Historical Annual Change (1990-2000)	$5,005	3.8%

Secondary Trade Area Makaiwa Hills	SECONDARY	
Projected Annual Change (2000-2009)	$1,239	0.8%
Other Income		
Est. Median Disposable Income (2004)	$51,950	
Proj. Median Disposable Income (2009)	$57,414	
Est. Median Household Net Worth (2004)	$45,681	
Household Income Distribution (2004)		
HH Income $200,000 or More	1,083	1.8%
HH Income $150,000 to 199,999	1,792	3.0%
HH Income $125,000 to 149,999	3,118	5.2%
HH Income $100,000 to 124,999	6,314	10.5%
HH Income $75,000 to 99,999	11,141	18.5%
HH Income $50,000 to 74,999	14,166	23.6%
HH Income $35,000 to 49,999	8,622	14.3%
HH Income $25,000 to 34,999	5,280	8.8%
HH Income $15,000 to 24,999	4,176	6.9%
HH Income $10,000 to 14,999	1,594	2.7%
HH Income $0 to 9,999	2,851	4.7%
HH Income $35,000+	46,236	76.9%
HH Income $50,000+	37,615	62.5%
HH Income $75,000+	23,448	39.0%
Race & Ethnicity (2004)		
Total Population	215,554	
White	28,297	13.1%
Black or African American	4,003	1.9%
American Indian & Alaska Native	451	0.2%
Asian	104,855	48.6%
Hawiian & Pacific Islander	24,395	11.3%
Other Race	2,324	1.1%
Two or More Races	51,228	23.8%
Not Hispanic or Latino Population	197,207	91.5%
Non Hispanic: White	*25,722*	*13.0%*
Non Hispanic: Black or African American	*3,626*	*1.8%*
Non Hispanic: Amer Indian & AK Native	*426*	*0.2%*
Non Hispanic: Asian	*96,375*	*48.9%*
Non Hispanic: Hawiian & Pacific Islander	*21,790*	*11.0%*
Non Hispanic: Other Race	*2,321*	*1.2%*
Non Hispanic: Two or More Races	*46,946*	*23.8%*
Hispanic or Latino Population	18,347	8.5%
Hispanic: White	*2,575*	*14.0%*
Hispanic: Black or African American	*377*	*2.1%*
Hispanic: American Indian & Alaska Native	*24*	*0.1%*
Hispanic: Asian	*8,480*	*46.2%*
Hispanic: Hawiian & Pacific Islander	*2,606*	*14.2%*
Hispanic: Other Race	*3*	*0.0%*
Hispanic: Two or More Races	*4,282*	*23.3%*
Not of Hispanic Origin Population (1990)	144,955	90.4%
Hispanic Origin Population (1990)	15,393	9.6%
Not Hispanic or Latino Population (2000)	185,752	91.7%

Secondary Trade Area
Makaiwa Hills

	SECONDARY	
Hispanic or Latino Population (2000)	16,850	8.3%
Not Hispanic or Latino Population 5yr (2009)	209,554	90.8%
Hispanic or Latino Population 5yr (2009)	21,341	9.2%
Historical Annual Change (1990-2000)	1,457	0.9%
Projected Annual Change (2000-2009)	4,491	3.0%
Age Distribution (2004)		
Total Population	215,554	
Age 0 to 4 yrs	17,779	8.2%
Age 5 to 9 yrs	16,790	7.8%
Age 10 to 14 yrs	16,149	7.5%
Age 15 to 19 yrs	15,056	7.0%
Age 20 to 24 yrs	13,811	6.4%
Age 25 to 29 yrs	15,056	7.0%
Age 30 to 34 yrs	16,708	7.8%
Age 35 to 39 yrs	17,184	8.0%
Age 40 to 44 yrs	16,423	7.6%
Age 45 to 49 yrs	14,457	6.7%
Age 50 to 54 yrs	13,113	6.1%
Age 55 to 59 yrs	11,774	5.5%
Age 60 to 64 yrs	9,192	4.3%
Age 65 to 69 yrs	6,778	3.1%
Age 70 to 74 yrs	5,641	2.6%
Age 75 to 79 yrs	4,286	2.0%
Age 80 to 84 yrs	2,802	1.3%
Age 85 yrs plus	2,555	1.2%
Median Age	33.9	yrs
Age 19 yrs or less	65,774	30.5%
Age 20 to 64 years	127,718	59.3%
Age 65 years Plus	22,062	10.2%
Female Age Distribution (2004)		
Female Population	107,361	49.8%
Age 0 to 4 yrs	*8,540*	*8.0%*
Age 5 to 9 yrs	*8,192*	*7.6%*
Age 10 to 14 yrs	*7,866*	*7.3%*
Age 15 to 19 yrs	*7,260*	*6.8%*
Age 20 to 24 yrs	*6,500*	*6.1%*
Age 25 to 29 yrs	*7,080*	*6.6%*
Age 30 to 34 yrs	*8,167*	*7.6%*
Age 35 to 39 yrs	*8,505*	*7.9%*
Age 40 to 44 yrs	*8,108*	*7.6%*
Age 45 to 49 yrs	*7,328*	*6.8%*
Age 50 to 54 yrs	*6,776*	*6.3%*
Age 55 to 59 yrs	*6,155*	*5.7%*
Age 60 to 64 yrs	*4,770*	*4.4%*
Age 65 to 69 yrs	*3,610*	*3.4%*
Age 70 to 74 yrs	*3,116*	*2.9%*
Age 75 to 79 yrs	*2,346*	*2.2%*
Age 80 to 84 yrs	*1,583*	*1.5%*
Age 85 yrs plus	*1,458*	*1.4%*
Female Median Age	*35.1*	*yrs*

Secondary Trade Area
Makaiwa Hills

	SECONDARY	
Age 19 yrs or less	*31,860*	*29.7%*
Age 20 to 64 years	*63,390*	*59.0%*
Age 65 years Plus	*12,111*	*11.3%*
Male Age Distribution (2004)		
Male Population	108,193	50.2%
Age 0 to 4 yrs	*9,238*	*8.5%*
Age 5 to 9 yrs	*8,598*	*7.9%*
Age 10 to 14 yrs	*8,283*	*7.7%*
Age 15 to 19 yrs	*7,795*	*7.2%*
Age 20 to 24 yrs	*7,311*	*6.8%*
Age 25 to 29 yrs	*7,976*	*7.4%*
Age 30 to 34 yrs	*8,541*	*7.9%*
Age 35 to 39 yrs	*8,679*	*8.0%*
Age 40 to 44 yrs	*8,315*	*7.7%*
Age 45 to 49 yrs	*7,129*	*6.6%*
Age 50 to 54 yrs	*6,337*	*5.9%*
Age 55 to 59 yrs	*5,619*	*5.2%*
Age 60 to 64 yrs	*4,422*	*4.1%*
Age 65 to 69 yrs	*3,168*	*2.9%*
Age 70 to 74 yrs	*2,525*	*2.3%*
Age 75 to 79 yrs	*1,940*	*1.8%*
Age 80 to 84 yrs	*1,220*	*1.1%*
Age 85 yrs plus	*1,097*	*1.0%*
Male Median Age	*32.6*	*yrs*
Age 19 yrs or less	*33,914*	*31.3%*
Age 20 to 64 years	*64,329*	*59.5%*
Age 65 years Plus	*9,950*	*9.2%*
Males per 100 Females, Male % Pop (2004)		
Overall Comparison	101	
Age 0 to 4 yrs	*108*	*52.0%*
Age 5 to 9 yrs	*105*	*51.2%*
Age 10 to 14 yrs	*105*	*51.3%*
Age 15 to 19 yrs	*107*	*51.8%*
Age 20 to 24 yrs	*112*	*52.9%*
Age 25 to 29 yrs	*113*	*53.0%*
Age 30 to 34 yrs	*105*	*51.1%*
Age 35 to 39 yrs	*102*	*50.5%*
Age 40 to 44 yrs	*103*	*50.6%*
Age 45 to 49 yrs	*97*	*49.3%*
Age 50 to 54 yrs	*94*	*48.3%*
Age 55 to 59 yrs	*91*	*47.7%*
Age 60 to 64 yrs	*93*	*48.1%*
Age 65 to 69 yrs	*88*	*46.7%*
Age 70 to 74 yrs	*81*	*44.8%*
Age 75 to 79 yrs	*83*	*45.3%*
Age 80 to 84 yrs	*77*	*43.5%*
Age 85 yrs plus	*75*	*42.9%*
Age 19 yrs or less	*106*	*51.6%*
Age 20 to 39 yrs	*107*	*51.8%*
Age 40 to 64 yrs	*96*	*49.0%*

Secondary Trade Area Makaiwa Hills	SECONDARY	
Age 65 years Plus	*82*	*45.1%*
Household Type (2004)		
Total Households	60,138	
Households with Children	29,575	49.2%
Average Household Size	3.52	
Est. Household Density	585.95	psm
Population Family	184,226	85.5%
Population Non-Family	27,334	12.7%
Population Group Qtrs	3,994	1.9%
Family Households	48,723	81.0%
Married Couple Hhlds	*37,425*	*76.8%*
Other Family Hhlds	*11,298*	*23.2%*
Family Households With Children	29,305	60.1%
Married Couple With Children	*22,175*	*75.7%*
Other Family Hhlds With Children	*7,130*	*24.3%*
Family Households No Children	19,418	39.9%
Married Couple No Children	*15,250*	*78.5%*
Other Family Households No Children	*4,167*	*21.5%*
Average Family Household Size	3.78	
Average Family Income	$72,606	
Median Family Income	$67,506	
Non-Family Households	11,415	19.0%
Non-Family Hhlds With Children	269	2.4%
Non-Family Hhld No Children	11,146	97.6%
N-F Hhld Lone Person No Children	*8,333*	*73.0%*
Lone Male Householder	4,494	53.9%
Lone Female Householder	3,839	46.1%
N-F Hhld 2+ Persons No Children	*2,812*	*24.6%*
Average Non-Family Hhld Size	2.39	
Marital Status (2004)		
(15 Years or Older)	164,836	
Never Married	49,572	30.1%
Now Married	83,021	50.4%
Previously Married	32,242	19.6%
Separated	*11,625*	*36.1%*
Widowed	*12,141*	*37.7%*
Divorced	*8,476*	*26.3%*
Educational Attainment (2004)		
Adult Population (25 Years or Older)	135,969	
Elementary (0 to 8)	11,516	8.5%
Some High School (9 to 11)	12,698	9.3%
High School Graduate (12)	42,746	31.4%
Some College (13 to 16)	30,134	22.2%
Associate Degree Only	12,290	9.0%
Bachelor Degree Only	20,869	15.3%
Graduate Degree	5,716	4.2%
Any College + (Some College or higher)	69,009	50.8%
College Degree + (Bachelor Degree or higher)	26,585	19.6%

Secondary Trade Area Makaiwa Hills	SECONDARY	
Housing (2004)		
Total Housing Units	64,517	
Housing Units, Occupied	60,138	93.2%
Housing Units, Owner-Occupied	*40,590*	*67.5%*
Housing Units, Renter-Occupied	*19,547*	*32.5%*
Housing Units, Vacant	4,379	6.8%
Total Housing Units (2000)	59,888	
Historical Annual Change (2000-2004)	4,629	1.9%
Household Size (2004)		
Total Households	60,138	
1 Person Household	8,333	13.9%
2 Person Households	14,175	23.6%
3 Person Households	11,434	19.0%
4 Person Households	11,142	18.5%
5 Person Households	6,702	11.1%
6 Person Households	3,577	5.9%
7+ Person Households	4,773	7.9%
Household Stability (2004)		
Total Households	60,138	
In current residence < 1 year	18,031	30.0%
In current residence 1-2 years	16,169	26.9%
In current residence 3-5 years	9,861	16.4%
In current residence 6-10 years	6,712	11.2%
In current residence > 10 years	9,364	15.6%
Turnover (% Annual Residential Turnover)		30.0%
Stability (% In Current Residence 5+ Years)		26.7%
Median Years in Residence	2.9	yrs
Household Vehicles (2004)		
Total Vehicles Available	113,653	
Household: 0 Vehicles Available	3,844	6.4%
Household: 1 Vehicles Available	18,861	31.4%
Household: 2 Vehicles Available	24,309	40.4%
Household: 3+ Vehicles Available	13,124	21.8%
Average Per Household	1.9	*Vehicles*
Owner Occupied Hhlds Vehicles	85,580	75.3%
Average Per Owner Household	*2.1*	*Vehicles*
Renter Occupied Hhlds Vehicles	28,073	24.7%
Average Per Renter Household	*1.4*	*Vehicles*
Travel Time (2000)		
Worker Base (16 Years or Older)	94,623	
Travel to Work in 14 Minutes or Less	12,137	12.8%
Travel to Work in 15 to 29 Minutes	27,994	29.6%
Travel to Work in 30 to 59 Minutes	37,996	40.2%
Travel to Work in 60 Minutes or More	14,625	15.5%
Work at Home	1,871	2.0%
Average Travel Time to Work	32.6	mins
Transportation To Work (2000)		
Work Base	94,623	

Secondary Trade Area Makaiwa Hills	SECONDARY	
Drive to Work Alone	59,923	63.3%
Drive to Work in Carpool	21,488	22.7%
Travel to Work - Public Transportation	7,793	8.2%
Drive to Work on Motorcycle	315	0.3%
Bicycle to Work	271	0.3%
Walk to Work	2,114	2.2%
Other Means	847	0.9%
Work at Home	1,871	2.0%
Daytime Demos (2004)		
Total Number of Businesses	3,664	
Total Number of Employees	42,335	
Company Headqtrs: Businesses	7	0.2%
Company Headqtrs: Employees	174	0.4%
Employee Population per Business	11.6 to 1	
Residential Population per Business	58.8 to 1	
Potential Combined Area Demographics	102,818	
Labor Force (2004)		
Labor: Population Age 16+	161,791	
Unemployment Rate		4.2%
Labor Force Total: Males	80,539	49.8%
Male civilian employed	*47,990*	*59.6%*
Male civilian unemployed	*3,828*	*4.8%*
Males in Armed Forces	*6,371*	*7.9%*
Males not in labor force	*22,349*	*27.8%*
Labor Force Total: Females	81,252	50.2%
Female civilian employed	*46,017*	*56.6%*
Female civilian unemployed	*3,041*	*3.7%*
Females in Armed Forces	*930*	*1.1%*
Females not in labor force	*31,265*	*38.5%*
Labor Force Change (2000-2004)	75,073	21.6%
Male Change (2000-2004)	36,560	20.8%
Female Change (2000-2004)	38,513	22.5%
Occupation (2000)		
Occupation: Population Age 16+	86,718	
Occupation Total: Males	*43,979*	*50.7%*
Occupation Total: Females	*42,739*	*49.3%*
Mgmt, Business, & Financial Operations	9,746	11.2%
Professional and Related	13,300	15.3%
Service	18,077	20.8%
Sales and Office	26,087	30.1%
Farming, Fishing, and Forestry	566	0.7%
Construction, Extraction, & Maintenance	9,076	10.5%
Production, Transport, & Material Moving	9,866	11.4%
White Collar		*56.7%*
Blue Collar		*43.3%*
Units In Structure (2000)		
Total Units	59,888	
1 Detached Unit	35,333	59.0%
1 Attached Unit	6,403	10.7%

Secondary Trade Area Makaiwa Hills	SECONDARY	
2 Units	838	1.4%
3 to 4 Units	3,305	5.5%
5 to 9 Units	6,955	11.6%
10 to 19 Units	2,800	4.7%
20 to 49 Units	1,323	2.2%
50 or more Units	2,782	4.6%
Mobile Home or Trailer	135	0.2%
Other Structure	14	0.0%
Homes Built By Year (2000)		
Homes Built 1999 to 2000	1,521	2.5%
Homes Built 1995 to 1998	6,391	10.7%
Homes Built 1990 to 1994	10,278	17.2%
Homes Built 1980 to 1989	9,701	16.2%
Homes Built 1970 to 1979	13,472	22.5%
Homes Built 1960 to 1969	11,899	19.9%
Homes Built 1950 to 1959	4,558	7.6%
Homes Built 1940 to 1949	1,291	2.2%
Homes Built Before 1939	776	1.3%
Median Age of Homes	21.4	yrs
Home Values (2000)		
Owner Specified Housing Units	29,334	
Home Values $1,000,000 or More	7	0.0%
Home Values $750,000 or $999,999	67	0.2%
Home Values $500,000 or $749,999	412	1.4%
Home Values $400,000 to $499,999	1,052	3.6%
Home Values $300,000 to $399,999	5,396	18.4%
Home Values $250,000 to $299,999	6,610	22.5%
Home Values $200,000 to $249,999	7,321	25.0%
Home Values $175,000 to $199,999	2,706	9.2%
Home Values $150,000 to $174,999	2,261	7.7%
Home Values $125,000 to $149,999	1,265	4.3%
Home Values $100,000 to $124,999	1,098	3.7%
Home Values $90,000 to $99,999	270	0.9%
Home Values $80,000 to $89,999	204	0.7%
Home Values $70,000 to $79,999	84	0.3%
Home Values $60,000 to $69,999	128	0.4%
Home Values $50,000 to $59,999	80	0.3%
Home Values $35,000 to $49,999	87	0.3%
Home Values $25,000 to $34,999	95	0.3%
Home Values $10,000 to $24,999	145	0.5%
Home Values $0 to $9,999	45	0.2%
Owner Occupied Median Home Value	$242,293	
Renter Occupied Median Rent	$775	
Consumer Expenditure *(Annual Total)*		
Total Household Expenditure (2004)	$3,110,341,278	
Total Non-Retail Expenditures (2004)	*$1,823,844,755*	
Total Retail Expenditures (2004)	*$1,286,496,521*	
Apparel (2004)	$170,197,883	
Contributions (2004)	$90,761,529	

Secondary Trade Area Makaiwa Hills	SECONDARY	
Education (2004)	$54,253,406	
Entertainment (2004)	$162,157,185	
Food And Beverages (2004)	$524,084,504	
Furnishings And Equipment (2004)	$119,962,394	
Gifts (2004)	$87,383,839	
Health Care (2004)	$213,365,812	
Household Operations (2004)	$97,644,107	
Miscellaneous Expenses (2004)	$37,065,084	
Personal Care (2004)	$51,274,995	
Personal Insurance (2004)	$35,978,709	
Reading (2004)	$16,660,602	
Shelter (2004)	$510,739,550	
Tobacco (2004)	$28,792,425	
Transportation (2004)	$667,389,381	
Utilities (2004)	$242,629,881	
Consumer Expenditure *(per Household per Month)*		
Total Household Expenditure (2004)	$4,310	
Total Non-Retail Expenditures (2004)	*$2,527*	*58.6%*
Total Retail Expenditures (2004)	*$1,783*	*41.4%*
Apparel (2004)	$236	*5.5%*
Contributions (2004)	$126	*2.9%*
Education (2004)	$75	*1.7%*
Entertainment (2004)	$225	*5.2%*
Food And Beverages (2004)	$726	*16.8%*
Furnishings And Equipment (2004)	$166	*3.9%*
Gifts (2004)	$121	*2.8%*
Health Care (2004)	$296	*6.9%*
Household Operations (2004)	$135	*3.1%*
Miscellaneous Expenses (2004)	$51	*1.2%*
Personal Care (2004)	$71	*1.6%*
Personal Insurance (2004)	$50	*1.2%*
Reading (2004)	$23	*0.5%*
Shelter (2004)	$708	*16.4%*
Tobacco (2004)	$40	*0.9%*
Transportation (2004)	$925	*21.5%*
Utilities (2004)	$336	*7.8%*

DEMOGRAPHIC PROFILE COMPLETE

1990 - 2000 Census, 2004 Estimates & 2009 Projections

Calculated using Proportional Block Groups

Prepared For Makaiwa Hills LLC

Lat/Lon: 21.407576/-158.0640055

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Tertiary Trade Area Makaiwa Hills	TERTIARY	
Population		
Estimated Population (2004)	343,959	
Census Population (1990)	284,246	
Census Population (2000)	325,663	
Projected Population (2009)	366,236	
Forecasted Population (2014)	388,708	
Historical Annual Change (1990-2000)	41,417	1.5%
Historical Annual Change (2000-2004)	18,295	1.4%
Projected Annual Change (2004-2009)	22,277	1.3%
Est. Population Density (2004)	1,732.24	*psm*
Trade Area Size	198.56	*sq mi*
Households		
Estimated Households (2004)	100,017	
Census Households (1990)	79,128	
Census Households (2000)	93,522	
Projected Households (2009)	107,548	
Forecasted Households (2014)	115,286	
Historical Annual Change (1990-2000)	14,394	1.8%
Projected Annual Change (2000-2009)	14,026	1.7%
Average Household Income		
Est. Average Household Income (2004)	$68,343	
Census Average Hhld Income (1990)	$48,941	
Census Average Hhld Income (2000)	$65,332	
Proj. Average Household Income (2009)	$67,228	
Historical Annual Change (1990-2000)	$16,391	3.3%
Projected Annual Change (2000-2009)	$1,896	0.3%
Median Household Income		
Est. Median Household Income (2004)	$62,908	
Census Median Hhld Income (1990)	$44,668	
Census Median Hhld Income (2000)	$58,344	
Proj. Median Household Income (2009)	$70,699	
Historical Annual Change (1990-2000)	$13,676	3.1%
Projected Annual Change (2000-2009)	$12,355	2.4%
Per Capita Income		
Est. Per Capita Income (2004)	$20,179	
Census Per Capita Income (1990)	$13,624	
Census Per Capita Income (2000)	$18,750	
Proj. Per Capita Income (2009)	$20,063	
Historical Annual Change (1990-2000)	$5,126	3.8%
Projected Annual Change (2000-2009)	$1,312	0.8%

Tertiary Trade Area Makaiwa Hills	TERTIARY	
Other Income		
Est. Median Disposable Income (2004)	$51,726	
Proj. Median Disposable Income (2009)	$57,107	
Est. Median Household Net Worth (2004)	$45,412	
Household Income Distribution (2004)		
HH Income $200,000 or More	1,759	1.8%
HH Income $150,000 to 199,999	3,102	3.1%
HH Income $125,000 to 149,999	5,523	5.5%
HH Income $100,000 to 124,999	10,740	10.7%
HH Income $75,000 to 99,999	17,811	17.8%
HH Income $50,000 to 74,999	22,777	22.8%
HH Income $35,000 to 49,999	14,088	14.1%
HH Income $25,000 to 34,999	9,145	9.1%
HH Income $15,000 to 24,999	7,455	7.5%
HH Income $10,000 to 14,999	2,658	2.7%
HH Income $0 to 9,999	4,961	5.0%
HH Income $35,000+	75,799	75.8%
HH Income $50,000+	61,711	61.7%
HH Income $75,000+	38,935	38.9%
Race & Ethnicity (2004)		
Total Population	343,959	
White	55,973	16.3%
Black or African American	9,914	2.9%
American Indian & Alaska Native	917	0.3%
Asian	158,472	46.1%
Hawiian & Pacific Islander	33,892	9.9%
Other Race	5,044	1.5%
Two or More Races	79,748	23.2%
Not Hispanic or Latino Population	313,396	91.1%
Non Hispanic: White	*50,219*	*16.0%*
Non Hispanic: Black or African American	*8,672*	*2.8%*
Non Hispanic: Amer Indian & AK Native	*852*	*0.3%*
Non Hispanic: Asian	*145,613*	*46.5%*
Non Hispanic: Hawiian & Pacific Islander	*30,115*	*9.6%*
Non Hispanic: Other Race	*5,038*	*1.6%*
Non Hispanic: Two or More Races	*72,887*	*23.3%*
Hispanic or Latino Population	30,562	8.9%
Hispanic: White	*5,754*	*18.8%*
Hispanic: Black or African American	*1,242*	*4.1%*
Hispanic: American Indian & Alaska Native	*65*	*0.2%*
Hispanic: Asian	*12,859*	*42.1%*
Hispanic: Hawiian & Pacific Islander	*3,777*	*12.4%*
Hispanic: Other Race	*5*	*0.0%*
Hispanic: Two or More Races	*6,861*	*22.4%*
Not of Hispanic Origin Population (1990)	258,543	91.0%
Hispanic Origin Population (1990)	25,703	9.0%
Not Hispanic or Latino Population (2000)	297,336	91.3%
Hispanic or Latino Population (2000)	28,327	8.7%
Not Hispanic or Latino Population 5yr (2009)	330,984	90.4%

Tertiary Trade Area Makaiwa Hills	TERTIARY	
Hispanic or Latino Population 5yr (2009)	35,252	9.6%
Historical Annual Change (1990-2000)	2,623	1.0%
Projected Annual Change (2000-2009)	6,925	2.7%
Age Distribution (2004)		
Total Population	343,959	
Age 0 to 4 yrs	28,440	8.3%
Age 5 to 9 yrs	25,962	7.5%
Age 10 to 14 yrs	25,252	7.3%
Age 15 to 19 yrs	23,777	6.9%
Age 20 to 24 yrs	23,660	6.9%
Age 25 to 29 yrs	24,808	7.2%
Age 30 to 34 yrs	25,876	7.5%
Age 35 to 39 yrs	26,814	7.8%
Age 40 to 44 yrs	26,330	7.7%
Age 45 to 49 yrs	23,415	6.8%
Age 50 to 54 yrs	21,513	6.3%
Age 55 to 59 yrs	18,333	5.3%
Age 60 to 64 yrs	14,117	4.1%
Age 65 to 69 yrs	10,678	3.1%
Age 70 to 74 yrs	9,063	2.6%
Age 75 to 79 yrs	7,119	2.1%
Age 80 to 84 yrs	4,683	1.4%
Age 85 yrs plus	4,117	1.2%
Median Age	34.1	*yrs*
Age 19 yrs or less	103,432	30.1%
Age 20 to 64 years	204,866	59.6%
Age 65 years Plus	35,661	10.4%
Female Age Distribution (2004)		
Female Population	170,350	49.5%
Age 0 to 4 yrs	*13,747*	*8.1%*
Age 5 to 9 yrs	*12,667*	*7.4%*
Age 10 to 14 yrs	*12,386*	*7.3%*
Age 15 to 19 yrs	*11,329*	*6.7%*
Age 20 to 24 yrs	*10,764*	*6.3%*
Age 25 to 29 yrs	*11,409*	*6.7%*
Age 30 to 34 yrs	*12,458*	*7.3%*
Age 35 to 39 yrs	*13,269*	*7.8%*
Age 40 to 44 yrs	*13,007*	*7.6%*
Age 45 to 49 yrs	*11,820*	*6.9%*
Age 50 to 54 yrs	*11,058*	*6.5%*
Age 55 to 59 yrs	*9,424*	*5.5%*
Age 60 to 64 yrs	*7,273*	*4.3%*
Age 65 to 69 yrs	*5,756*	*3.4%*
Age 70 to 74 yrs	*5,052*	*3.0%*
Age 75 to 79 yrs	*3,966*	*2.3%*
Age 80 to 84 yrs	*2,646*	*1.6%*
Age 85 yrs plus	*2,318*	*1.4%*
Female Median Age	*35.3*	*yrs*
Age 19 yrs or less	*50,129*	*29.4%*
Age 20 to 64 years	*100,483*	*59.0%*

Tertiary Trade Area
Makaiwa Hills

Tertiary Trade Area Makaiwa Hills	TERTIARY	
Age 65 years Plus	*19,739*	*11.6%*
Male Age Distribution (2004)		
Male Population	173,608	50.5%
Age 0 to 4 yrs	*14,694*	*8.5%*
Age 5 to 9 yrs	*13,296*	*7.7%*
Age 10 to 14 yrs	*12,866*	*7.4%*
Age 15 to 19 yrs	*12,448*	*7.2%*
Age 20 to 24 yrs	*12,896*	*7.4%*
Age 25 to 29 yrs	*13,399*	*7.7%*
Age 30 to 34 yrs	*13,418*	*7.7%*
Age 35 to 39 yrs	*13,545*	*7.8%*
Age 40 to 44 yrs	*13,323*	*7.7%*
Age 45 to 49 yrs	*11,595*	*6.7%*
Age 50 to 54 yrs	*10,455*	*6.0%*
Age 55 to 59 yrs	*8,909*	*5.1%*
Age 60 to 64 yrs	*6,843*	*3.9%*
Age 65 to 69 yrs	*4,922*	*2.8%*
Age 70 to 74 yrs	*4,011*	*2.3%*
Age 75 to 79 yrs	*3,153*	*1.8%*
Age 80 to 84 yrs	*2,037*	*1.2%*
Age 85 yrs plus	*1,798*	*1.0%*
Male Median Age	*32.9*	*yrs*
Age 19 yrs or less	*53,303*	*30.7%*
Age 20 to 64 years	*104,383*	*60.1%*
Age 65 years Plus	*15,922*	*9.2%*
Males per 100 Females, Male % Pop (2004)		
Overall Comparison	102	
Age 0 to 4 yrs	*107*	*51.7%*
Age 5 to 9 yrs	*105*	*51.2%*
Age 10 to 14 yrs	*104*	*51.0%*
Age 15 to 19 yrs	*110*	*52.4%*
Age 20 to 24 yrs	*120*	*54.5%*
Age 25 to 29 yrs	*117*	*54.0%*
Age 30 to 34 yrs	*108*	*51.9%*
Age 35 to 39 yrs	*102*	*50.5%*
Age 40 to 44 yrs	*102*	*50.6%*
Age 45 to 49 yrs	*98*	*49.5%*
Age 50 to 54 yrs	*95*	*48.6%*
Age 55 to 59 yrs	*95*	*48.6%*
Age 60 to 64 yrs	*94*	*48.5%*
Age 65 to 69 yrs	*86*	*46.1%*
Age 70 to 74 yrs	*79*	*44.3%*
Age 75 to 79 yrs	*80*	*44.3%*
Age 80 to 84 yrs	*77*	*43.5%*
Age 85 yrs plus	*78*	*43.7%*
Age 19 yrs or less	*106*	*51.5%*
Age 20 to 39 yrs	*111*	*52.6%*
Age 40 to 64 yrs	*97*	*49.3%*
Age 65 years Plus	*81*	*44.6%*
Household Type (2004)		

Tertiary Trade Area Makaiwa Hills	TERTIARY	
Total Households	100,017	
Households with Children	47,650	47.6%
Average Household Size	3.35	
Est. Household Density	503.70	psm
Population Family	291,172	84.7%
Population Non-Family	43,948	12.8%
Population Group Qtrs	8,839	2.6%
Family Households	80,047	80.0%
Married Couple Hhlds	*62,050*	*77.5%*
Other Family Hhlds	*17,997*	*22.5%*
Family Households With Children	47,224	59.0%
Married Couple With Children	*35,865*	*75.9%*
Other Family Hhlds With Children	*11,359*	*24.1%*
Family Households No Children	32,822	41.0%
Married Couple No Children	*26,185*	*79.8%*
Other Family Households No Children	*6,637*	*20.2%*
Average Family Household Size	3.64	
Average Family Income	$72,269	
Median Family Income	$67,832	
Non-Family Households	19,970	20.0%
Non-Family Hhlds With Children	426	2.1%
Non-Family Hhld No Children	19,545	97.9%
N-F Hhld Lone Person No Children	*14,873*	*74.5%*
Lone Male Householder	7,914	53.2%
Lone Female Householder	6,958	46.8%
N-F Hhld 2+ Persons No Children	*4,672*	*23.4%*
Average Non-Family Hhld Size	2.20	
Marital Status (2004)		
(15 Years or Older)	264,304	
Never Married	78,340	29.6%
Now Married	135,485	51.3%
Previously Married	50,478	19.1%
Separated	*17,385*	*34.4%*
Widowed	*19,925*	*39.5%*
Divorced	*13,168*	*26.1%*
Educational Attainment (2004)		
Adult Population (25 Years or Older)	216,866	
Elementary (0 to 8)	16,123	7.4%
Some High School (9 to 11)	18,169	8.4%
High School Graduate (12)	65,460	30.2%
Some College (13 to 16)	49,275	22.7%
Associate Degree Only	20,248	9.3%
Bachelor Degree Only	35,439	16.3%
Graduate Degree	12,153	5.6%
Any College + (Some College or higher)	117,114	54.0%
College Degree + (Bachelor Degree or higher)	47,591	21.9%
Housing (2004)		
Total Housing Units	107,574	
Housing Units, Occupied	100,017	93.0%
Housing Units, Owner-Occupied	*64,466*	*64.5%*

This report was produced using data from private and government sources deemed to be reliable. The information herein is provided without representation or warranty.

Tertiary Trade Area Makaiwa Hills	TERTIARY	
Housing Units, Renter-Occupied	*35,551*	*35.5%*
Housing Units, Vacant	7,557	7.0%
Total Housing Units (2000)	100,607	
Historical Annual Change (2000-2004)	6,967	1.7%
Household Size (2004)		
Total Households	100,017	
1 Person Household	14,873	14.9%
2 Person Households	25,036	25.0%
3 Person Households	19,502	19.5%
4 Person Households	18,737	18.7%
5 Person Households	10,350	10.3%
6 Person Households	5,148	5.1%
7+ Person Households	6,371	6.4%
Household Stability (2004)		
Total Households	100,017	
In current residence < 1 year	27,606	27.6%
In current residence 1-2 years	27,534	27.5%
In current residence 3-5 years	16,652	16.6%
In current residence 6-10 years	11,490	11.5%
In current residence > 10 years	16,736	16.7%
Turnover (% Annual Residential Turnover)		27.6%
Stability (% In Current Residence 5+ Years)		28.2%
Median Years in Residence	3.0	yrs
Household Vehicles (2004)		
Total Vehicles Available	187,301	
Household: 0 Vehicles Available	6,687	6.7%
Household: 1 Vehicles Available	31,912	31.9%
Household: 2 Vehicles Available	40,390	40.4%
Household: 3+ Vehicles Available	21,029	21.0%
Average Per Household	1.9	*Vehicles*
Owner Occupied Hhlds Vehicles	135,507	72.3%
Average Per Owner Household	*2.1*	*Vehicles*
Renter Occupied Hhlds Vehicles	51,794	27.7%
Average Per Renter Household	*1.5*	*Vehicles*
Travel Time (2000)		
Worker Base (16 Years or Older)	155,464	
Travel to Work in 14 Minutes or Less	27,687	17.8%
Travel to Work in 15 to 29 Minutes	46,043	29.6%
Travel to Work in 30 to 59 Minutes	57,714	37.1%
Travel to Work in 60 Minutes or More	20,730	13.3%
Work at Home	3,290	2.1%
Average Travel Time to Work	30.3	mins
Transportation To Work (2000)		
Work Base	155,464	
Drive to Work Alone	100,659	64.7%
Drive to Work in Carpool	32,931	21.2%
Travel to Work - Public Transportation	10,870	7.0%
Drive to Work on Motorcycle	593	0.4%

Tertiary Trade Area Makaiwa Hills	TERTIARY	
Bicycle to Work	628	0.4%
Walk to Work	5,229	3.4%
Other Means	1,264	0.8%
Work at Home	3,290	2.1%
Daytime Demos (2004)		
Total Number of Businesses	5,806	
Total Number of Employees	65,516	
Company Headqtrs: Businesses	10	0.2%
Company Headqtrs: Employees	427	0.7%
Employee Population per Business		11.3 to 1
Residential Population per Business		59.2 to 1
Potential Combined Area Demographics	160,008	
Labor Force (2004)		
Labor: Population Age 16+	259,590	
Unemployment Rate		4.1%
Labor Force Total: Males	130,364	50.2%
Male civilian employed	*74,647*	*57.3%*
Male civilian unemployed	*5,639*	*4.3%*
Males in Armed Forces	*15,336*	*11.8%*
Males not in labor force	*34,742*	*26.7%*
Labor Force Total: Females	129,226	49.8%
Female civilian employed	*72,680*	*56.2%*
Female civilian unemployed	*4,915*	*3.8%*
Females in Armed Forces	*2,435*	*1.9%*
Females not in labor force	*49,196*	*38.1%*
Labor Force Change (2000-2004)	122,156	22.2%
Male Change (2000-2004)	60,965	22.0%
Female Change (2000-2004)	61,191	22.5%
Occupation (2000)		
Occupation: Population Age 16+	137,434	
Occupation Total: Males	*69,399*	*50.5%*
Occupation Total: Females	*68,035*	*49.5%*
Mgmt, Business, & Financial Operations	16,511	12.0%
Professional and Related	23,853	17.4%
Service	26,672	19.4%
Sales and Office	41,010	29.8%
Farming, Fishing, and Forestry	1,079	0.8%
Construction, Extraction, & Maintenance	13,884	10.1%
Production, Transport, & Material Moving	14,425	10.5%
White Collar		*59.2%*
Blue Collar		*40.8%*
Units In Structure (2000)		
Total Units	100,607	
1 Detached Unit	56,072	55.7%
1 Attached Unit	11,550	11.5%
2 Units	1,693	1.7%
3 to 4 Units	6,716	6.7%
5 to 9 Units	10,332	10.3%
10 to 19 Units	4,689	4.7%

Tertiary Trade Area Makaiwa Hills	TERTIARY	
20 to 49 Units	2,649	2.6%
50 or more Units	6,702	6.7%
Mobile Home or Trailer	180	0.2%
Other Structure	23	0.0%
Homes Built By Year (2000)		
Homes Built 1999 to 2000	2,012	2.0%
Homes Built 1995 to 1998	8,478	8.4%
Homes Built 1990 to 1994	13,601	13.5%
Homes Built 1980 to 1989	17,103	17.0%
Homes Built 1970 to 1979	25,747	25.6%
Homes Built 1960 to 1969	18,893	18.8%
Homes Built 1950 to 1959	9,116	9.1%
Homes Built 1940 to 1949	3,651	3.6%
Homes Built Before 1939	2,004	2.0%
Median Age of Homes	23.8	yrs
Home Values (2000)		
Owner Specified Housing Units	46,597	
Home Values $1,000,000 or More	42	0.1%
Home Values $750,000 or $999,999	131	0.3%
Home Values $500,000 or $749,999	1,213	2.6%
Home Values $400,000 to $499,999	2,565	5.5%
Home Values $300,000 to $399,999	10,196	21.9%
Home Values $250,000 to $299,999	10,762	23.1%
Home Values $200,000 to $249,999	10,134	21.7%
Home Values $175,000 to $199,999	3,552	7.6%
Home Values $150,000 to $174,999	3,028	6.5%
Home Values $125,000 to $149,999	1,781	3.8%
Home Values $100,000 to $124,999	1,440	3.1%
Home Values $90,000 to $99,999	480	1.0%
Home Values $80,000 to $89,999	303	0.7%
Home Values $70,000 to $79,999	134	0.3%
Home Values $60,000 to $69,999	172	0.4%
Home Values $50,000 to $59,999	120	0.3%
Home Values $35,000 to $49,999	140	0.3%
Home Values $25,000 to $34,999	168	0.4%
Home Values $10,000 to $24,999	185	0.4%
Home Values $0 to $9,999	52	0.1%
Owner Occupied Median Home Value	$258,433	
Renter Occupied Median Rent	$798	
Consumer Expenditure *(Annual Total)*		
Total Household Expenditure (2004)	$5,152,482,267	
Total Non-Retail Expenditures (2004)	*$3,019,611,888*	
Total Retail Expenditures (2004)	*$2,132,870,380*	
Apparel (2004)	$281,690,798	
Contributions (2004)	$150,607,749	
Education (2004)	$89,853,739	
Entertainment (2004)	$268,532,690	
Food And Beverages (2004)	$866,591,399	
Furnishings And Equipment (2004)	$199,176,198	

Tertiary Trade Area Makaiwa Hills	TERTIARY	
Gifts (2004)	$145,438,226	
Health Care (2004)	$351,420,375	
Household Operations (2004)	$161,986,502	
Miscellaneous Expenses (2004)	$61,232,849	
Personal Care (2004)	$85,084,835	
Personal Insurance (2004)	$59,616,590	
Reading (2004)	$27,603,093	
Shelter (2004)	$850,202,159	
Tobacco (2004)	$47,650,099	
Transportation (2004)	$1,104,191,468	
Utilities (2004)	$401,603,529	
Consumer Expenditure *(per Household per Month)*		
Total Household Expenditure (2004)	$4,293	
Total Non-Retail Expenditures (2004)	*$2,516*	*58.6%*
Total Retail Expenditures (2004)	*$1,777*	*41.4%*
Apparel (2004)	$235	*5.5%*
Contributions (2004)	$125	*2.9%*
Education (2004)	$75	*1.7%*
Entertainment (2004)	$224	*5.2%*
Food And Beverages (2004)	$722	*16.8%*
Furnishings And Equipment (2004)	$166	*3.9%*
Gifts (2004)	$121	*2.8%*
Health Care (2004)	$293	*6.8%*
Household Operations (2004)	$135	*3.1%*
Miscellaneous Expenses (2004)	$51	*1.2%*
Personal Care (2004)	$71	*1.7%*
Personal Insurance (2004)	$50	*1.2%*
Reading (2004)	$23	*0.5%*
Shelter (2004)	$708	*16.5%*
Tobacco (2004)	$40	*0.9%*
Transportation (2004)	$920	*21.4%*
Utilities (2004)	$335	*7.8%*

Retail Square Footage Estimation Models

A. Population Growth Model

B. Consumer Expenditure Model

PRIMARY TRADE AREA RETAIL INVENTORY AND NEW DEVELOPMENTS

Shopping Center	Address	City	Trade Area	Year Built	Retail RBA
Primary Trade Area					
Shell Commercial Center	91-557 Farrington Highway	Kapolei	Primary Trade Area	1999	15,936
Halekuai Center	565 Farrington Highway	Kapolei	Primary Trade Area	2000	18,117
Big Kmart	500 Kamokila Boulevard	Kapolei	Primary Trade Area	2000	122,848
Marketplace @ Kapolei	590 Farrington Highway	Kapolei	Primary Trade Area	2003	64,106
Kapolei Shopping Center	91-590 Farrington Highway	Kapolei	Primary Trade Area	1993	134,400
Home Depot	4600 Kpaolei Parkway	Kapolei	Primary Trade Area	2004	102,000
Primary Trade Area Totals					457,407

PRIMARY TRADE AREA Projected New Retail Projects	Location	Projected Project Completion	Estimated RBA	Probability of Completion	
Ace Hardware	Kapolei	2005	21,000	100.00%	21,000
Kapolei Parkway	Kapolei	2005	22,000	100.00%	22,000
Assagio/Fortune Chinese	Kapolei	2005	6,000	100.00%	6,000
Kapolei Center	Kapolei	2006	150,000	100.00%	150,000
Wal-Mart	Kapolei	2007	125,000	75.00%	93,750
Kapolei Commons	Kapolei	2008	450,000	75.00%	337,500
Ko Olina Resort Community Center	Koolina	2008	125,000	50.00%	62,500
DHHL Regional Mall	Kapolei	2008	350,000	50.00%	175,000
UH Campus Village	Kapolei	2009	175,000	25.00%	43,750
Villages at Kapolei	Kapolei	2009	160,000	25.00%	40,000
Boat Parcel	Kapolei	2009	125,000	25.00%	31,250
Kapolei Commons Phase II	Kapolei	2010	242,000	50.00%	121,000
UH West Commercial 2005-2010	Kapolei	2010	300,000	25.00%	75,000
DHHL Regional Mall Phase II	Kapolei	2010	250,000	25.00%	62,500
DHHL Regional Mall Phase III	Kapolei	2012	250,000	25.00%	62,500
Kapolei City 2006-2010	Kapolei	2010	100,000	25.00%	25,000
UH West Commercial 2011-2015	Kapolei	2015	300,000	25.00%	75,000
Kapolei City 2011-2015	Kapolei	2015	80,000	25.00%	20,000
UH West Commercial 2016-2020	Kapolei	2020	300,000	25.00%	75,000
Kapolei City 2015-2020	Kapolei	2020	80,000	25.00%	20,000
UH West Commercial 2021-2025	Kapolei	2025	200,000	25.00%	50,000
Kapolei City 2021-2025	Kapolei	2025	50,000	25.00%	12,500
Totals			2,751,000		1,581,250

SOURCE: COLLIERS HAWAII CONSULTING

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SECONDARY TRADE AREA RETAIL INVENTORY AND PLANNED PROJECTS

Secondary Trade Area Shopping Center	Address	City	Trade Area	Year Built	Retail RBA
Ewa Beach Shopping Center	91-919 Fort Weaver Road	Ewa Beach	Secondary Trade Area	1960	77,159
Ewa Towne Center	91-1401 Fort Weaver Road	Ewa Beach	Secondary Trade Area	1999	79,659
Ewa Beach Marketplace	91-831 Fort Weaver Road	Ewa Beach	Secondary Trade Area	2004	16,639
Pearl Highland Center	1000 Kamahemaha Highway	Pearl City	Secondary Trade Area	1993	410,325
Times Square Shopping Center	98-1245 Kaahumanu Street	Pearl City	Secondary Trade Area	1979	64,712
Pearl City Plaza	97-719 Kamehameha Highway	Pearl City	Secondary Trade Area	1980	38,293
Pearl City Shopping Center	850 Kamehameha Hihgway	Pearl City	Secondary Trade Area	1967	252,000
Makaha Marketplace/Cornet Village	84-1170 Farrington Highway	Waianae	Secondary Trade Area	1964	90,000
Waianae Store	85-863 Farrington Highway	Waianae	Secondary Trade Area	1966	40,000
Tamura Store	86-032 Farrington Highway	Waianae	Secondary Trade Area	1972	35,122
Pacific Shopping Mall	87-2070 Farrington Highway	Waianae	Secondary Trade Area	1975	76,085
Waianae Mall	86-120 Farrington Highway	Waianae	Secondary Trade Area	1975	208,000
Waipahu Shopping Plaza	94-300 Farrington Highway	Waipahu	Secondary Trade Area	1962	109,744
Westgate Center	94-366 Pupupani Street	Waipahu	Secondary Trade Area	1965	42,616
Times Supermarket	94-766 Farrington Highway	Waipahu	Secondary Trade Area	1965	29,098
Waipahu Square	94-210 Leokane Street	Waipahu	Secondary Trade Area	1966	12,661
Waipahu Shopping Village	94-226 Leoku Street	Waipahu	Secondary Trade Area	1969	20,164
Tropicana Square Shopping Center	94-866 Moloalo Street	Waipahu	Secondary Trade Area	1978	25,427
Gentry Waipio Shopping Center	94-1040 Waipio Uka Boulevard	Waipahu	Secondary Trade Area	1985	133,537
City Mill	94-157 Leoleo Street	Waipahu	Secondary Trade Area	1985	42,250
Waipahu Town Center	94-050 Farrington Highway	Waipahu	Secondary Trade Area	1988	137,556
Lee Towne Center	94-216 Farrington Highway	Waipahu	Secondary Trade Area	1993	58,360
Waikele Center (Outlet)	94-790 Lumiaina Street	Waipahu	Secondary Trade Area	1993	215,974
Waikele Center (Value)	94-795 Lumiaina Street	Waipahu	Secondary Trade Area	1993	560,328
Times Royal Kunia Center	94-615 Kukuohi Street	Waipahu	Secondary Trade Area	1994	65,000
Wal-Mart Kunia	94-595 Kupuohi Street	Waipahu	Secondary Trade Area	1995	137,000
Daiei	94-144 Farrington Highway	Waipahu	Secondary Trade Area	1996	156,916
Costco (Waipio)	94-1331 Ka Uka Boulevard	Waipahu	Secondary Trade Area	2000	153,376
Kunia Shopping Center	Kunia Road	Waipahu	Secondary Trade Area	2005	66,000
Secondary Trade Area Totals					**3,354,001**
Combined Trade Area Totals					**3,811,408**

SECONDARY TRADE AREA Projected New Retail Projects	Location	Projected Project Completion	Estimated RBA	Probability of Completion	
Best Buy Store	Pearl City	2005	40,000	100.00%	40,000
West Loch, Phase II	Ewa Beach	2006	30,000	75.00%	22,500
Ewa Villages	Ewa Beach	2006	25,000	75.00%	18,750
Ewa Marina Village	Ewa Beach	2006	112,000	75.00%	84,000
Laulani Shopping Center	Ewa Beach	2007	138,000	75.00%	103,500
Manana Retail Lands	Pearl City	2008	150,000	50.00%	75,000
Waiawa Retail Development	Pearl City	2009	500,000	25.00%	125,000
Oceanpointe	Ewa Beach	2015	500,000	25.00%	125,000
Totals			**167,000**		**593,750**
Combined Trade Area Totals			**167,000**		**2,175,000**

TERTIARY TRADE AREA RETAIL INVENTORY AND PLANNED PROJECTS

Tertiary Trade Area

Property Name:	Property Address:	Address2	Trade Area:	Retail Area (Leasable):	Year Built:
Aiea Commercial Center	99-185 Aiea Heights Drive	Aiea	Tertiary Trade Area	1963	32,695
Waimalu Shopping Center	98-020 Kamehameha Highway	Aiea	Tertiary Trade Area	1965	20,000
Aiea Town Square	99-115 Aiea Heights Drive	Aiea	Tertiary Trade Area	1967	105,233
Pearlridge Center	98-1005 Moanalua Road	Aiea	Tertiary Trade Area	1972	1,250,000
Waimalu Shopping Plaza	98-1277 Kaahumanu Street	Aiea	Tertiary Trade Area	1975	142,000
Westridge Shopping Center	98-150 Kaonohi Street	Aiea	Tertiary Trade Area	1984	61,202
Pearl Kai Shopping Center	98-199 Kamehameha Highway	Aiea	Tertiary Trade Area	1989	76,747
Toys R Us	98-1101 Moanalua Road	Aiea	Tertiary Trade Area	1990	40,000
Aiea Shopping Plaza	99-800 Kaunale Street	Aiea	Tertiary Trade Area	1992	45,818
Mililani Shopping Center	95-2221 Kipapa Drive	Mililani	Tertiary Trade Area	1970	179,781
Mililani Marketplace	94-780 Meheula Parkway	Mililani	Tertiary Trade Area	1984	81,321
Town Center of Mililani	95-1249 Meheula Parkway	Mililani	Tertiary Trade Area	1994	433,662
Wahiawa Shopping Center	823 California Avenue	Wahiawa	Tertiary Trade Area	1959	66,450
Wahiawa Town Center	909 California Avenue	Wahiawa	Tertiary Trade Area	1990	61,250
					2,596,159

TERTIARY TRADE AREA Projected New Retail Projects	Location	Aiea	Tertiary Trade Area	Probability of Completion	
Mililani Mauka	Mililani	2007	75,000	80.00%	60,000
Totals			**75,000**		**60,000**
Combined Trade Area Totals			**75,000**		

CENSUS POPULATION MODEL - RETAIL SQUARE FOOTAGE ESTIMATE

CENSUS POPULATION MODEL

POPULATION ESTIMATE

MARKET	POPULATION 2004	GROWTH RATE	%	2005	2006-2010	2011-2015	2016-2020	2021-2025
PRIMARY	38,991	Conservative	1.00%	39,381	41,390	43,501	45,720	48,052
		Moderate	2.50%	39,966	45,218	51,160	57,882	65,489
		Aggressive	4.00%	40,551	49,336	60,025	73,029	88,851
SECONDARY	176,563	Conservative	1.50%	179,211	193,062	207,982	224,056	241,372
		Moderate	1.75%	179,653	195,932	213,687	233,051	254,169
		Aggressive	2.10%	180,271	200,011	221,913	246,213	273,175
TERTIARY	128,405	Conservative	1.00%	129,689	136,304	143,257	150,565	158,245
		Moderate	1.50%	130,331	140,403	151,254	162,944	175,537
		Aggressive	2.00%	130,973	144,605	159,655	176,272	194,619

RETAIL MARKET POTENTIAL

		2005	2006-2010	2011-2015	2016-2020	2021-2025
RETAIL SQUARE FOOTAGE PER RESIDENT		20.78	21.30	21.83	22.38	22.94
PRIMARY	Conservative	818,295	881,536	949,665	1,023,059	1,102,125
	Moderate	830,448	963,064	1,116,857	1,295,211	1,502,045
	Aggressive	842,601	1,050,780	1,310,394	1,634,150	2,037,896
SECONDARY	Conservative	3,723,830	4,111,909	4,540,430	5,013,610	5,536,102
	Moderate	3,733,002	4,173,051	4,664,973	5,214,883	5,829,617
	Aggressive	3,745,843	4,259,922	4,844,553	5,509,418	6,265,530
TERTIARY	Conservative	2,694,803	2,903,068	3,127,429	3,369,129	3,629,509
	Moderate	2,708,144	2,990,372	3,302,013	3,646,132	4,026,113
	Aggressive	2,721,484	3,079,854	3,485,413	3,944,377	4,463,779

INVENTORY ESTIMATE

		2005	2006-2010	2011-2015	2016-2020	2021-2025
PRIMARY	EXISTING AND NEW INVENTORY	506,407	1,723,657	1,881,157	1,976,157	2,038,657
	Conservative	311,888	(842,121)	(931,492)	(953,098)	(936,532)
	Moderate	324,041	(760,593)	(764,300)	(680,946)	(536,612)
	Aggressive	336,194	(672,877)	(570,763)	(342,007)	(761)
SECONDARY	EXISTING AND NEW INVENTORY	3,394,001	3,822,751	3,947,751	3,947,751	3,947,751
	Conservative	329,829	289,158	592,679	1,065,859	1,588,351
	Moderate	339,001	350,300	717,222	1,267,132	1,881,866
	Aggressive	351,842	437,171	896,802	1,561,667	2,317,779
TERTIARY	EXISTING AND NEW INVENTORY	2,596,159	2,671,159	2,671,159	2,671,159	2,671,159
	Conservative	98,644	(919,683)	456,270	697,970	958,350
	Moderate	111,985	(832,379)	630,854	974,973	1,354,954
	Aggressive	125,325	(742,897)	814,254	1,273,218	1,792,620

CAPTURE RATE

	CAPTURE RATE		2005	2006-2010	2011-2015	2016-2020	2021-2025
PRIMARY	85.00%	Conservative	265,105	(715,803)	(791,768)	(810,134)	(796,052)
		Moderate	275,435	(646,504)	(649,655)	(578,804)	(456,120)
		Aggressive	285,765	(571,945)	(485,148)	(290,706)	(647)
SECONDARY	15.00%	Conservative	49,474	43,374	88,902	159,879	238,253
		Moderate	50,850	52,545	107,583	190,070	282,280
		Aggressive	52,776	65,576	134,520	234,250	347,667
TERTIARY	5.00%	Conservative	4,932	(45,984)	22,814	34,899	47,918
		Moderate	5,599	(41,619)	31,543	48,749	67,748
		Aggressive	6,266	(37,145)	40,713	63,661	89,631

RETAIL MARKET POTENTIAL - CENSUS MODEL

	2005	2006-2010	2011-2015	2016-2020	2021-2025
Conservative	319,511	(718,413)	(680,053)	(615,356)	(509,882)
Moderate	331,884	(635,578)	(510,529)	(339,986)	(106,092)
Aggressive	344,807	(543,514)	(309,915)	7,205	436,651

Source: Census, Colliers Hawaii Consulting

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PLANNED AND PROPOSED RESIDENTIAL DEVELOPMENTS

PRIMARY AND SECONDARY TRADE AREA RESIDENTIAL DEVELOPMENTS

Name of Development	Developer or Owner	Trade Area	2004-2005	2006-2010	2011-2015	2016-2020	2021-2025	Total
Makaiwa Hills I & II	Aina Nui Corporation	primary	0	500	1,250	1,250	66	3,066
Kapolei West	Aina Nui Corporation	primary	0	2,370	0	0	0	2,370
City of Kapolei	Campbell Estate	primary	0	300	700	0	0	1,000
Palehua East B	Castle & Cooke	primary	60	210	0	0	0	270
Makakilo Build-out 2/3	Finance Realty	primary	200	50	0	0	0	250
Palehua East C&D	Finance Realty	primary	0	80	400	220	0	700
UH West Oahu	State of Hawaii (DLNR)	primary	0	500	1,250	1,250	1,000	4,000
Villages of Kapolei	State of Hawaii (HCDCH/DHHL)	primary	0	327	0	0	0	327
Unnamed	State of Hawaii (DHHL)	primary	0	500	0	0	0	500
Unnamed	State of Hawaii (DHHL)	primary	0	0	240	0	0	240
Ewa by Gentry	Gentry Homes	secondary	600	700	0	0	0	1,300
Gentry Ewa Makai	Gentry Homes	secondary	0	800	1,065	0	0	1,865
Ocean Pointe	HASEKO(Ewa) Inc.	secondary	500	1,250	1,250	650	0	3,650
Mehana	Schuler Homes	secondary	0	450	698	0	0	1,148
Ewa Villages	City & County of Honolulu	secondary	100	567	0	0	0	667
	TOTALS		**1,460**	**8,604**	**6,853**	**3,370**	**1,066**	**21,353**

NON-RESIDENT/SECOND HOME DEVELOPMENTS			2004-2005	2006-2010	2011-2015	2016-2020	2021-2025	Total
Ko Olina Resort & Marina	Ko Olina Development LLC	primary	100	600	185	0	0	885
Ko Olina Timeshare		primary	210	175	175	0	0	560
Ko Olina SFH		primary	40	12	12	480		544
			350	**787**	**372**	**480**	**0**	**1,989**

HOTEL DEVELOPMENTS								
Oceanpoint Hotel		secondary	0	0	950	0	0	950
Ko Olina Hotel		primary	387	250	0	0	0	637
		annual totals	**387**	**250**	**950**	**0**	**0**	**1587**
TOTAL HOTEL ROOMS			**387**	**637**	**1587**	**1587**	**1587**	**1587**

Source: DPP, Makiko Feasibility Report,Bruce Plasch

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PLANNED AND PROPOSED RESIDENTIAL DEVELOPMENT MODEL

RESIDENTIAL AND RESORT DEVELOPMENT MODEL

PRIMARY TRADE AREA	BASE YEAR	2004-2005	2006-2010	2011-2015	2016-2020	2021-2025
POPULATION ESTIMATES	38,991	39,872	84,614	118,873	132,501	136,115
RETAIL SF DEMAND PER RESIDENT		20.78	21.30	21.83	22.38	22.94
RETAIL SF DEMAND PROJECTIONS		828,508	1,802,137	2,595,099	2,964,917	3,121,921
RETAIL PROJECTS UNDER WAY/BUILT		506,407	1,723,657	1,881,157	1,976,157	2,038,657
OVERAGE OR SHORTAGE OF RETAIL		322,101	78,480	713,942	988,760	1,083,264

SECONDARY TRADE AREA	BASE YEAR	2004-2005	2006-2010	2011-2015	2016-2020	2021-2025
POPULATION ESTIMATES	176,563	180,955	194,742	205,770	208,149	223,760
RETAIL SF DEMAND PER RESIDENT		20.78	21.30	21.83	22.38	22.94
RETAIL SF DEMAND PROJECTIONS		3,760,060	4,147,703	4,492,132	4,657,663	5,132,157
RETAIL PROJECTS UNDER WAY/BUILT		3,394,001	3,822,751	3,822,751	3,822,751	3,822,751
OVERAGE OR SHORTAGE OF RETAIL		366,059	324,952	669,381	834,912	1,309,406

TERTIARY TRADE AREA	BASE YEAR	2004-2005	2006-2010	2011-2015	2016-2020	2021-2025
POPULATION ESTIMATES	128,405	128,405	135,341	142,134	149,951	158,199
RETAIL SF DEMAND PER RESIDENT		20.78	21.30	21.83	22.38	22.94
RETAIL SF DEMAND PROJECTIONS		2,668,122	2,882,545	3,102,904	3,355,399	3,628,440
RETAIL PROJECTS UNDER WAY/BUILT		2,596,159	2,656,159	2,656,159	2,656,159	2,656,159
OVERAGE OR SHORTAGE OF RETAIL		71,963	226,386	446,745	699,240	972,281

CAPTURE RATE ANALYSIS	CAPTURE RATE	2004-2005	2006-2010	2011-2015	2016-2020	2021-2025
PRIMARY TRADE AREA						
CAPTURE RATE 85%	85.00%	273,786	66,708	606,851	840,446	920,774
SECONDARY TRADE AREA						
CAPTURE RATE 15%	15.00%	54,909	48,743	100,407	125,237	196,411
TERTIARY TRADE AREA						
CAPTURE RATE 5%	5.00%	3,598	11,319	22,337	34,962	48,614
TOTAL RESIDENT RETAIL SF DEMAND		**332,293**	**126,770**	**729,595**	**1,000,645**	**1,165,799**

TOTAL RESORT AND TIMESHARE SF DEMAND		2004-2005	2006-2010	2011-2015	2016-2020	2021-2025
HOTEL						
POPULATION ESTIMATES		387	637	1587	1587	1587
HOTEL AT 75% OCCUPIED 2.1 PER ROOM		609.525	1003.275	2499.525	2499.525	2499.525
ANNUAL CONSUMER EXPENDITURE AT $130 PER DAY		28,921,961	47,605,399	118,602,461	118,602,461	118,602,461
RETAIL SF PER CONSUMER EXPENDITURE ($400)		72,305	119,013	296,506	296,506	296,506
TIMESHARE						
POPULATION ESTIMATES		210	385	560	560	560
TIMESHARE AT 90% OCCUPIED AT 3.0 PER UNIT		567	1,040	1,512	1,512	1,512
ANNUAL CONSUMER EXPENDITURE AT $110 PER DAY		22,765,050	41,735,925	60,706,800	60,706,800	60,706,800
RETAIL SF PER CONSUMER EXPENDITURE ($400)		56,913	104,340	151,767	151,767	151,767
TOTAL RESORT RETAIL SF DEMAND	**85%**	**109,835**	**189,850**	**381,032**	**381,032**	**381,032**
TOTAL RESIDENT AND RESORT RETAIL SF DEMAND		**442,127**	**316,620**	**1,110,627**	**1,381,677**	**1,546,832**

Source: DPP, Makiko Feasibility Report,Bruce Plasch

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CENSUS CONSUMER EXPENDITURE MODEL - RESIDENT RETAIL SQ.FT. ESTIMATE

CENSUS CONSUMER EXPENDITURE MODEL

MARKET	RETAIL SALES GROWTH RATE	ESTIMATE	BASE YEAR	2005	2006-2010	2011-2015	2016-2020	2021-2025
PRIMARY	4.00%	Conservative	$229,342,745	$238,516,455	$290,191,737	$353,062,620	$429,554,661	$522,618,925
	5.00%	Moderate	$229,342,745	$240,809,883	$307,341,213	$392,253,924	$500,626,451	$638,940,309
	6.00%	Aggressive	$229,342,745	$243,103,310	$325,327,068	$435,361,003	$582,611,230	$779,665,249
SECONDARY	2.00%	Conservative	$1,197,578,911	$1,221,530,490	$1,348,668,364	$1,489,038,851	$1,644,019,210	$1,815,130,050
	3.00%	Moderate	$1,197,578,911	$1,233,506,279	$1,429,971,850	$1,657,729,292	$1,921,762,591	$2,227,849,548
	4.00%	Aggressive	$1,197,578,911	$1,245,482,068	$1,515,319,373	$1,843,617,713	$2,243,042,841	$2,729,004,583
TERTIARY	1.50%	Conservative	$1,983,000,188	$2,012,745,190	$2,168,298,198	$2,335,872,964	$2,516,398,579	$2,710,875,937
	2.00%	Moderate	$1,983,000,188	$2,022,660,191	$2,233,180,289	$2,465,611,487	$2,722,234,311	$3,005,566,644
	3.00%	Aggressive	$1,983,000,188	$2,042,490,193	$2,367,805,928	$2,744,936,025	$3,182,133,170	$3,688,964,485

RETAIL SQUARE FOOTAGE POTENTIAL

	RETAIL SALES PER SQ. FT.	ESTIMATE	BASE YEAR	2005	2006-2010	2011-2015	2016-2020	2021-2025
PRIMARY	$331	Conservative	692,878	720,594	876,712	1,066,654	1,297,748	1,578,909
	$331	Moderate	692,878	727,522	928,523	1,185,057	1,512,467	1,930,333
	$331	Aggressive	692,878	734,451	982,861	1,315,290	1,760,155	2,355,484
SECONDARY	$331	Conservative	3,618,063	3,690,424	4,074,527	4,498,607	4,966,825	5,483,777
	$331	Moderate	3,618,063	3,726,605	4,320,157	5,008,246	5,805,929	6,730,663
	$331	Aggressive	3,618,063	3,762,786	4,578,004	5,569,842	6,776,564	8,244,727
TERTIARY	$331	Conservative	5,990,937	6,080,801	6,550,750	7,057,018	7,602,413	8,189,958
	$331	Moderate	5,990,937	6,110,756	6,746,768	7,448,977	8,224,273	9,080,262
	$331	Aggressive	5,990,937	6,170,665	7,153,492	8,292,858	9,613,695	11,144,908

CAPTURE RATE ANALYSIS

	CAPTURE RATE		BASE YEAR	2005	2006-2010	2011-2015	2016-2020	2021-2025
PRIMARY	85.00%	Conservative	588,947	612,504	745,205	906,656	1,103,086	1,342,073
		Moderate	588,947	618,394	789,245	1,007,299	1,285,597	1,640,783
		Aggressive	588,947	624,283	835,432	1,117,997	1,496,132	2,002,162
SECONDARY	15.00%	Conservative	542,709	553,564	611,179	674,791	745,024	822,566
		Moderate	542,709	558,991	648,023	751,237	870,889	1,009,599
		Aggressive	542,709	564,418	686,701	835,476	1,016,485	1,236,709
TERTIARY	5.00%	Conservative	299,547	304,040	327,537	352,851	380,121	409,498
		Moderate	299,547	305,538	337,338	372,449	411,214	454,013
		Aggressive	299,547	308,533	357,675	414,643	480,685	557,245

RESIDENT RETAIL ESTIMATE OF SQUARE FOOTAGE
(CAPTURE RATE FIGURES LESS CURRENT AND PLANNED INVENTORY)

	2005	2006-2010	2011-2015	2016-2020	2021-2025
Conservative	(353,684)	(383,370)	(69,494)	349,438	727,845
Moderate	(340,870)	(292,685)	127,192	688,907	1,258,104
Aggressive	(326,558)	(187,485)	364,324	1,114,509	1,949,824

Source: Census, Colliers Hawaii Consulting

8/1/2005

CLARITAS CONSUMER EXPENDITURE MODEL - RETAIL SQUARE FOOTAGE ESTIMATES

CLARITAS CONSUMER EXPENDITURE MODEL								
MARKET	RETAIL SALES GROWTH RATE	ESTIMATE	BASE YEAR	2005	2006-2010	2011-2015	2016-2020	2021-2025
PRIMARY	4.00%	Conservative	$704,433,000	$732,610,320	$891,332,472	$1,084,442,239	$1,372,165,390	$1,605,239,427
	5.00%	Moderate	$704,433,000	$739,654,650	$944,007,592	$1,204,819,485	$1,537,688,895	$1,962,523,985
	6.00%	Aggressive	$704,433,000	$746,698,980	$999,251,674	$1,337,224,148	$1,789,507,558	$2,394,764,786
SECONDARY	2.00%	Conservative	$1,396,565,000	$1,424,496,300	$1,572,759,019	$1,736,453,041	$1,917,184,468	$2,116,726,568
	3.00%	Moderate	$1,396,565,000	$1,438,461,950	$1,667,571,646	$1,933,172,576	$2,241,076,848	$2,598,022,289
	4.00%	Aggressive	$1,396,565,000	$1,452,427,600	$1,767,100,255	$2,149,947,654	$2,615,740,053	$3,182,447,728
TERTIARY	1.50%	Conservative	$1,533,362,000	$1,556,362,430	$1,676,644,350	$1,806,222,139	$1,945,814,217	$2,096,194,531
	2.00%	Moderate	$1,533,362,000	$1,564,029,240	$1,726,814,660	$1,906,542,916	$2,147,076,983	$2,324,065,176
	3.00%	Aggressive	$1,533,362,000	$1,579,362,860	$1,830,914,418	$2,122,531,616	$2,460,595,875	$2,852,505,005
RETAIL SQUARE FOOTAGE POTENTIAL								
	RETAIL SALES PER SQ. FT.	ESTIMATE	BASE YEAR	2005	2006-2010	2011-2015	2016-2020	2021-2025
PRIMARY	$331	Conservative	2,128,196	2,213,324	2,692,847	3,276,261	4,145,515	4,849,666
	$331	Moderate	2,128,196	2,234,606	2,851,987	3,639,938	4,645,586	5,929,075
	$331	Aggressive	2,128,196	2,255,888	3,018,887	4,039,952	5,406,367	7,234,939
SECONDARY	$331	Conservative	4,219,230	4,303,614	4,751,538	5,246,082	5,792,098	6,394,944
	$331	Moderate	4,219,230	4,345,806	5,037,981	5,840,401	6,770,625	7,849,010
	$331	Aggressive	4,219,230	4,387,999	5,338,671	6,495,310	7,902,538	9,614,646
TERTIARY	$331	Conservative	4,632,514	4,702,001	5,065,391	5,456,864	5,878,593	6,332,914
	$331	Moderate	4,632,514	4,725,164	5,216,963	5,759,948	6,486,637	7,021,345
	$331	Aggressive	4,632,514	4,771,489	5,531,463	6,412,482	7,433,824	8,617,840
CAPTURE RATE ANALYSIS								
	CAPTURE RATE		BASE YEAR	2005	2006-2010	2011-2015	2016-2020	2021-2025
PRIMARY	85.00%	Conservative	1,808,967	1,881,326	2,288,920	2,784,821	3,523,688	4,122,216
		Moderate	1,808,967	1,899,415	2,424,189	3,093,947	3,948,748	5,039,714
		Aggressive	1,808,967	1,917,505	2,566,054	3,433,959	4,595,412	6,149,698
SECONDARY	15.00%	Conservative	632,884	645,542	712,731	786,912	868,815	959,242
		Moderate	632,884	651,871	755,697	876,060	1,015,594	1,177,351
		Aggressive	632,884	658,200	800,801	974,297	1,185,381	1,442,197
TERTIARY	5.00%	Conservative	231,626	235,100	253,270	272,843	293,930	316,646
		Moderate	231,626	236,258	260,848	287,997	324,332	351,067
		Aggressive	231,626	238,574	276,573	320,624	371,691	430,892
RESIDENT RETAIL ESTIMATE OF SQUARE FOOTAGE								
(CAPTURE RATE FIGURES LESS CURRENT AND PROJECTED INVENTORY)				2005	2006-2010	2011-2015	2016-2020	2021-2025
		Conservative		938,176	(289,872)	17,285	148,508	1,413,311
		Moderate		963,752	(104,058)	430,713	617,452	2,583,341
		Aggressive		990,487	98,636	901,588	1,156,216	4,037,995

Source: Claritas, Colliers Hawaii Consulting

8/1/2005

NON-RESIDENT CONSUMER EXPENDITURE PROJECTIONS 2005-2025

RESORT-NON-RESIDENT CONSUMER EXPENDITURE PROJECTIONS	2006-2015	2016-2025	2006-2025
HOTEL ROOMS	1,200	300	1,500
OCCUPIED AT 75%	900	225	1,125
NUMBER OF VISITORS 2.1 PER ROOM	1,890	473	2,363
CONSUMPTION EXPENDITURES @ $130 PER DAY	$89,680,500	$22,420,125	$112,100,625
TIMESHARE UNITS	350	400	750
OCCUPIED 90%	315	360	675
NUMBER OF VISITORS PER UNIT 3.0	945	1,080	2,025
CONSUMPTION EXPENDITURES @ $110 PER DAY	$37,941,750	$43,362,000	$81,303,750
TOTAL CONSUMPTION EXPENDITURES (RESORT)	$127,622,250	$65,782,125	$193,404,375

Source: Bluce Plasch

Source: Bruce Plasch

8/1/2005

RETAIL MARKET ASSESSMENT - RESIDENT AND NON-RESIDENT MARKET TOTALS

RESIDENT MARKET

CENSUS POPULATION MODEL	ANNUAL GROWTH %	2005	2006-2010	2011-2015	2016-2020	2021-2025
CONSERVATIVE	1.0% TO 1.5%	319,511	(660,834)	(527,428)	(381,981)	(223,382)
MODERATE	1.5% TO 2.5%	331,884	(577,999)	(357,904)	(106,611)	180,408
AGGRESSIVE	2.0% TO 4.0%	344,807	(485,935)	(157,290)	240,580	723,151

RESIDENTIAL PLANNED DEVELOPMENT MODEL		2005	2006-2010	2011-2015	2016-2020	2021-2025
RESIDENTIAL SF DEMAND TOTALS		**332,293**	**126,770**	**729,595**	**1,000,645**	**1,165,799**

CENSUS CONSUMER EXPENDITURE MODEL	ANNUAL GROWTH %	2005	2006-2010	2011-2015	2016-2020	2021-2025
CONSERVATIVE	1.5% TO 3%	(353,684)	(383,370)	(69,494)	349,438	727,845
MODERATE	2% TO 4%	(340,870)	(292,685)	127,192	688,907	1,258,104
AGGRESSIVE	3% TO 6%	(326,558)	(187,485)	364,324	1,114,509	1,949,824

CLARITAS CONSUMER EXPENDITURE MODEL	ANNUAL GROWTH %	2005	2006-2010	2011-2015	2016-2020	2021-2025
CONSERVATIVE	1.5% TO 3%	938,176	(289,872)	17,285	628,613	1,413,311
MODERATE	2% TO 4%	963,752	(104,058)	430,713	1,360,022	2,583,341
AGGRESSIVE	4% TO 6%	990,487	98,636	901,588	2,230,192	4,037,995

RESORT MARKET

RESORT MARKET CONSUMER EXPENDITURE MODEL	CAPTURE RATE	2005	2006-2010	2011-2015	2016-2020	2021-2025
HOTEL MARKET	85.00%	61,459	101,161	252,030	252,030	252,030
TIMESHARE MARKET	85.00%	48,376	88,689	129,002	129,002	129,002
RESORT SF DEMAND TOTALS		109,835	189,850	381,032	381,032	381,032

RESIDENT AND RESORT RETAIL MARKET ESTIMATES

RESIDENTIAL AND RESORT SF DEMAND TOTALS	2005	2006-2010	2011-2015	2016-2020	2021-2025
CENSUS POPULATION (MODERATE ESTIMATE)	441,719	(388,148)	23,129	274,421	561,440
CENSUS CONSUMER EXPENDITURE (MODERATE)	(231,035)	(102,835)	508,224	1,069,940	1,639,136
RESIDENTIAL DEVELOPMENT	442,127	316,620	1,110,627	1,381,677	1,546,832
CLARITAS CONSUMER EXPENDITURE (MODERATE ESTIMATE)	1,073,587	85,792	811,745	1,741,054	2,964,373

OFFICE MARKET

OFFICE DEMAND MODEL (154 SF PER OFFICE WORKER)	ANNUAL JOB GROWTH	2005	2006-2010	2011-2015	2016-2020	2021-2025
CONSERVATIVE	1.25%	13,704	(66,307)	9,385	89,927	175,630
MODERATE	1.75%	19,186	(30,874)	79,369	199,603	330,732
AGGRESSIVE	2.25%	24,667	5,439	152,879	317,669	501,850

HOSPITAL MARKET

HOSPITAL DEMAND MODEL (BY FULL TIME PHYSICIANS)	# OF PHYSICIANS	POPULATION	AREA MARKET RATIO	US WEST RATIO	% DIFF
PRIMARY TRADE AREA	26	38,991	0.067%	0.133%	0.066%
SECONDARY TRADE AREA	181	176,562	0.103%	0.133%	0.030%
TOTALS	207	215,554	0.096%	0.133%	0.037%

For the Total Secondary Trade Area, there is a shortage of roughly 37 FTE Physicians

Source: Colliers Hawaii Consulting, Census, Claritas, Bruce Plasche 8/1/2005

Retail Shopping Center Competition

A. Primary Competition and Secondary Trade Area Shopping Center Competition

(1) Project Descriptions
(2) Site Plans

B. Smart Growth Trends Article

PEARLRIDGE CENTER

Address: 98-1005 Moanalua Road
City: Aiea **State:** HI **Zip:** 96701
Tax Map Key: 1-9-8-16-51
Land Size: 56 acres
GLA: 1,250,000 sf
Date Built: 1972
Shopping Center Type: Regional
Asking Rental Rate Range:
$2.00 - $12.00
CAM: $1.20

Retail Square Footage by Retailer Type

Product Type	Estimated Square Footage
Apparel	525,000
Auto	0
Children	75,000
Computer/Electronics	82,000
Shoes	27,000
Grocery	0
Discount Merchandise	123,000
Drugs	27,000
Fast Food	30,000
Restaurants	40,000
Specialty	56,000
Services	70,000

Primary Tenant List
Anchor Tenants
Macy's Circuit City
GAP Integrated Renal Care
Longs Drug Sears
Ross Dress for Less Pearlridge West Theaters

Pad Sites Tenants
Monterey Bay Canners Sizzler Restaurant
Anna Millers & Bravo Inspiration Furniture
Chilis Toys R Us American Savings Bank

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WAIKELE PREMIUM OUTLETS

Address: 94-790 Lumiaina Street
City: Waipahu **State:** HI **Zip:** 96797
Tax Map Key: 1-9-4-7-56
Land Size: 42 acres
GLA: 214,000 sf
Date Built: 1988
Shopping Center Type: Power Center
Asking Rental Rate Range: $3.00 - $6.00
CAM: $0.60

Retail Square Footage by Retailer Type

Product Type	Estimated Sq. Ft.
Apparel	157,047
Children	9,900
Shoes	17,336
Fast Food	700
Specialty	4,591

Primary Tenant List
Anchor Tenants
Saks Fifth Avenue
Ralph Lauren
Levi's Outlet
Factory Brand Shoes

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WAIKELE VALUE OUTLETS

Address: 94-795 Lumiaina Street
City: Waipahu **State:** HI **Zip:** 96797
Tax Map Key: 1-9-4-7-50,54
Land Size: 32 acres
GLA: 521,539 sf
Date Built: 1988
Shopping Center Type: Power Center
Asking Rental Rate Range:
$2.00-$3.25
CAM: $0.67

Primary Tenant List
Anchor Tenants
Lowe's Sports Authority
Old Navy Borders Books
Kmart

Retail Square Footage by Retailer Type

Product Type	**Estimated Sq. Ft.**
Apparel	24,755
Discount Merchandise	120,000
Fast Food	19,900
Restaurants	8,500
Specialty	88,000
Services	6,500

PEARL HIGHLANDS CENTER

Address: 1000 Kamehameha Hwy
City: Pearl City **State:** HI **Zip:** 96782
Tax Map Key: 1-9-7-24-34
Land Size: 13.46 acres
GLA: 410,325
Date Built: 1993
Shopping Center Type: Power Center
Asking Rental Rate Range:
$2.00 - $3.50
CAM: $0.59

Primary Tenant List
Anchor Tenants
Sams Club Comp USA
Signature Theaters Ross Dress for Less
Pier One

Retail Square Footage by Retailer Type

Product Type	**Estimated Sq. Ft.**
Apparel	37,936
Shoes	4,275
Discount Merchandise	176,997
Computers/Electronics	44,174
Entertainment	47,699
Fast Food	8,010
Specialty	29,234
Services	12,634

EWA TOWNE CENTER

Address: 91-1401 Fort Weaver Road
City: Ewa Beach **State**: HI **Zip**:96706
Tax Map Key: 1-9-1-61-60
Land Size: 290,738 sf
GLA: 79,659 sf
Date Built: 1999
Shopping Center Type: Neighborhood

Asking Rental Rate Range: $2.00- $2.25
CAM: $0.37

Retail Square Footage by Retailer Type

Product Type	Estimated Sq.Ft.
Jewelry	1,459
Grocery	25,000
Drugs	25,000
Fast Food	9,000
Restaurants	3,500
Specialty	1,000
Services	10,700

Primary Tenant List
Anchor Tenants
Foodland
Longs Drug

Pad Sites Tenants
Blockbuster Moshi Moshi Tei
Starbucks

EWA BEACH SHOPPING CENTER

Address: 91-919 Fort Weaver Road
City: Ewa Beach **State:** HI **Zip:** 96706
Tax Map Key: 1-9-1-61-60
Land Size: 6.4 acres
GLA: 77,159 sf
Date Built: 1960
Shopping Center Type: Neighborhood
Asking Rental Rate Range:
$1.75-$2.25
CAM: $0.42

Retail Square Footage by Retailer Type

Product Type	Estimated Sq. Ft.
Apparel	506
Auto	33,330
Grocery	13,899
Fast Food	9,580
Services	8,568

PrimaryTenant List
Anchor Tenants
Star Supermarket
Goodyear

Pad Sites Tenants
McDonalds
Chevron

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KAPOLEI SHOPPING CENTER

Address: 91-590 Farrington Hwy
City: Kapolei **State:** HI **Zip:** 96707
Tax Map Key: 1-9-1-106-10
Land Size: 18.35 acres
GLA: 134,400 sf
Date Built: 1993
Shopping Center Type: Neighborhood

Asking Rental Rate Range: $3.00
CAM: $0.69

Primary Tenant List
Anchor Tenants
Safeway
Longs Drug

Pad Sites Tenants
Tesoro Pizza Hut
Taco Bell KFC
McDonalds Chilis

Retail Square Footage by Retailer Type

Product Type	Estimated Sq. Ft.
Apparel	1,207
Auto	10,159
Children	955
Shoes	3,057
Grocery	46,012
Drugs	26,979
Fast Food	17,329
Restaurants	5,500
Specialty	3,208
Services	8,038

MARKETPLACE AT KAPOLEI

Address: 590 Farrington Highway
City: Kapolei **State:** HI **Zip:** 96707
Tax Map Key: 1-9-1-105-16
Land Size:
GLA: 64,104
Date Built: 2003
Shopping Center Type: Strip
Asking Rental Rate Range:
$2.35 - $2.50
CAM:
$0.83

Primary Tenant List
Anchor Tenants
Blockbuster
Fun Factory

Retail Square Footage by Retailer Type

Product Type	Estimated Sq. Ft.
Apparel	1,174
Auto	1,200
Children	3,965
Fast Food	14,117
Restaurants	6,500
Specialty	4,574
Services	20,779

WAIPAHU TOWN CENTER

Address: 94-050 Farrington Hwy
City: Waipahu **State:** HI **Zip:** 96797
Tax Map Key: 1-9-4-47-29,35,36
Land Size: 11 acres
GLA: 137,556 sf
Date Built: 1988
Shopping Center Type: Neighborhood
Asking Rental Rate Range: $3.00
CAM: $0.42

Primary Tenant List
Anchor Tenants
Marukai 99 Cent Store
Longs Drug
New Hope Church

Pad Sites Tenants
Tesoro Sizzler Oriental City
Taco Bell/Pizza Hut Dr. Higa Popeye's
Baskin Robbins Fantastic Sams

Retail Square Footage by Retailer Type

Product Type	Estimated Sq Ft.
Apparel	3,500
Auto	5,500
Children	8,500
Discount Merchandise	25,500
Drugs	26,500
Fast Food	12,256
Restaurants	7,000
Specialty	5,200
Services	18,100

WAIPAHU DAIEI CENTER

Address: 94-144 Farrington Highway
City: Waipahu **State:** HI **Zip:** 96797
Tax Map Key: 1-9-4-47-8
Land Size: 9.73 acres
GLA: 166,134 sf
Date Built: 1996
Shopping Center Type: Neighborhood
Asking Rental Rate Range:
CAM:

Primary Tenant List
Anchor Tenants
Daiei

Pad Sites Tenants
Zippy's
First Hawaiian Bank
Tesoro

Retail Square Footage by Retailer Type

Product Type	Estimated Sq.Ft.
Discount Merchandise	141,630
Restaurants	5,000
Specialty	1,000
Services	15,000

GENTRY WAIPIO SHOPPING CENTER

Address: 94-050 Farrington Hwy
City: Waipahu **State:** HI **Zip:** 96797
Tax Map Key: 1-9-4-47-29,35,36
Land Size: 12.96 acres
GLA: 133,573 sf
Date Built: 1985
Shopping Center Type: Neighborhood
Asking Rental Rate Range: $2.50-$3.00
CAM: $0.85

Retail Square Footage by Retailer Type

Product Type	Estimated Sq. Ft.
Auto	1,400
Grocery	27,421
Fast Food	9,707
Restaurants	7,280
Services	81,165

Primary Tenant List
Anchor Tenants
Foodland
Calvary Church
Blockbuster

Pad Sites Tenants
Aloha Petroleum
Taco Bell/Pizza Hut
Outback Steakhouse
Jack in the Box

TIMES ROYAL KUNIA CENTER

Address: 94-615 Kupuohi Street
City: Waipahu **State:** HI **Zip:** 96797
Tax Map Key: 1-9-4-2-58
Land Size:
GLA: 65,000 sf
Date Built: 1994
Shopping Center Type: Neighborhood

Asking Rental Rate Range: $1.85-$2.00
CAM: $0.67

Retail Square Footage by Retailer Type

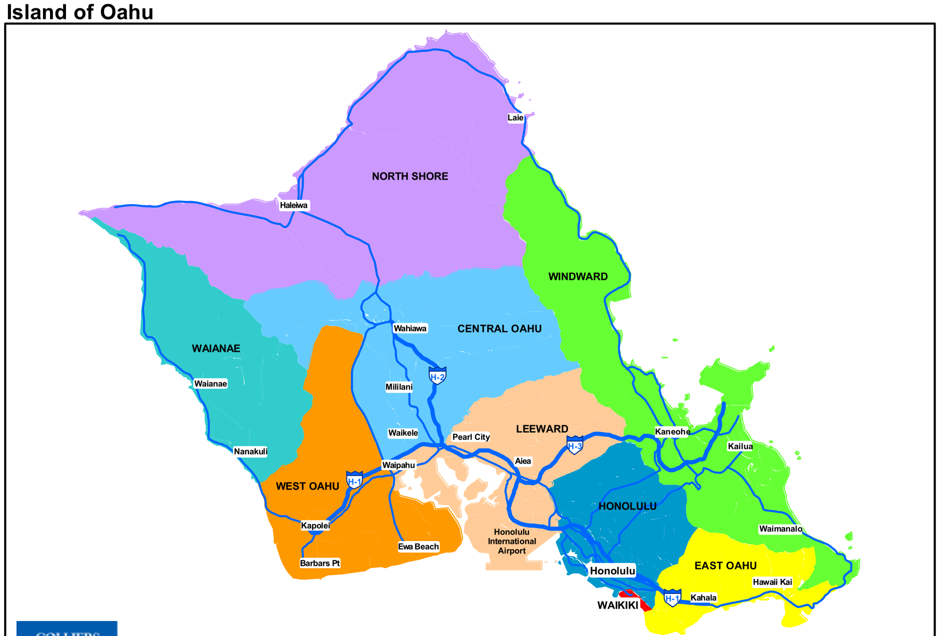
Product Type	Estimated Sq.Ft.
Auto	2,500
Grocery	47,850
Fast Food	2,500
Restaurants	2,500
Specialty	1,000
Services	9,000

Primary Tenant List
Anchor Tenants
Times Supermarket

Pad Sites Tenants
Wendy's
76 Gas Express

Retail Trade Areas

Island of Oahu



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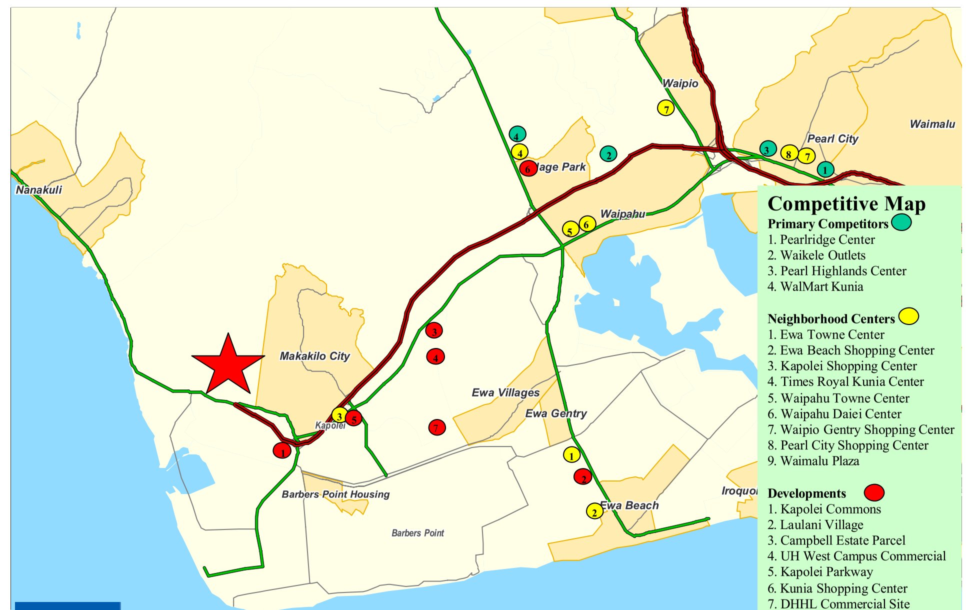
Competitive Retail Shopping Center Sites



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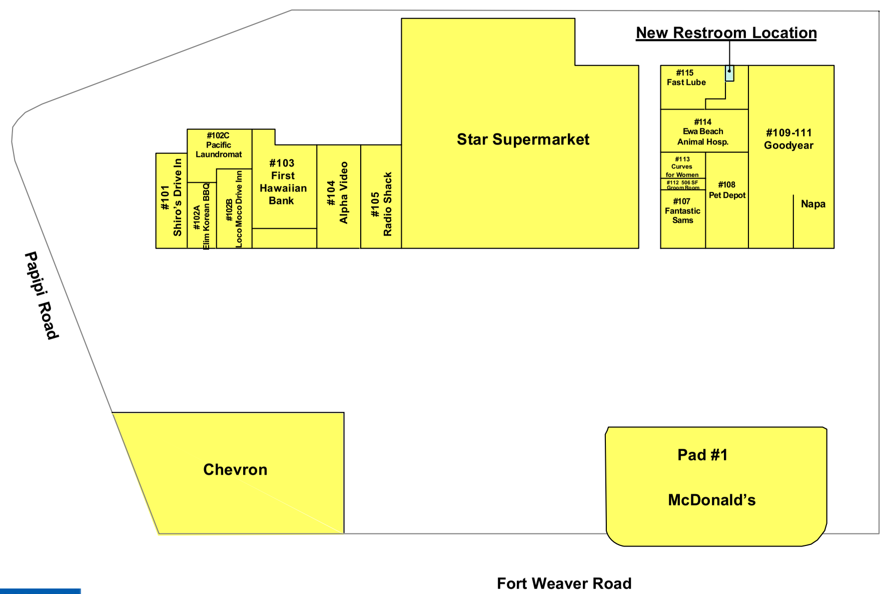
Ewa Beach Shopping Center



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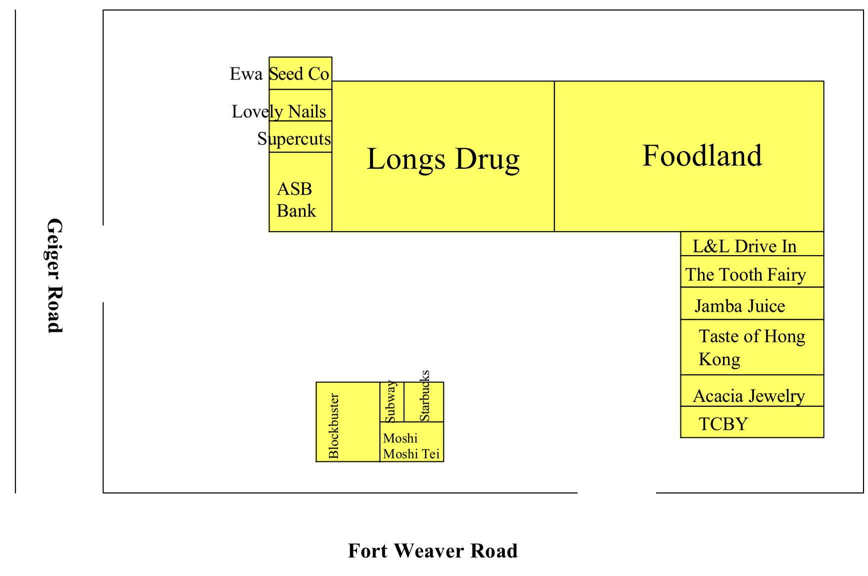
Ewa Town Center



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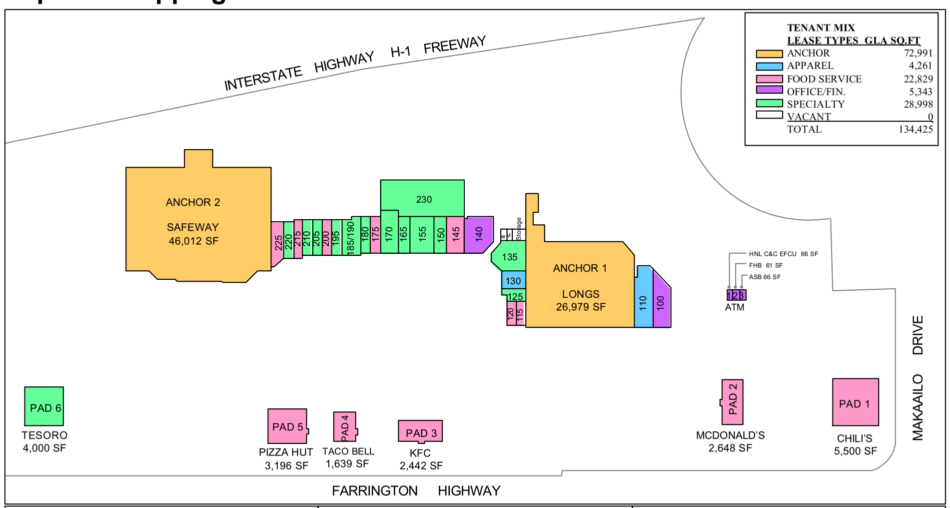
Kapolei Shopping Center – Phase I



100	First Hawaii Bank	2,434 SF	145	Dunkin Donuts	1,829 SF	195	Toy-rrific	955 SF
110	Payless Shoesource	3,057 SF	150	GNC	1,204 SF	200	Subway	963 SF
115	Cookie Corner	613 SF	155	Radio Shack	2,409 SF	205	Young Laundry & Dry Cleaning	960 SF
120	Baskin-Robbins	600 SF	165	Samurai, Inc.	1,202 SF	210	Postal Connection	955 SF
125	Kapolei Gold Mart	708 SF	170	Napa Auto Parts	2,086 SF	215	Tasty Korean BBQ	1,028 SF
130	Jeans Warehouse	1,207 SF	175	Loco Moco	967 SF	220	Eyes Plus	973 SF
135	Alpha Video	2,504 SF	180	Fantastic Sam's	967 SF	225	Panda Express	1,404 SF
140	Bank of Hawaii	2,716 SF	185/190	AT&T Wireless	2,002 SF	230	Goodyear	8,073 SF

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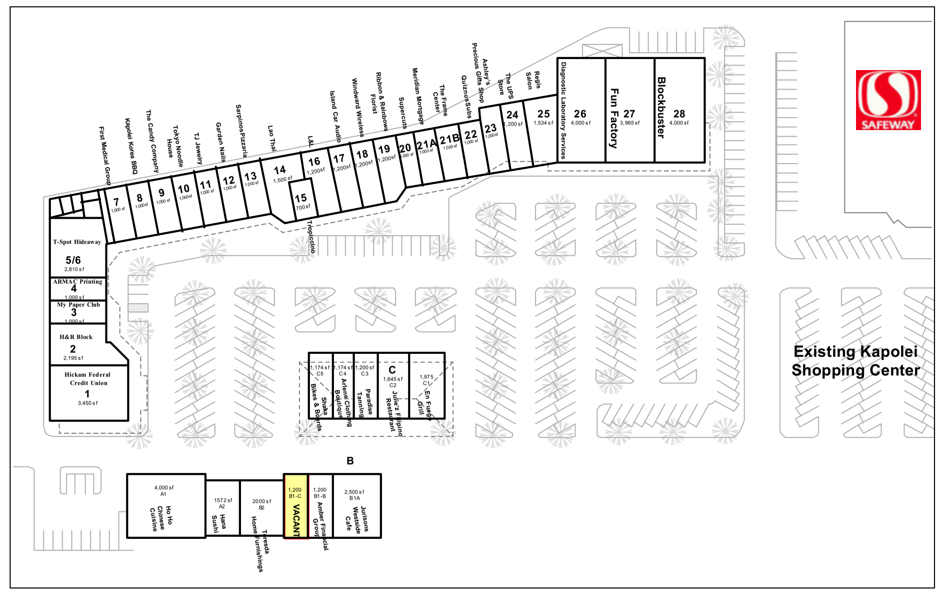
The Marketplace at Kapolei



COLLIERS
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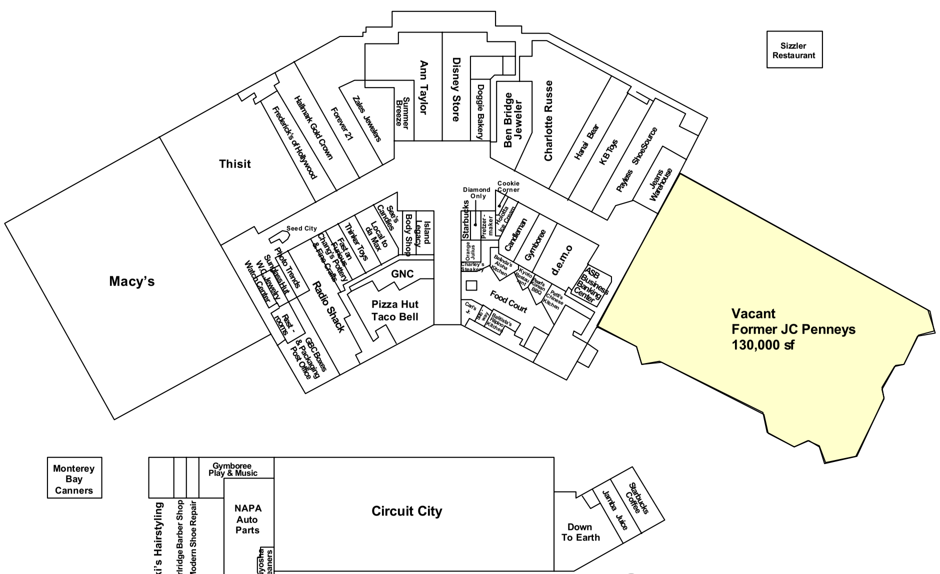
Pearlridge Shopping Center
Site Plan – Uptown Lower Level



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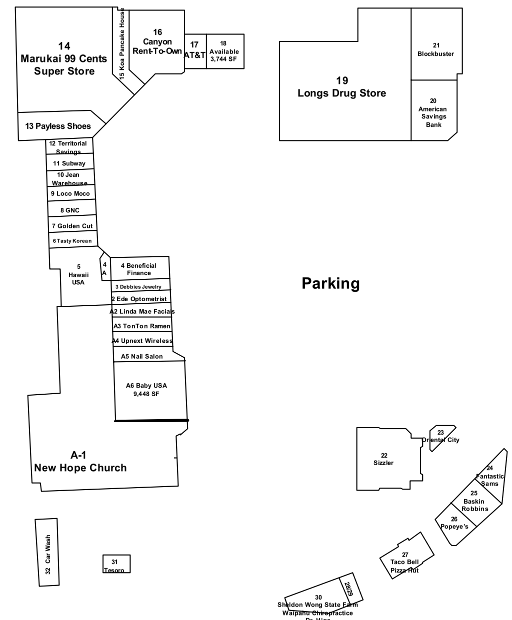
Waipahu Town Center



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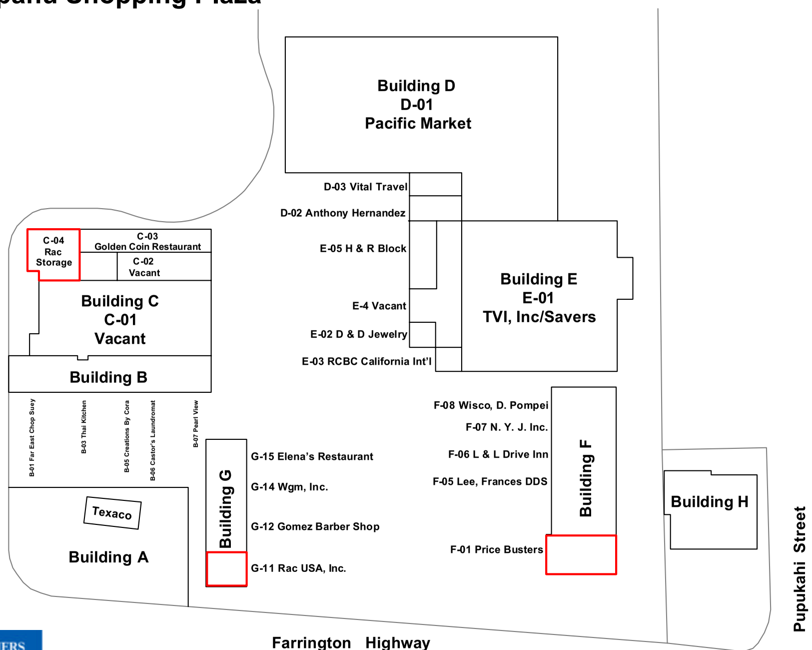
Waipahu Shopping Plaza



COLLIERS MONROE FRIEDLANDER

CMF Consulting 04/04
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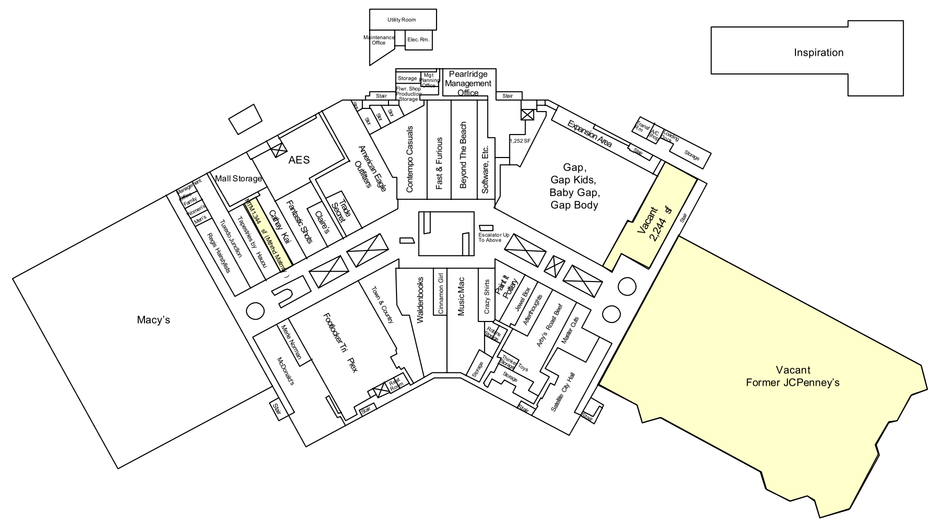
Pearlridge Shopping Center
Site Plan – Uptown Upper Level



COLLIERS MONROE FRIEDLANDER

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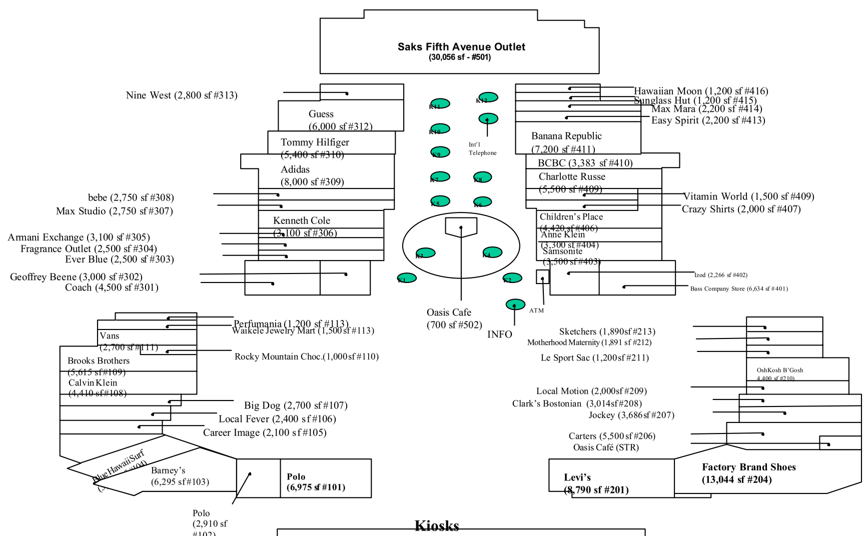
Waikele Premium Outlet
Floor Plan



Kiosks

K1 – Hawaiian Kine	K7 –
K2 – Logo, Logo, Inc.	K8 –
K3 – Friends Home	K9 – Lahens Designs
K4 – Ohana Gifts	K10 – Dressy Keiki
~~K5~~	~~K11 – Sweet Pears~~
K6 – Head & Feet	K12 – Fantastic Sewing Gifts

COLLIERS MONROE FRIEDLANDER

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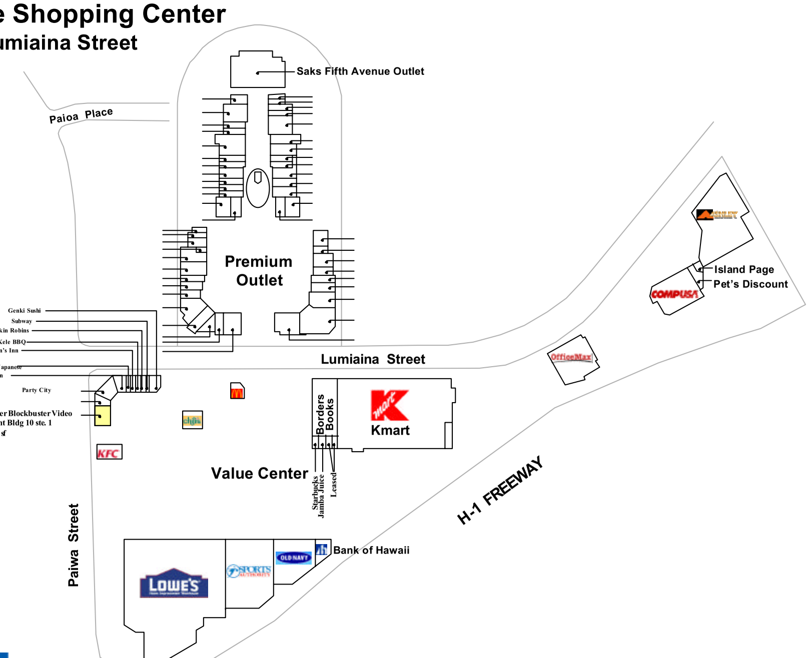
Waikele Shopping Center
94-849 Lumiaina Street



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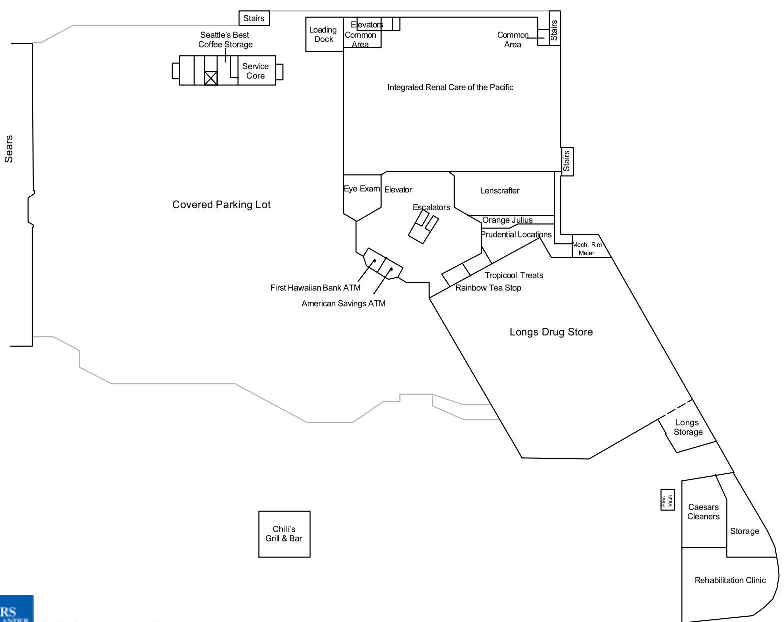
Pearlridge Shopping Center
Site Plan – Downtown Ground Level



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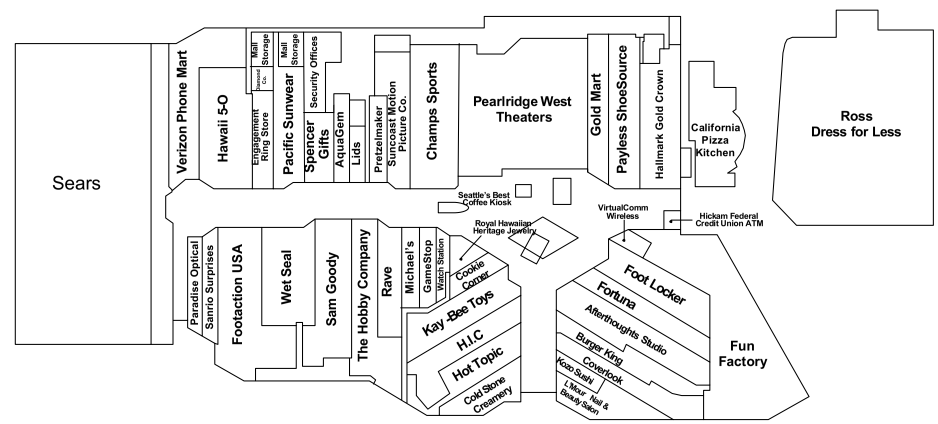
Pearlridge Shopping Center
Site Plan –Downtown Main Level



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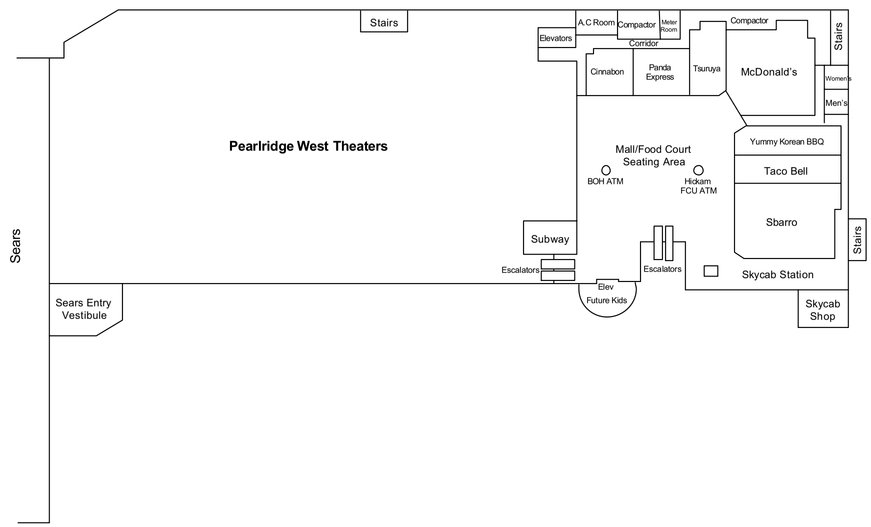
Pearlridge Shopping Center
Site Plan – Downtown Third Level



CMF Consulting 04/03
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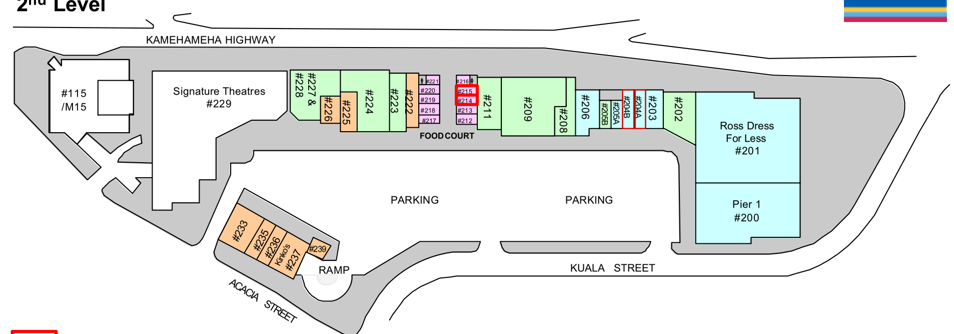
Pearl Highlands Shopping Center
2nd Level

CMF Consulting 12/04
A Division of Colliers Monroe Friedlander, Inc.



Designates Vacant Spaces

LEGEND #1

BAY #	TENANT
#200	PIER 1
#201	ROSS DRESS FOR LESS
#202	THE GIVING TREE
#203	JEANS WAREHOUSE
#204A	VACANT
#204B	VACANT
#205A	WORLD CAR TOYS
#205B	GAMESTOP
#206/207	PAYLESS SHOE SOURCE
#208	PIANO OUTLET
#209	PRICE BUSTERS
#211	MATTRESS OUTLET
#222	COUNTRYWIDE HOME LOANS
#223	NEVADA BOBS

LEGEND #2

BAY #	TENANT
#224	PICTURES PLUS
#225	VERIZON WIRELESS
#226	3.33 CAESAR'S CLEANERS
#227/228	CRAFT SUPPLY
#229	SIGNATURE THEATRES
#233/234	LIFETOUCH
#235	PEARL FAMILY DENTAL CTR
#236	FANTASTIC SAM
#237	KINKO'S
#239	QUEEN NAILS
#115/M15	COMP USA

LEGEND #3 FOODCOURT TENANTS

BAY #	TENANT
#212	SUMO RAMEN
#213	SUSHIMAN
#214	VACANT
#215	VACANT
#216	BLIMPIES SUBS & SALADS
#217	MINGS CANTON FOOD
#218	DAIRY QUEEN/ORANGE JULIUS
#219	L & L DRIVE INN
#220	HIGHLAND INN
#221	THAI MIXED PLATE

GENERAL MERCHANDISE FOOD CONVENIENCE / SERVICE APPAREL & ACCESSORIES

Smart Growth Trends

By Edward T. McMahon
Courtesy of the Planning Commissioners Journal

Ignoring trends is not smart, especially when those trends affect the bottom line. This article discusses five important "smart growth" trends, each of which represents a hopeful shift from the sprawling, segregated land use pattern that has predominated since the end of World War 11.

1. Suburban Town Centers

Take a drive into the Virginia suburbs outside of Washington, D.C. and you will see three projects -Reston Town Center, Cascades Village Center, and Kentlands Town Center - that exemplify one of the most hopeful new smart growth trends: a shift from endless strip development to compact, highly defined suburban town centers.

In the early 1990s, American LIVES and Intercommunication Inc. conducted several nationwide surveys to determine what features and amenities homebuyers would most like in a new community. One surprise was that people said they preferred "town centers" with a village green surrounded by shops and civic buildings to commercial strip malls strung out along major highways. As a result, developers, aided by savvy local governments and proponents of "new urbanism," are starting to build town centers again.

All over the country failed strip malls are being recast as walkable town centers with a mix of stores, offices, housing, and civic buildings. Schaumberg, Illinois; Boca Raton, Florida; and Rockville, Maryland, for example, have all demolished failed malls to construct mixed use town centers. On the West Coast, the Village Galleria in La Jolla, California incorporates apartments above retail shops into a new town center. Similarly, Bainbridge Island, Washington is now constructing thirtyfour apartments atop a 20,000 square foot retail complex on a downtown corner.

These projects are just the tip of the iceberg. Town centers are becoming one of the hottest trends in both retailing and community development. In the Washington, D.C. area alone, there are more than twenty town center developments under construction or in advanced stages of planning. Ironically, small town main streets have long been touted for their mix of uses, walkability, and charm, but until recently walkable town centers were treated as anachronisms rather than as models for how we could build in the future. This outmoded view is now changing.

2. Green Space as a Residential Amenity

The 1980s saw a proliferation of gated developments in which a golf course served as the focal point for the community's design and image. Golf courses are, of course, important recreational and visual amenities, and in most cases create highly profitable lot premiums. However, golf courses are expensive to construct and only appeal to a narrow segment of the home buying public.

When American LIVES asked homebuyers what features they most wanted in a new home community, golf courses ranked thirtieth. By contrast having lots of "natural open space" ranked third. Similarly, a survey by the *Philadelphia Inquirer* of homeowners in golf course developments in southeastern Pennsylvania found that only about twenty percent of the owners actually played golf. They said they bought there because they liked the view across the fairway.

These findings suggest that open space is a far important feature in community planning than golf courses, and that homebuyers are willing to pay premium prices to live in communities with green space.

3. Open Space Systems

Almost lost in the 1998 election coverage was mention of the more than 200 state and local open space initiatives voters approved. These initiatives, which will provide nearly $7 billion for farmland preservation, parkland acquisition, and open space protection, reflect another smart growth trend: the development of open space systems.

New Jersey voters, for example, endorsed a constitutional amendment that commits $1 billion to preserving open space and constructing a network of trails and greenways. Similarly, voters in Alabama, Florida, Michigan, Minnesota, Oregon, and Rhode Island approved hundreds of millions of dollars for statewide open space protection programs. Localities as diverse as Fairfax County, Virginia; Douglas County, Colorado; and Cape Cod, Massachusetts, also endorsed new funding for community open space protection projects.

Perhaps more important than all the new money is the fact that all levels of government are beginning to recognize the economic, social, and environmental benefits of "open space systems." Thirty of the nation's fifty largest metropolitan areas have developed or are in the process of developing regional greenspace plans, as have hundreds of smaller communities. just as regions need to upgrade and expand their *grey* infrastructure (i.e., roads, transit lines, sewers), so too, they need to upgrade and expand their *green* infrastructure (i.e., parks, greenways, natural areas). When communities have a road map delineating which land should be preserved, it becomes easier to facilitate development in areas where it is most appropriate. Also, given the growing opposition to sprawl, many officials see open space preservation as a politically acceptable way to shape urban form.

4. Downtown Housing

A 1998 survey conducted by the Brookings Institution and the Fannie Mae Foundation found that one of the fastest growing segments of the nation's housing market is downtown housing. For example, Houston expects its downtown population to quadruple by 2010. Cleveland expects its to triple. Denver, Memphis, and **Seattle all anticipate doubling the number of downtown** residents in the next ten years.

The growth in downtown housing is not restricted to large cities. Many smaller cities and towns are also seeing a growing market for downtown housing. Asheville, North Carolina; Portsmouth, Virginia; Burlington, Vermont; Dayton, Ohio; Bangor, Maine; and Sheboygan Falls, Wisconsin are just a few examples.

So what accounts for the growing demand for downtown housing?

- *Access.* Downtowns usually have the largest concentration of jobs in a metropolitan region, and downtown housing makes walking to work an attractive option. Downtowns also have the most public transportation facilities. Even when downtown residents have to drive, reverse commuting is an attractive option.

- *Amenities.* Virtually every downtown has amenities not typically found in suburban neighborhoods - museums, waterfront parks, colleges, theatres, unique views, and interesting architecture. While the quality of city schools remains a concern for families with school age children, only one-third of American households fall in this category.

- *Pedestrian Friendly Environment.* Older downtowns are walkable. They evolved during a period when development was compact, high density, and pedestrian friendly. Senior citizens, in particular, like the option of being able to walk to church, the post office, or shopping. Downtown housing also gives them access to public transportation. A growing number of cities have converted abandoned hotels, old schools, and vacant industrial buildings into housing for seniors and others.

5. Cooperation Instead of Confrontation A few years ago cooperation between environmentalists and developers was unheard of. Not anymore. Across the country, developers and environmentalists are working together to promote smart growth. Both recognize that *Nimby*ism is the biggest obstacle to new development, no matter how well conceived.

Growth is going to occur. The real questions for most communities are: where should development take place, and what form should it take.

Developers and environmentalists are starting to cooperate to change local laws and policies that impede smart growth. Both realize that land use regulations need to be more flexible to allow for innovation. Street standards, parking lot design, stormwater management, wetlands regulation, open space protection, mixed use zoning, and tree preservation are all areas where builders and environmentalists are finding common ground.

This cooperative approach has led to a series of smart growth conferences and roundtables. It has also led to the development of new consensus-based design guidelines such as *Better Site Design: A Handbook for Changing Development Rules in Your Community.* This publication sets out twenty-two model development principles endorsed by interests as diverse as traffic engineers, planners, homebuilders, fire department administrators, and environmental organizations.

While builders, environmentalists, and planning commissioners will never see "eye-to-eye" on everything, it is certainly true that all these groups have much in common. Establishing non-adversarial mechanisms for identifying common interests is one planning trend that benefits us all.

Office Market Demand Model

WEST, CENTRAL AND LEEWARD OAHU OFFICE INVENTORY (MULTI-TENANT OFFICE BUILDINGS)

OFFICE INVENTORY - WEST, CENTRAL AND LEEWARD OAHU

Office/Service Usage Primary Trade Area	Address	City	Trade Area	Year Built	Office RBA
Ewa Beach Professional	91-902 Fort Weaver Road	Ewa Beach	Primary Trade Area	1963	14,126
Former ASB Bank Building	94-230 Farrington Highway	Waipahu	Primary Trade Area	1990	31,032
Government Offices	94-275 Mokuola Street	Waipahu	Primary Trade Area	1993	42,248
Campbell Square	1001 Kamokila Boulevard	Kapolei	Primary Trade Area	1993	136,868
Bank of Hawaii Building	1001 Kamokila Boulevard	Kapolei	Primary Trade Area	1995	208,406
State Gov't Offices	601 Kamokila Blvd	Kapolei	Primary Trade Area	1998	222,228
Police Station	1100 Kamokila Boulevard	Kapolei	Primary Trade Area	1999	50,689
Filipino Community Center	94-428 Mokuola Street	Waipahu	Primary Trade Area	2002	33,051
Ewa Oceanpointe	91-831 Fort Weaver Road	Ewa Beach	Primary Trade Area	2004	16,639
Primary Trade Area Totals					**755,287**

Office/Service Usage Secondary Trade Area	Address	City	Trade Area	Year Built	Office RBA
Aiea Commercial Center	99-079 Kauhale Street	Aiea	Secondary Trade Area	1963	20,616
Newtown Square	98-1247 Kaahumanu Street	Aiea	Secondary Trade Area	1975	61,000
Pearlridge Office Building	98-211 Pali Momi Street	Aiea	Secondary Trade Area	1976	89,461
Pearl City Business Plaza	803 Kamehameha Highway	Pearl City	Secondary Trade Area	1981	53,400
Pearl City Plaza	917 Kamehameha Highway	Pearl City	Secondary Trade Area	1988	38,658
Leilehua Building	300 Kahelu Drive	Mililani	Secondary Trade Area	1988	21,563
Castle & Cooke Building	100 Kahelu Drive	Mililani	Secondary Trade Area	1989	40,000
Intellect Building	200 Kahelu Drive	Mililani	Secondary Trade Area	1990	32,000
Mililani Professional Center	95-750 Lanikuhana Drive	Mililani	Secondary Trade Area	1993	21,000
Secondary Trade Area Totals					**377,698**
Combined Trade Area Totals					**1,132,985**

New Office Projects Planned or Proposed	Square Footage	Occupancy Date
Laulani Village	81,000	2008
Kapolei Commons	30,000	2008
Kapolei Parkway	10,144	2006
Pearlridge Office Building	30,000	2008

Source: Colliers Hawaii Consulting

8/1/2005

WEST, CENTRAL AND LEEWARD OAHU OFFICE INVENTORY (MULTI-TENANT OFFICE BUILDINGS)

WEST, CENTRAL, LEEWARD OAHU OFFICE DEMAND ESTIMATES

ANNUAL TOTAL OFFICE WORKER JOB COUNTS						
BASE YEAR	JOB GROWTH ESTIMATE	2005	2006-2010	2011-2015	2016-2020	2021-2025
Conservative	1.25%	7,208	7,670	8,161	8,684	9,241
Moderate	1.75%	7,244	7,900	8,616	9,397	10,248
Aggressive	2.25%	7,279	8,136	9,093	10,163	11,359
ANNUAL INCREASE IN JOBS						
		2005	2006-2010	2011-2015	2016-2020	2021-2025
Conservative		89	95	101	107	114
Moderate		125	136	148	162	176
Aggressive		160	179	200	224	250
CUMULATIVE INCREASE IN OFFICE SQUARE FOOTAGE DEMAND						
		2005	2006-2010	2011-2015	2016-2020	2021-2025
Conservative		13,704	84,837	160,529	241,071	326,774
Moderate		19,186	120,270	230,513	350,747	481,876
Aggressive		24,667	156,583	304,023	468,813	652,994
PROJECTED OFFICE SQUARE FOOTAGE ESTIMATE						
		2005	2006-2010	2011-2015	2016-2020	2021-2025
New Supply		0	151,144	0	0	0
OFFICE SPACE DEMAND ESTIMATES						
Conservative		13,704	(66,307)	9,385	89,927	175,630
Moderate		19,186	(30,874)	79,369	199,603	330,732
Aggressive		24,667	5,439	152,879	317,669	501,850

Source: Colliers Hawaii Consulting

8/1/2005

Hospital FTE Physicians Demand Model

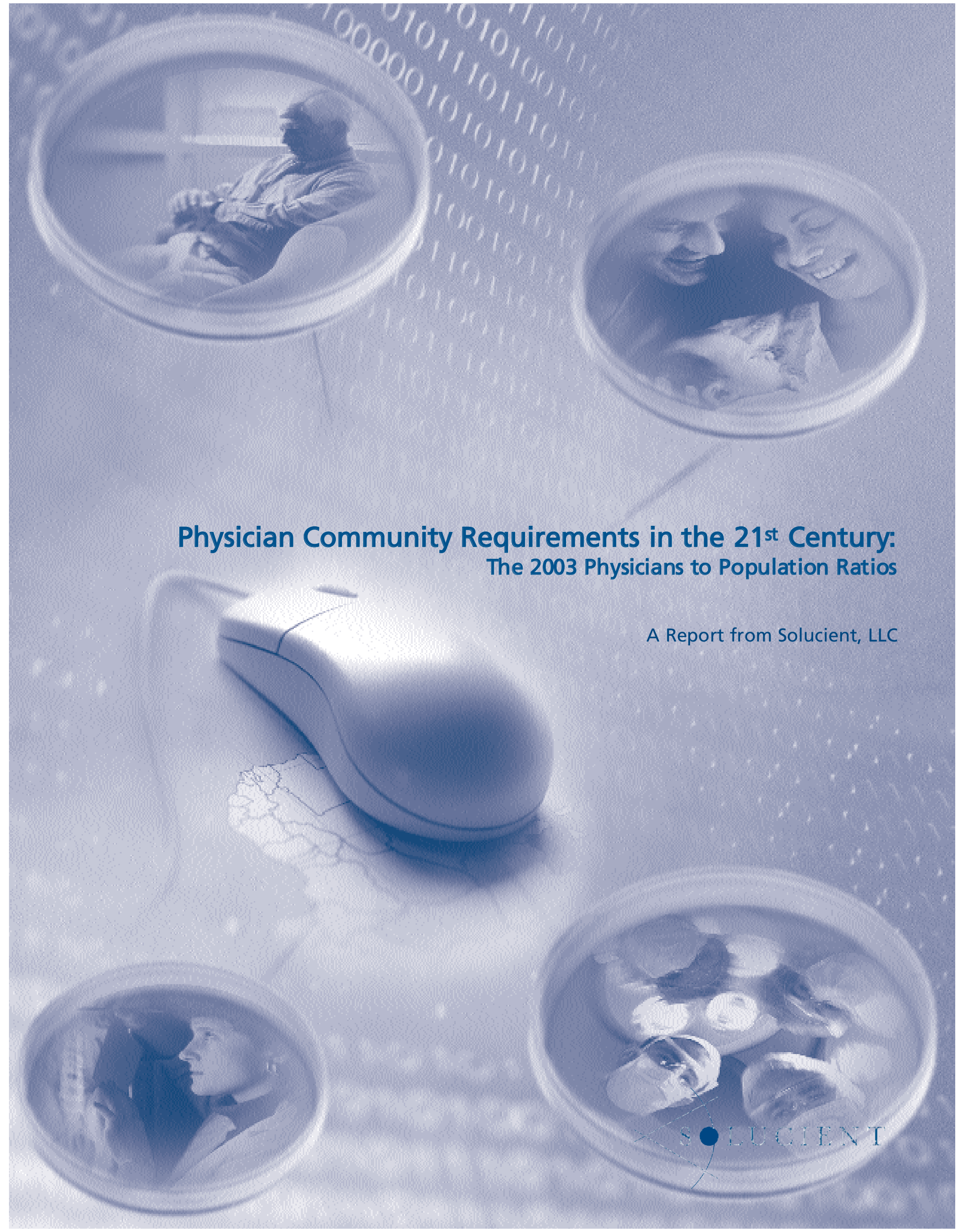
FTE PHYSICIANS MARKET ASSESSMENT FOR PRIMARY AND SECONDARY TRADE AREAS

MEDICAL CLINIC/WELLNESS FACILITY MARKET ASSESSMENT					
TRADE AREA	NUMBER OF PHYSICIANS	POPULATION BASE	U.S. WEST RATIO	LOCAL MARKET RATIO	PHYSICIAN OVERAGE/SHORTFALL
PRIMARY - KAPOLEI	26				
PRIMARY - EWA BEACH	46				
PRIMARY TRADE AREA TOTALS	**72**	**38,991**	**0.1324%**	**0.1847%**	**0.0523%**
SECONDARY-WAIANAE	44				
SECONDARY - WAIPAHU	72				
SECONDARY - PEARL CITY	19				
SECONDARY TRADE AREA	**135**	**176,562**	**0.1324%**	**0.0765%**	**-0.0559%**
PRIMARY AND SECONDARY TOTALS	**207**	**215,554**	**0.1324%**	**0.0960%**	**-0.0363%**

* There is a shortfall of roughly 36 full time physicians for the primary and secondary trade areas

Source: Solucient LLC, Colliers Hawaii Consulting

8/1/2005



Physician Community Requirements in the 21st Century: The 2003 Physicians to Population Ratios

Executive Summary

Assessing the current physician requirements of a community has never been more challenging. A number of national and local environmental factors have emerged since the turn of the century that have rendered traditional physician models obsolete and, sometimes, misleading. This paper presents a fresh set of models built on recent information that reflects changes to the population and physician work force over the past several years. These new models are critical to the well-being of hospitals, physicians and communities. They can be used to gauge physician requirements in specific communities and identify potential specialties that are undersupplied. These requirements reflect actual current average physician to population ratios and should not be interpreted as representing an ideal level of access to care.

Background

Demand for physician services in the U.S. continues to grow and shift due to an aging population, relaxation of managed care restrictions and the mounting malpractice insurance crisis. In particular, physician access continues to be a major factor in ensuring that a community has appropriate health-care services. In addition, physician referrals to specialists and hospitals remain critical, as they help patients obtain the correct care at the right time. Market changes, however, have resulted in acute physician supply issues for specific specialists in several U.S. markets within the past several years. A lack of particular types of physicians directly impacts a community's access to critical procedures, preventive medicine, and the latest in medical technologies.

Physician models created during the 1980s and 1990s are based on very different market conditions that no longer pertain to today's population and health-care climate. These older models are not incorrect, but based partially on outdated data sources and methodology assumptions. Solucient's new physician ratios are appropriate for dealing with physician community requirements because they address the new demographics and market dynamics of the 21st century.

2003 Physicians to Population Ratios

The new Solucient physicians to population ratios are provided in Table 1 below. These ratios were constructed from a combination of public claims, private claims and several surveys, including the National Ambulatory Medical Care Survey (NAMCS) and the National Hospital Ambulatory Medical Care Survey (NHAMCS).

These ratios represent the number of full-time-equivalent (FTE) physicians currently serving the ambulatory care needs of a typical U.S. community in 2003. A national model and four regional models are presented to show a range of physician requirements based on regional practice patterns. These ratios serve as national and regional guidelines and are not intended to estimate the current demand for or supply of physicians in any specific market.

A more detailed methodology is described at the end of this document.

Table 1: 2003 Physicians to Population Ratios

	FTE Demand per 100,000 Population				
PHYSICIAN SPECIALTY	**Nation**	**Midwest**	**Northeast**	**South**	**West**
Primary Care					
General & Family Medicine	22.53	27.85	18.98	22.48	20.20
Internal Medicine	19.01	14.22	21.83	20.05	19.86
Pediatrics General	13.90	11.91	17.09	12.70	15.20
Medical Specialties					
Allergy/Immunology	1.72	1.13	1.54	1.98	2.02
Cardiology	4.22	3.55	6.77	3.44	3.91
Dermatology	3.13	2.30	3.97	3.18	3.19
Gastroenterology	3.50	1.64	3.53	4.40	3.95
Hematology/Oncology	1.08	1.28	0.92	1.03	1.08
Nephrology	0.73	0.37	0.30	0.98	1.10
Neurology	1.79	0.92	1.75	2.10	2.21
Physical Medicine and Rehab.	1.44	1.37	1.95	1.11	1.64
Psychiatry	5.73	4.79	8.86	4.45	6.04
Pulmonary	1.30	0.94	1.59	1.82	0.54
Rheumatology	1.33	1.00	1.46	1.53	1.20
Other Medical Specialties	2.01	2.83	3.08	0.64	2.51
Surgical Specialties					
General Surgery	6.01	6.68	5.82	6.42	4.79
Obstetrics and Gynecology	10.17	9.10	10.20	11.81	8.57
Ophthalmology	4.71	3.98	5.77	4.52	4.83
Orthopedic Surgery	6.12	4.46	7.50	5.77	7.18
Otolaryngology	2.84	3.22	2.46	2.86	2.72
Plastic Surgery	2.22	1.72	3.06	2.28	1.95
Urology	2.86	2.52	3.54	2.95	2.45
Other Surgical Specialties	2.20	2.86	2.60	1.52	2.29
Pediatric Subspecialties					
Pediatric Cardiology	0.20	0.13	0.15	0.26	0.22
Pediatric Neurology	0.12	0.14	0.07	0.10	0.18
Pediatric Psychiatry	0.59	0.52	0.84	0.59	0.45
Other Pediatric Subspecialties	0.89	0.89	0.81	0.79	1.10
Emergency Department*	12.34	12.30	12.65	13.07	10.98
Grand Total All Specialties	**134.69**	**124.62**	**149.10**	**134.83**	**132.36**

*Physicians working in emergency departments can be board certified in any specialty. The most common specialties are emergency medicine, internal medicine and family medicine.

Adjusting the National Ratios for Local Demographics

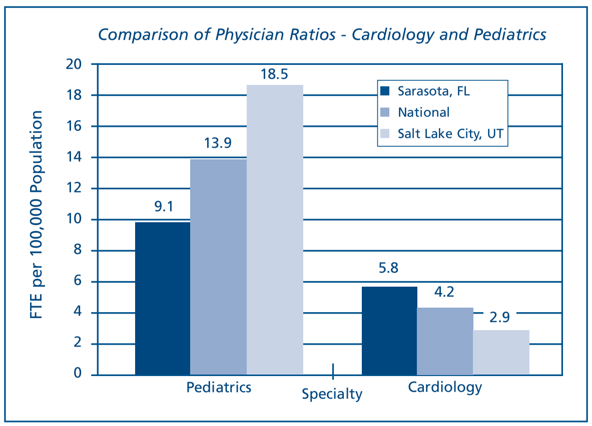
While the ratios above provide general benchmarks of actual physician requirements nationally and regionally, the ratios must also be adjusted to represent local demographics of a community. Physician requirements by specialty are highly dependent on the age and gender composition of the population in question. Failure to use appropriate ratios for the demographics of a market can result in overestimation or underestimation of true physician requirements.

For example, the requirements for pediatricians are dependent on the proportion of children in the total population, while cardiologist demand is an important factor for the older population. While the ratios in Table 1 reflect the age and gender distribution of the entire U.S. population in 2003 applied to national and regional models, those same ratios applied to specific markets can provide very different results. Figure 1 shows how ratios can vary when applied to the populations of Sarasota, Florida, and Salt Lake City, Utah.

Sarasota's population has a much higher percentage of seniors than the rest of the nation, while Salt Lake City has a much higher proportion of children. Adjusting the appropriate regional model for the demographics of these two markets shows that cardiologist demand is much higher in Sarasota and much lower in Salt Lake City, compared to national ratios. In contrast, pediatrician requirements are much lower in Sarasota and much higher in Salt Lake City, compared to national ratios. Even though these two markets are very different demographically from the country as a whole, every market will vary somewhat from national and regional ratios due to unique demographic composition.

If you are interested in purchasing local physicians to population ratios for a specific market, call 1-800-366-PLAN or e-mail info@solucient.com.

Figure 1: Variation in Local Ratios



Data Sources and Methodology

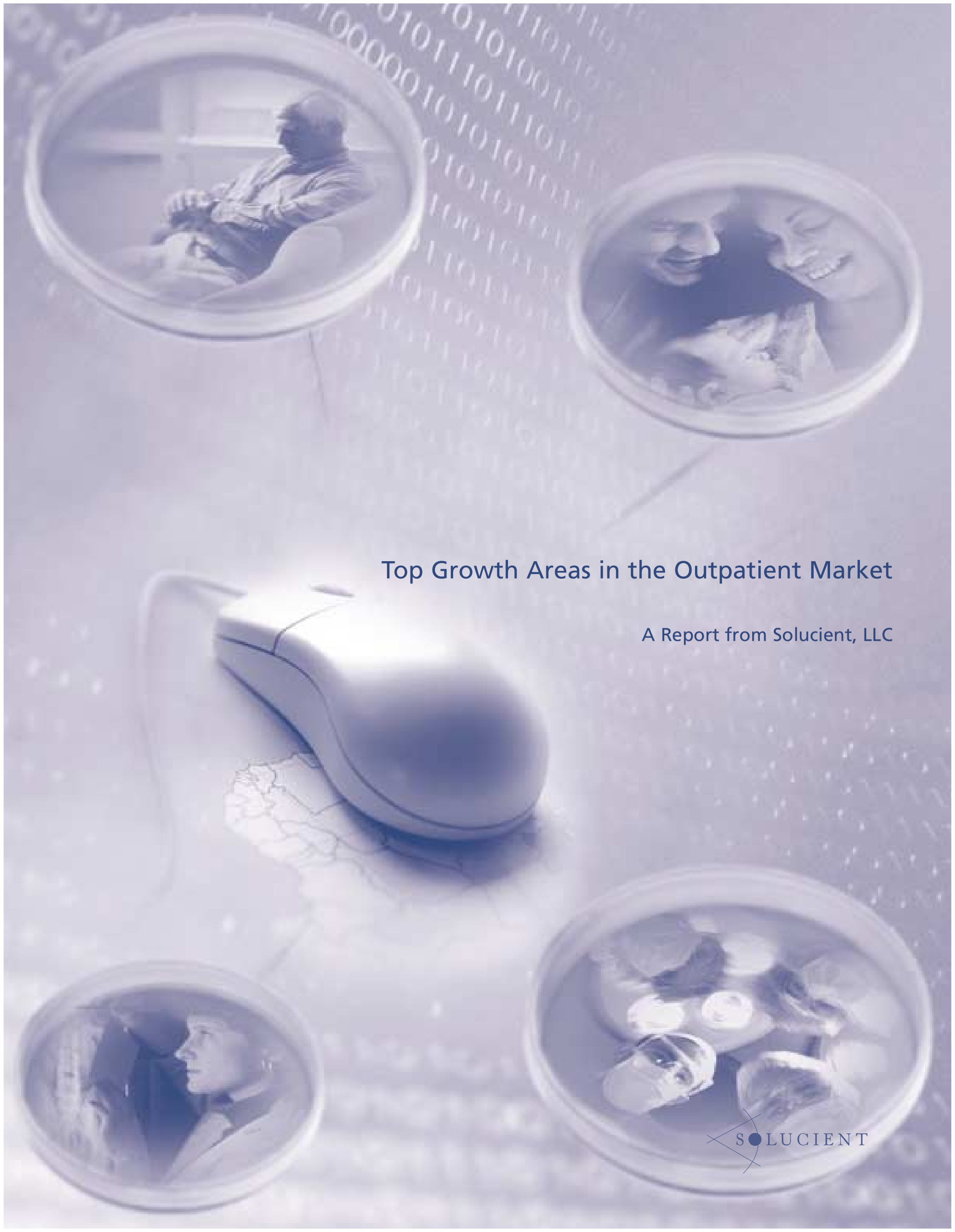
Solucient's physicians to population ratios were created following the three steps described below:

1. Solucient analyzed 2001 private and public claims in order to calculate national and regional population-based overall physician visit rates by age group and gender of the patient. Age groups used are 0-17, 18-44, 45-64 and 65+. Regions are defined using the U.S. Census Bureau's four regional definitions. These visit rates include evaluation and management CPT4 codes for ambulatory encounters with physicians in private offices, hospital clinics, emergency departments and free-standing centers. These rates do NOT include ambulatory surgery encounters, inpatient admissions or ancillary services such as laboratory and diagnostic imaging.
2. Solucient analyzed four years of data from the National Ambulatory Medical Care Survey (NAMCS) and the National Hospital Ambulatory Medical Care Survey (NHAMCS) to determine specialty distribution for each patient visit. Data from 1997-2000 was used to create age-, gender-, and specialty-specific use rates for the nation and for each of the four Census regions. Since physicians of any specialty can staff emergency departments, Solucient did not break out specialties for ED visits but combined them into a single rate for each age, gender and region combination.
3. In order to convert the national and regional visit rates described above into FTE physician demand, Solucient divided each visit rate by the national average median annual ambulatory visit productivity rate as reported by the Medical Group Management Association (MGMA) for 2001-2003. All of the national and regional ratios presented in Table 1 (page 2) are weighted using age and gender demographic distribution of the entire United States in 2003. Solucient used the productivity rate of emergency medicine physicians to convert ED visits into FTEs, since the majority of physicians working in the ED are board certified in emergency medicine.

About Solucient

Solucient is the leading source of health-care business intelligence. The company provides comprehensive, results-oriented information to drive business growth, manage costs and help deliver quality care. Solucient's expertise and proven solutions enable providers, payers, employers and pharmaceutical companies to achieve results and realize value. For more information, visit www.solucient.com.

For more information on the findings and trends highlighted in this report, or if you are interested in purchasing local physicians to population ratios for a specific market, call 1-800-366-PLAN or e-mail info@solucient.com.



A Report from Solucient, LLC

The growth in outpatient care, driven by advances in medical technology, demand from patients wanting to avoid hospital stays, and cost-containment pressures, shows no signs of abating. Hospital outpatient spending jumped 11.2 percent in 2000– the largest increase since 1992, according to a 2001 article in *Health Affairs*. In contrast, inpatient spending rose only 2.8 percent in 2000. The following year, spending on outpatient services grew 16.3 percent, outstripping prescription drug spending as the fastest growing component of total health care spending.

Within the burgeoning outpatient market, a variety of medical procedures are experiencing meteoric growth. Several factors contribute to the impressive volume– a new technology or technique that makes shifting the procedure to an outpatient setting possible, a change in physician practice patterns resulting from updated clinical guidelines or research, a recent decision by insurers to cover the procedure, and increased patient demand or need.

This report highlights four procedures that have had noteworthy growth in the last three years:

- Colonoscopy due to altered physician practice patterns;
- Acupuncture and chiropractic resulting from physician acceptance, patient demand, and insurers covering the therapies;
- Positron emission tomography (PET scans) driven by new clinical applications;
- And, dual energy X-ray absorptiometry (DEXA bone density tests) in response to the aging of the population and superior screening technology.

Figure 1 shows the gains among some of the fastest growing outpatient procedures.

FIGURE 1: Estimated Encounters by Procedure Group With More Than a 15% Change Over Three Years

CPT Procedure Group	1999	2000	2001	1998-2001
Chiropractic Treatment	60,534,483	69,808,382	115,505,330	90.81%
Physical Therapy	235,474,919	264,307,055	400,477,975	70.07%
Nuclear Medicine	12,401,927	15,229,747	18,508,535	49.24%
Neuro Testing and Other Neurological Procedures	25,921,678	29,795,704	34,892,634	34.61%
Chemotherapy	9,068,775	11,950,743	12,198,171	34.51%
Diagnostic and Other Digestive Tract Procedures	17,268,009	19,460,663	21,147,120	22.46%
Radiation Oncology	30,716,020	36,479,861	36,336,399	18.30%
Dermatological and Tissue Procedures	89,139,379	99,292,177	104,644,590	17.39%
Diagnostic Radiology	327,760,589	368,605,186	384,351,086	17.27%
Endoscopy and Other Respiratory Procedures	5,037,962	5,434,475	5,857,294	16.26%
Musculoskeletal Procedures	28,816,474	31,433,669	33,358,545	15.76%

Source: Solucient's OutpatientView™, 1999-2001

In the quickly changing environment of medical technology, accurate measurement of diagnosis and procedure volumes is essential for pharmaceutical and medical device manufacturers to make smart business decisions. The companies that remain competitive understand how many patients are being treated, who is treating them, and where they are receiving care.

Solucient's procedural and diagnostic data– both inpatient and outpatient– give key insights into market potential for new and existing products and services, and it helps define future growth opportunities for product development and service lines. Solucient helps hundreds of subscribers from major pharmaceutical and device manufacturers size the inpatient and outpatient markets through its Web-based products: InpatientView™ and OutpatientView™.

A Shift in Screening Technologies for Digestive Disorders

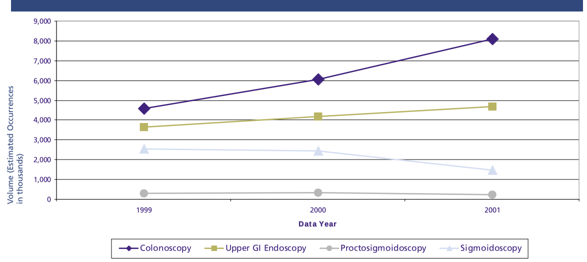
Screening for colorectal cancer is undergoing a sea change as physicians alter their practice patterns based on new research and guidelines. Solucient's data show that the number of colonoscopies increased by 76.6 percent from 1999 to 2001, while 41.7 percent fewer sigmoidoscopies were performed during that same period. (See Figure 2 and Figure 3)

FIGURE 2: Select Digestive Procedures With More Than a 10 Percent Change Over Three Years

CPT Procedure Group	1999	2000	2001	1999-2001 % Change
Colonoscopy	4,593,549	6,071,206	8,110,719	76.57%
Upper GI Endoscopy	3,647,476	4,168,548	4,698,012	28.80%
Laparoscopy Biliary Tract	1,655	1,726	1,922	16.13%
Dentoalveolar Procedures	141,980	147,311	160,940	13.35%
Laparoscopy Cholecystectomy	700,092	754,168	785,021	12.13%
Proctosigmoidoscopy	316,552	330,340	245,245	-22.53%
Sigmoidoscopy	2,537,713	2,445,464	1,480,555	-41.66%

Source: Solucient's OutpatientView™, 1999-2001

FIGURE 3: Growth and Decline of Select Digestive Procedures



Source: Solucient's OutpatientView™, 1999-2001

Recent studies have shown colonoscopy to be not only much more accurate in detecting cancer in asymptomatic adults than sigmoidoscopy, but also more cost effective. According to OutpatientView, in 2001 the mean Medicare payment for colonoscopy procedures was $199 versus $100 for sigmoidoscopy procedures. The mean commercial payment was $272 and $125 for colonoscopies and sigmoidoscopies, respectively. While colonoscopies can be double the cost of sigmoidoscopies, the recommended interval for repeat screening for colonoscopy is 10 years versus five years for sigmoidoscopy. Additional cost savings may be attributed to not doing both procedures in many patients. And colonoscopy allows physicians to screen for and remove polyps in one process instead of subjecting the patient to multiple procedures. In early 2003, the U.S. Multisociety Task Force on Colorectal Cancer issued revised clinical guidelines that recommend colonoscopy as the preferred test for patients at increased risk for colon cancer.

Alternative Care Becoming More Mainstream

The limitations of conventional medicine and a desire for more holistic, less procedurally oriented care are causing many patients to seek adjunct therapy through practitioners of complementary and alternative medicine (CAM). According to the often quoted 1998 JAMA article on alternative medicine trends, 42 percent of Americans used some form of alternative therapy in 1997, and made an estimated 629 million visits to alternative medicine practitioners, exceeding the number of visits to U.S. primary care physicians that year. Individuals spent $21.2 billion on alternative care in 1997, and paid at least half out of their own pockets. A more recent study published in the Annuals of Internal Medicine in 2001 found that seven out of 10 post-baby boomers have used CAM therapy by age 33, compared to half of baby boomers, and three out of 10 individuals born before 1946. And at least half of the individuals who have tried CAM continue to use alternative medicine therapies.

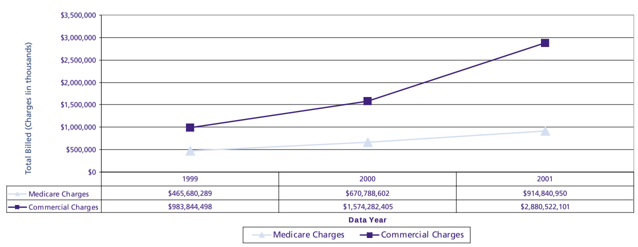
Solucient's OutpatientView confirms the growing popularity of acupuncture, which had a 200 percent increase in volume from 1999 to 2001, and chiropractic care, which rose 91 percent in that three-year period.

Women, individuals with a holistic orientation to health, and those with a higher level of education are most likely to try alternative medicine. A national survey conducted by Solucient found that 61 percent of individuals visiting chiropractors, acupuncturists, homeopaths, and massage therapists are women; 47 percent are between the ages of 35 and 54; more than half earned $50,000 or more; and 68 percent have attended college. Respondents who visited alternative medicine practitioners reported a high incidence of allergies, arthritis, chronic back problems, weight problems, migraines, and high cholesterol, according to the survey. Other studies have found that individuals with depression and anxiety try alternative medicine, and one survey of surgery patients found that half were interested in using acupuncture to relieve preoperative anxiety.

Studies of the cost effectiveness of CAM treatments have prompted insurers to cover a limited number of alternative therapies, particularly acupuncture and chiropractic. The status of acupuncture was further elevated in 1997 when the National Institutes of Health declared that there is evidence that acupuncture is effective for treating pain, nausea and vomiting, addiction, stroke rehabilitation, and asthma. The NIH also called for health insurers, including Medicare and Medicaid, to expand their coverage to include acupuncture treatments.

And that reimbursement is undoubtedly contributing to the enormous growth of acupuncture and chiropractic care. Figure 4 illustrates how the volume of one chiropractic procedure correlates with increasing coverage by insurers and the increasing volume of patients. Managed care organizations and other third-party payers have strong incentive to reimburse for chiropractic care as studies demonstrate that the therapy reduces the rate of surgical interventions and inpatient stays. One recent study published on the online Chiropractic Resource Organization reported that the cost of treating episodes of low back pain was 28 percent lower in patients whose health plan provided chiropractic coverage compared to health plans without coverage. And total health care costs were 12 percent less for patients in plans that reimbursed for chiropractic services.

FIGURE 4: Three-Year Trend of Spinal Chiropractic Manipulation Charges



Source: Solucient's OutpatientView™, 1999-2001

Spurred by their patients, physicians are increasingly recommending CAM, especially for chronic conditions, such as back problems, anxiety, depression, and headaches. A 1996 survey of providers at the Kaiser Permanente Northern California medical group found that 90 percent of adult primary care physicians and obstetrics-gynecology clinicians recommended at least one alternative therapy to their patients, primarily for pain management. Researchers at Stanford University School of Medicine reported in a 1998 Archives of Internal Medicine article that acupuncture had the highest rate of physician referral (43 percent)

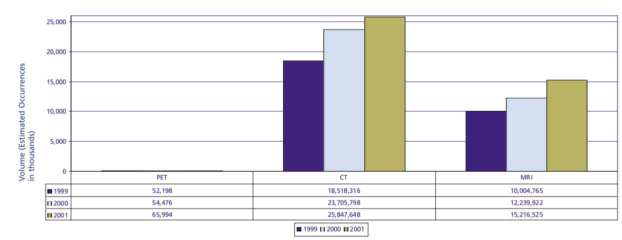
followed by chiropractic (40 percent), and half of the physicians believed the treatments were effective. And among family practitioners, 48.7 percent said they would be willing to use acupuncture in their own practices and 29 percent were open to integrating chiropractic in their practices, according to a 1998 article in the Journal of the American Board of Family Practice.

The top five specialties submitting claims for acupuncture treatment are chiropractic, physical medicine and rehabilitation, neurology, internal medicine, and general and family practice[1].

Growth Explosion in Imaging Procedures

Although positron emission tomography (PET) was invented more than a quarter century ago, only recently has the technology extended beyond the research lab and into clinical medicine, particularly oncology. Unlike computed tomography (CT) scans and magnetic resonance imaging (MRI), PET provides images of metabolic and physiologic processes, which allow physicians to detect disease sooner and more precisely differentiate scar tissue, necrosis, and tumor mass so they can better evaluate whether cancer has spread or recurred. PET's superior accuracy over other imaging modalities has resulted in reduced costs through the elimination of unnecessary surgeries and the need for other diagnostic tests. Researchers at Albert Einstein College of Medicine and Montefiore MedicalCenter writing in Seminars in Nuclear Medicine in 2000 predict that the "next decade will witness an explosive growth of PET technology in oncologic imaging."

FIGURE 5: Three-Year Trend in PET, CT, and MRI Volume



Source: Solucient's OutpatientView™, 1999-2001

[1]The procedure codes included in the analysis were CPT codes 97780 and 97781, acupuncture with and without electrical stimulation.

PET scans' rapid rise in outpatient settings— volume grew a mere 4.4 percent from 1999 to 2000 but then leapt 21.1 percent the following year— was bolstered by the Centers for Medicare and Medicaid Services' approval of PET as an imaging tool to diagnose six types of cancer and as a diagnostic test for heart disease in late 2000. Medicare is now covering PET scans to diagnose nearly half of the cancer cases in elderly Americans each year, according to a report on MedTech, an Internet site devoted to medical technologies.

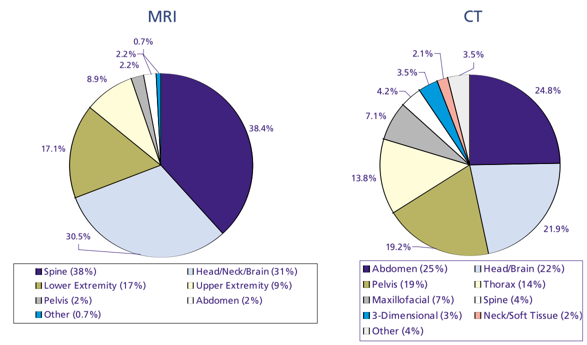
Since PET has only recently been adopted for clinical applications, its growth is expected to continue to explode. Yet other well-established major imaging procedures, such as CT and MRI, also are experiencing impressive growth. The volume of MRI increased 22 percent from 1999 to 2000 and rose another 24 percent the following year, according to Solucient's OutpatientView. CT scans experienced a 28 percent growth from 1999 to 2000, which tapered to a 9 percent increase from 2000 to 2001. The major areas of decrease in CT utilization were for the abdomen and pelvis. Likewise, these were major growth areas for MRI utilization.

FIGURE 6: Growth Trends of CT and MRI by Imaged Body Part

CPT Procedure Group	% Change from 1999 - 2000	% Change from 2000 - 2001
CT 3-Dimension	4.34%	17.86%
CT Abdomen	**36.11%**	**8.32%**
CT Brain/Ear	4.28%-	0.11%
CT Guidance	4.28%	3.85%
CT Head/Brain	31.07%	2.60%
CT Lower Extremity	4.33%	5.39%
CT Maxillofacial	12.07%	9.39%
CT Neck/Soft Tissue	4.36%	18.98%
CT Pelvis	**36.48%**	**15.01%**
CT Spine	4.48%	1.89%
CT Stereo Local	4.79%	1.83%
CT Thorax	36.68%	12.88%
CT Upper Extremity	4.25%	3.05%
MRI Abdomen	**4.34%**	**48.92%**
MRI Bone Marrow	4.42%	0.49%
MRI Breast	4.95%	1.28%
MRI Chest	4.42%	31.46%
MRI Head/Neck/Brain	23.59%	15.38%
MRI Lower Extremity	26.80%	30.04%
MRI Myocardium	4.38%	1.55%
MRI Pelvis	**4.35%**	**68.04%**
MRI Spine	19.67%	21.74%
MRI TMJ	4.31%	1.83%
MRI Upper Extremity	34.71%	50.18%

Source: Solucient's OutpatientView™, 2001

FIGURE 7: Applications of CTs & MRIs in 2001



Source: Solucient's OutpatientView™, 2001

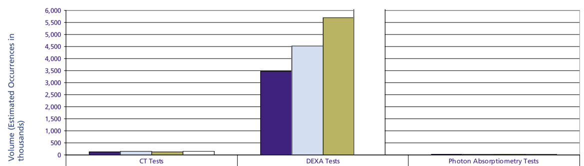
Proactive patients often ask for the noninvasive CT scans and MRIs because they want the best and latest technology and assume that the more sophisticated the imaging, the more accurate the diagnosis. Figure 7 depicts the applications of CT scans and MRIs.

Increased Osteoporosis Screening

As greater numbers of baby boomers transition into their senior years, osteoporosis and low bone mass are expected to rise dramatically. Over 10 million people currently have osteoporosis, and the National Osteoporosis Foundation (NOF) estimates that 14 million Americans will suffer this debilitating disease by 2020 with an additional 47 million at high risk for developing osteoporosis if current trends persist. Both the NOF and the U.S. Preventive Services Task Force (USPSTF) recommend that all women older than 65, regardless of other risk factors, be screened for osteoporosis, and Medicare began covering bone density tests in mid-1998. A heightened awareness of osteoporosis and the new reimbursement regulations likely contributed to the 31 percent increase in osteoporosis diagnoses during outpatient visits from 1999 to 2001, according to Solucient's OutpatientView. Considering that research indicates that only 12 percent of women over age 65 have had a bone mineral density test, the potential for osteoporosis screening is enormous as the population ages and if physicians and patients follow NOF's and the USPSTF's screening recommendations.

Dual energy X-ray absorptiometry (DEXA) is widely accepted as the most accurate screening method for identifying patients with low bone mineral density. The volume of outpatient DEXA bone density tests increased by 64 percent from 1999 to 2001, according to Solucient's data.

FIGURE 8: Growth Trends by Type of Bone Density Test[2]



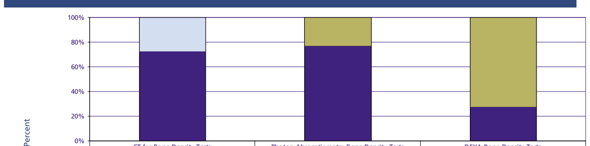
	CT Tests	DEXA Tests	Photon Absorptiometry Tests
1999	135,240	3,481,809	22,281
2000	141,370	4,535,089	23,435
2001	136,712	5,711,151	24,067
2006 Estimated	148,422	6,275,566	26,689

Bone Density Test Type

Source: Solucient's OutpatientView™, 1999-2001

DEXA has become the gold-standard screening test. It's highly accurate and precise, has low radiation, and is readily available. Single photon absorptiometry (SPA) tests can only measure bone density at the forearm, wrist, or finger, it requires a radionuclide, and it's not very precise. Quantitative computer tomography (qCT) is expensive, emits a high radiation dose, and isn't considered that precise. As Figure 8 shows, the growth rate for DEXA tests far exceeds CT and photon absorptiometry tests, which are showing fairly flat trends.

FIGURE 9: Type of Bone Density Test by Site of Care



	CT for Bone Density Tests	Photon Absorptiometry Bone Density Tests	DEXA Bone Density Tests
Emergency 2001	0	41	4,394
Physician Office 2001	0	5,450	4,121,534
Freestanding 2001	37,490	0	601
Hospital Based 2001	99,222	18,576	1,584,622

Bone Density Test Type

Source: Solucient's OutpatientView™, 1999-2001

Solucient's Methodology for OutpatientView

A person's experience with the health care system is defined by a series of encounters with health professionals in a variety of settings. An encounter is defined as a one-time, face-to-face meeting between a patient and a health

[2]The procedure codes used for this analysis are: 76070 CT bone density study; G0131 CT bone density-axial skeleton (e.g., hips, pelvis, spine); G0132 CT bone density-peripheral skeleton (e.g., radius, wrist, heel); 76075 DEXA bone density-axial skeleton (e.g., hips, pelvis, spine); 76076 DEXA bone density-peripheral skeleton (e.g., radius, wrist, heel); G0130 SEXA bone density-peripheral skeleton (e.g., radius, wrist, heel); 78350 Bone density-single photon absorptiometry; 78351 Bone density-dual photon absorptiometry.

professional. It is the collection of all procedures, diagnoses, and services performed by a single provider, for a single patient, in one place of service, on a single day. Solucient carefully builds estimates for these encounters to quantify demand for specific services performed within the context of the encounter. These estimates form the basis of Solucient's OutpatientView.

Health care utilization differs dramatically by age, sex, and payer. Solucient creates OutpatientView by carefully constructing utilization rates by all these variables, and then multiplies these rates by their appropriate populations to yield volume estimates. The majority of the utilization rates are built directly from the 2001 Standard Analytical File produced by the Centers for Medicare and Medicaid Services, and 2001 commercial claims data from Solucient's proprietary Claims Data Warehouse. National federal survey data is also integrated to create use rates for the Medicaid and uninsured populations, and as a source for validation.

The OutpatientView database integrates more than 180 million health care service records used to estimate demand and patient volumes for over 6,000 procedure codes and 8,000 diagnosis codes, across three years.

About Solucient

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Acknowledged throughout the industry as a leader in providing strategic and actionable health care intelligence, Solucient offers unique research, proprietary databases and advanced analytical models to help organizations improve performance, advance clinical care, grow market share, and increase return on investment.

For more information on the findings and trends in this report, please call your Service Account Manager, or email pharmainfo@solucient.com.

Colliers Hawaii Consulting, a division of Colliers Monroe Friedlander Inc.

Recognized for its comprehensive market reports and its thorough real estate analysis, Colliers Hawaii Consulting, the research and consulting division for Colliers Monroe Friedlander, Inc. (CMF), was established in 1992 as a support service for its brokerage and property management divisions. This department has evolved into a vital component of nearly every CMF client engagement and has advised a diverse array of developers, institutional ownerships, public companies, and commercial real estate tenants throughout Hawaii and the world.

Appendix C
Preliminary Engineering Report

~~Draft~~ FINAL

Preliminary Engineering Report

for

Makaiwa Hills

Submitted to:

Makaiwa Hills, LLC.

~~March 2007~~ October 2007

Submitted By

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- That the project, study or investigation meets the Client's objectives.
- That the requirements of our Agreement with the Client have been met, and the Client has received the value of the fee to be paid.

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I. INTRODUCTION

The Makaiwa Hills project, proposed by Makaiwa Hills, LLC, is a 4100 unit residential with supporting commercial development in Kapolei, Oahu. The project is bordered to the south by Farrington Highway, to the west by Waimanalo Gulch, to the north by Palehua Road and to the east by Makakilo (see Figure 1- Location Map). The project area is approximately 1,781 acres on the slopes of the Waianae mountain range (TMK: 9-1-15:5, Portion 17; 9-2-03: Portion 2, Portion 5, Portion 84).

This report will present information on infrastructure requirements for the proposed Makaiwa Hills. Specifically, this report will address:

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

II. PROJECT BACKGROUND

Topographical Features

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

The project site is transected from north to south by three major and three minor gulches (see Figure 2 – Topographic Map). The major gulches include Awanui Gulch, Palailai Gulch, and Makaiwa Gulch. Slopes vary throughout the site. On the southeastern corner of the site, slopes are as low as 2 percent. Across the plateaus and ridges, which traverse the site, common slopes are 10 percent. Within the gulches, slopes are steeper and range between 15 to 50 percent. Majority of the vegetation on the project site include tall grass with clumps of scattered brush or bushes, and patches of eroded ground. Vegetation in the gulch areas includes Kiawe and koa-haole shrubs.

Existing Uses

The project site is currently undeveloped land. A portion of the site is leased.

Leased lands north of the project site include the Camp Timberline private recreation facility and several private residences, several telecom transmitting sites and conservation lands. Access to the area mauka of the project is via the private, access-restricted Palehua Road. Also located north of the project are abandoned military buildings associated with a former Nike Station.

Climate

The climate in the Ewa Plain region is relatively warm and dry. Trade winds from the northeast occur much of the time, with occasional Kona winds. The temperature range in this region usually varies between the upper 60's (degrees Fahrenheit) to the lower 90's. Rainfall in the area is generally light, with a mean annual rainfall of approximately 20 inches near Farrington Highway, and about 30 inches at the northern boundary of the project site.

Land Use and Zoning
The proposed Makaiwa Hills will require zoning changes from agricultural to a variety of residential and commercial zoning. The proposed changes in land use are consistent with 1993 Urban District designation by the State Land Use Commission and with both the County's Ewa Development Plan and The Estate of James Campbell's Long Range Kapolei Area Master Plan for Ewa, Oahu. The proposed land uses and approximate quantities are summarized in Table 1 and shown in Figure 3 –Zoning Plan.

TABLE 1
PROPOSED LAND USES

Land Use	Acres (+/-)	Percent of Total	~~Acres in Open Space~~	~~% in Open Space~~
Residential	~~1027~~ 874	~~58%~~ 49%	~~423~~	~~41%~~
Mixed Use	~~127~~ 124	7%	44	~~34%~~
Commercial	33	2%	~~10~~	~~30%~~
~~Education~~	~~12~~	~~<1%~~	4	~~33%~~
Preservation	~~582~~ 750	~~33%~~ 42%	~~589~~	~~98%~~
TOTAL	1781	100%	~~1050~~	~~59%~~

* Figures are approximate

Soils
The anticipated soil types within the project site are identified in the U.S. Department of Agriculture, Soil Conservation Service, Soil Survey. The major soil types are listed below and depicted on Figure 4 – Soils Map.

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

III. DRAINAGE
Watershed Hydrology

The proposed development is situated within a 3,646-acre watershed in southwestern Oahu. Located on the leeward side of the island, the climate is warm and relatively dry with an annual average of 25 inches of rainfall across the watershed. Originating in the Waianae mountain range at the 2,200-foot elevation, the watershed slopes southerly towards its lower bound at Farrington Highway (elevation 120 ft above sea level).

Land use in the watershed is primarily undeveloped, with portions varying from natural forested areas, to open rangeland and barren grass meadows towards the south. To the east, the watershed borders Makakilo and collects runoff from portions of the residential areas. Throughout the watershed, there are well-defined gulches, which slope in a north to south direction at gradients up to 15%. Runoff from the gulches and adjacent tributary hillside is collected and conveyed across Farrington Highway through 17 culverts over the 3.0-mile section of the highway.

The three major gulches, which flow through the site, are Makaiwa Gulch, Palailai Gulch, and Awanui Gulch. Waimanalo Gulch is another watercourse in the area, located just west of the proposed development. Downstream of the highway, Makaiwa Gulch flows southwesterly through the Ko'Olina Resort. Both Palailai and Awanui Gulch cross beneath the highway and discharge into a drainage channel which flows through the Kapolei West site and Kapolei Harborside channel before outfalling below Malakole.

Drainage Criteria / Standards

Both the State Department of Transportation (DOT) and the City and County of Honolulu Drainage standards will apply to this development.

The DOT's standards require all Freeway and Arterial Highway bridges and culverts be designed to convey the ~~1 in~~ 50-year peak flows. For those structures covered by the National Flood Insurance Program, they should be designed to convey a ~~1 in~~ 100-year peak flow.

Rainfall intensity Plate Maps from the City and County of Honolulu Drainage standards were used to calculate rainfall intensities. These intensities were then used to estimate peak flows for a 10-year, 50-year and 100-year return period event.

The Rational Method was used to calculate peak flows for the 10-year and 50-year event, based on a 1-hour rainfall duration with rainfall intensities of 1.9 inches/hour and 2.4 inches/hour, respectively (as per Plate 1 and 2 of the aforementioned standards). Using these 1-hour intensities, a correction factor was applied (as per Plate 4 of the City and County Standards) to estimate peak intensities for varying time of concentrations as summarized in Table 2.

TABLE 2
RAINFALL INTENSITY FOR VARIOUS DURATIONS

Time of Concentration (min)	Correction Factor	Intensity (inches/hour) 10-year	50-year
5	2.8	5.6	7.7
10	2.35	4.7	6.5
15	1.9	3.8	5.2
30	1.45	2.9	4.0
60	1.0	2.0	2.75

Peak flow estimates for the major stream channels and drainage structures, with contributing areas greater than 100 acres, were developed using Plate 6 from the City and County Standards. This approach results in peak flow estimates on the order of a 100-year event or larger, which are typically used for designing major stream crossings (i.e. culverts and bridges). In this report, the peak flows estimated using Plate 6 are referred to as the "100-year" event. Table 3 below summarizes the peak discharge versus area relationship obtained from Plate 6, with the proposed site being located in the Group C area.

TABLE 3
"100-YEAR" PEAK DISCHARGE VS. AREA RELATIONSHIP
(FOR AREAS LARGER THAN 100 ACRES)

Area (acres)	"100-year" Peak Discharge (cfs)
100	680
200	825
400	1,400
600	1,850
800	2,250
1,000	3,300
1,500	3,600
2,000	4,500

Times of concentration were estimated for each subcatchment, based on the individual overland slopes and lengths; as well as Plates 3 and 5 in the City and County Standards.

Existing Conditions
The watershed originates above the proposed development site and runoff from "offsite" areas is conveyed through the development via the gulches and overland flow. Runoff from the site and upstream offsite regions is conveyed across Farrington Highway through 17 culverts, eventually draining onto the makai side of the highway.

The watershed was divided into 15 subcatchments. Figure 5 illustrates the pre-development sub-catchments' boundaries and corresponding drainage area ID's. The drainage areas ID's refer to the discharge locations at the existing Farrington Highway culvert crossings.

Runoff peak flow estimates were developed for each highway culvert for the 10-year, 50-year, and "100-year" return period events. These peak flow estimates are summarized in Table 4.

TABLE 4
PRE-DEVELOPMENT PEAK FLOWS

Discharge Location ID	Area (acres)	10-Year Flow (cfs)	50-Year Flow (cfs)	"100-Year" Flow (cfs)[1]
A	719	704	889	2,100
B	23.3	41	51	–
~~C (west)~~	~~27.0~~	~~38~~	~~48~~	–
~~C (east)~~ C	~~42.5~~ 69.5	~~60~~ 98	~~76~~ 124	–
D	7.5	14	17	–
~~E~~	~~149.4~~	~~190~~	~~239~~	750
~~F~~ E & F	~~10.6~~ 160.0	~~19~~ 209	~~24~~ 263	– 805
G	519	549	694	1,650
H	282	309	390	1,000
I	6.0	12	15	–
J	90	119	150	–
K	19	38	48	–
L (Palailai Gulch)	813	727	918	2,249
L (Awanui Gulch)	773	691	873	2,052
M	84.8	141	178	–
N	45.5	83	105	–
O	34.6	60	76	–

1. "100-year" flows were determined using Plate 6 from the City and County Standards.

The largest runoff rate predicted is that for catchment "L", which collects both Palailai Gulch and Awanui Gulch. Runoff from both gulches is piped across Farrington Highway, via separate culverts. Waimanalo Gulch in catchment "A" conveys the second highest peak flows. The tributary area to this gulch is located outside of the proposed development site.

There are 17 culverts, one for each of the above mentioned discharge locations, that convey runoff across Farrington Highway. Table 5 summarizes the dimensions, lengths, slope and capacity of these culverts – and compares the capacity to the estimated 10-year, 50-year and "100-year" peak flows.

TABLE 5
EXISTING FARRINGTON HIGHWAY CULVERT CAPACITY

Location ID	Culvert Size	Culvert Length (ft)	Culvert Slope (%)	Culvert Capacity[1] (cfs)	10-Yr Flow (cfs)	50-Yr Flow (cfs)	"100-Yr" Flow (cfs)[2]
A	3 x 96" diam.	220 ft	5.7 %	1,377	704	889	2,100
B	36" diam.	172 ft	4.7 %	35	41	51	–
~~C (west)~~	~~42" diam.~~	~~356 ft~~	~~1.4 %~~	~~53~~	~~38~~	48	–
~~C (east)~~ C	~~36" diam.~~ 2 x 42" diam.	~~115 ft~~ 356 ft.	~~1.1 %~~ 1.4 %	~~35~~ 127	~~60~~ 98	~~76~~ 124	–
D	36" diam.	125	1.3 %	35	14	17	–
~~E~~	~~2 x 36" diam.~~	~~108 ft~~	~~1.0 %~~	~~70~~	~~190~~	~~239~~	~~750~~
~~F~~ E & F	~~2 x 36" diam.~~ 4 x 42" diam.	~~149 ft~~ 2 – 108 ft 2 – 149 ft	4.8 %	~~70~~ 254	~~19~~ 209	~~24~~ 263	– 805
G	8ft high x 18ft wide Box	121 ft	5.6 %	1,170	549	694	1,650
H	2 x 84" diam.	142 ft	1.7 %	560	309	390	1,000
I	24" diam.	144 ft	9.8 %	12	12	15	–
J	6 ft x 6 ft Box	121 ft	5.6 %	258	119	150	–
K	36" diam.	107 ft	4.3 %	~~35~~ 44	38	48	–
L (Palailai)	2 x 120" diam.	120 ft	1.1 % & 0.7 %	1,410	727	918	2,249
L (Awanui)	2 x 108" diam.	115 ft	1.4 % & 0.03 %	1,200	691	873	2,052
M	2 x 48" diam.	175 ft	0.2 % & 0.02 %	~~140~~ 175	141	178	–
N	36" diam.	177 ft	0.4 %	~~35~~ 44	83	105	–
O	2 x 30" diam.	190 ft	0.6 %	~~42~~ 70	60	76	–

1. Culvert capacity is based on inlet capacity.
2. "100-year" flows were determined using Plate 6 from the City and County Standards.

Modifications After Development

Development will impact the hydrology of the watershed as sections of undeveloped areas and rangeland will be replaced with impervious surfaces (roads, buildings, etc.) and the vegetative surface cover will be altered. The corresponding impact will result in higher runoff volumes and peak flows. Since large areas in the upper watershed (uphill of the site) will remain undeveloped, the impact on peak flows downstream of the site should not be significant Culverts and drainage structures will be sized to accommodate peak flows in accordance with drainage standards. Off-site drainage improvements in Koolina and Kapolei West have been designed to accommodate peak runoff from the Makaiwa Hills project per City and County of Honolulu drainage standards.

Due to the construction of new roadways and residential neighborhoods transecting across the hillside, some of the existing drainage patterns and subcatchment areas will likely be altered. Therefore, the watershed and proposed development site was discretized into smaller subcatchments for the post development condition – in order to determine peak flows at the road crossings and various locations along the hillside. In total, 36 subcatchments were delineated for the watershed (ranging from 3.1 acres to 719 acres) using the proposed road network, lot layout and topographic contour information.

Figure 6 illustrates the post-development subcatchments and drainage node ID's, with the proposed road network and lot layout superimposed. The estimated 10-year, 50-year and "100-year" peak flows through the development are summarized below in Table 6.

TABLE 6
POST-DEVELOPMENT PEAK FLOWS

Area ID	Tributary Area (acres)	10-Year Flow (cfs)	50-Year Flow (cfs)	"100-Year" Flow (cfs)[1]
A05	719.0	704	889	2,100
B05	23.3	42	53	–
C05	71.2	126	160	–
D05	6.8	18	23	–
E05	91.5	130	164	–
E10	102.0	144	182	510
E15	151.2	218	276	760
E20	154.3	219	277	780
F05	7.0	15	19	–
G05	103.3	147	185	520
G10	375.9	565	714	1,300
G15	520.6	709	895	1,650
G20	523.7	701	886	1,665
H05	62.0	95	120	–
H10	183.0	318	401	800
H15	277.7	470	593	985
H20	286.0	473	598	1,015
I05	10.7	21	27	–
J05	18.6	50	63	–
J10	39.3	101	128	–
J15	59.3	145	184	–
K05	6.2	16	21	
L05	88.9	136	172	–
L10	315.4	542	685	1,110
L15	419.0	~~690~~ 720	~~872~~ 929	1,450
L20	438.6	~~711~~ 740	~~898~~ 955	1,480
L25	209.4	~~322~~ 337	~~407~~ 446	850
L30	302.0	~~442~~ 456	~~558~~ 600	1,070
L35	354.3	~~531~~ 550	~~671~~ 723	1,230
L40	801.7	~~534~~ 555	~~675~~ 730	2,255
L45	686.4	~~1,005~~ 1,027	~~1,270~~ 1,297	2,000
L50	743	~~1,092~~ 1,113	~~1,379~~ 1,406	2,110
L55	813	~~1,217~~ 1,223	~~1,537~~ 1,659	2,290
L60	773	~~1,111~~ 1,142	~~1,404~~ 1,442	2,170
M05	84.8	193	244	–
N05	45.5	91	115	–
O05	34.6	60	76	–

1. "100-year" flows were determined using Plate 6 from the City and County Standards. These flows are anticipated to be on the order of, or greater than, a 100-year return period. 100-Year flows were only estimated for drainage areas larger than 100 acres.

Preliminary Drainage Network

Storm Sewers and Culverts

As shown in Figure 6, the road network servicing the proposed development site is predicted to have 14 major "on-site" road crossings of the gulches. Based on the City and County Standards these crossings should be sized to convey the estimated "100-year" peak flows, in accordance with the Plate 6 of their standards. At the same time, the DOT standards require the highway culverts be sized to convey a 50-year peak flow per their design standards.

Subject to the estimated peak flows, topography, road grades and site constraints these road crossings could be either circular culverts, box culverts or bridges. Preliminary sizes of the structures at these locations are summarized below in Table 7~~, based on concrete pipe material and a 2% gradient~~. The sizing of the culverts is based on concrete pipe material, a 2% gradient and Plate 7, Freeboard Allowances. These culvert sizes will be confirmed during the detailed design stage when grades, structure type and contributing areas are confirmed. In some instances, bridges may be more favorable than culvert crossings based on the topography, height of the roadway above the channel bottom, and environmental consideration.

TABLE 7
PRELIMINARY HYDRAULIC STRUCTURE SIZING

Location	Tributary Area (acres)	"100-Year" Flow (cfs)[1]	Culvert Size	Culvert Capacity (cfs)	Q_{100}/Q_{cap}	Flow Depth (ft)	Vel. (fps)	Freeboard (ft)	Total Depth Req'd (ft)
G05	103.3	520	~~6 ft diameter~~ 1 - 6ft x 8ft box	575	~~0.90~~	3.8	23	2.85	6.65
G15	520.6	1,650	2 - 8ft wide x ~~6~~ 8ft high box	2,130	~~0.78~~	4.0	26	3.0	7.0
H05	62.0	600	1 - 6ft x ~~6~~ 8ft box	730	~~0.82~~	4.2	23.5	3.0	7.2
H10	183.0	800	1 - 8ft wide x ~~6~~ 8ft high box	1,065	~~0.75~~	3.9	25.5	3.0	6.9
H15	277.7	985	1 - 8ft wide x ~~6~~ 8ft high box	1,065	~~0.92~~	4.6	27	3.1	7.7
L05	88.9	650	1 - 6ft x ~~6~~ 8ft box	730	~~0.89~~	4.5	24	3.0	7.5
L10	315.4	1,110	2 - 6ft x ~~6~~ 8ft boxes	1,460	~~0.75~~	4.0	23	2.9	6.9
L15	419.0	1,450	1 - 8ft wide x ~~8~~ 10ft high box	1,575	~~0.92~~	6.2	29	3.4	9.6
L25	209.4	850	1 - 8ft wide x ~~6~~ 8ft high box	1,065	~~0.80~~	4.1	26	3.1	7.2
L30	302.0	1,070	2 - 6ft x ~~6~~ 8ft boxes	1,460	~~0.73~~	3.9	23	2.85	6.75
L35	354.3	1,230	1 - 8ft wide x ~~8~~ 10ft high box	1,575	~~0.78~~	5.45	28	3.3	8.75
L40	801.7	2,255	Bridge or 2 - 8ft wide x ~~8~~ 10ft high box	3,150	~~0.72~~	5.1	28	3.2	8.3
L45	686.4	2,000	2 - 8ft wide x ~~6~~ 8ft high box	2,130	~~0.94~~	4.6	27	3.15	7.75
L50	743.1	2,110	2 - 8ft wide x ~~6~~ 8ft high box	2,130	~~0.99~~	4.8	27	3.2	8.0

1. "100-year" flows were determined using Plate 6 from the City and County Standards. These flows are anticipated to be on the order of, or greater than, a 100-year return period. 100-Year flows were only estimated for drainage areas larger than 100 acres.

Retention/Detention Facilities

Retention (or detention) facilities are typically constructed to retain increases in storm drainage runoff that occurs as a result of development. These facilities often include: open basins, detention ponds, underground storage tanks and engineered lakes. Drainage improvements in

Koolina and Kapolei West have been designed to accommodate peak runoff from the Makaiwa Hills project per City and County of Honolulu drainage standards. Therefore, detention facilities are not anticipated to be required for this development from a stormwater quantity perspective, but they may be required to provide water quality improvements.

Stormwater Quality

City and County of Honolulu Standards

The project will be designed to meet the City and County of Honolulu stormwater quality requirements as outlined in the Rules Relating to Storm Drainage Standards, dated January 2000. The City and County of Honolulu requires all residential developments greater than 10 acres in size meet specific sizing criteria for storm water quality facilities. These requirements are currently being revised and storm water quality for this project will need to address any new requirements when they become available.

DOT Standards

Since runoff from the project will discharge through the State's DOT storm drainage system via the culverts across Farrington Highway, it is also anticipated that the project will need to incorporate water treatment BMPs in conformance with State DOT NPDES MS4 permit requirements. DOT is also in the process of developing stormwater quality criteria and it is anticipated this criteria will include the requirement for permanent structural BMPs to address water quality.

Water Quality Measures

During the more detailed planning and design of the infrastructure to service the site, the design engineers will work with the City and County of Honolulu and SDOT to determine the necessary water quality standards and which BMP's would be most effective for this project.

The objectives of the water quality BMP's would be to mitigate the impact of pollutants (sediment, grit, oil, heavy metals) that enter the drainage system from the frequent, smaller rainfall events such as a ~~1-in~~ 5-year event. A common technique is using detention basins or wetlands to retain runoff, thus allowing sediment and grit to settle out. Plants can be incorporated into the design to absorb particles and filter heavy metals. Detention ponds and wetlands are most effective when they: are "off-line" from a creek or gulch; have low flows/velocities; have sufficient retention time; and are in low-lying areas.

Additional water quality BMP's include construction of bio-swales and infiltration swales alongside the roadway. These swales collect runoff, filter particles and provide infiltration to recharge the groundwater. Swales are most effective on flat slopes, over short lengths and where favorable soils exist – such as a parking lot and cul-de-sacs.

Mechanical water quality structures such as centrfigual units and filter systems are also effective in settling suspended solids and extracting floatables (i.e. garbage, litter). These mechanical structures are often installed in-line with the underground storm sewer system.

Off-Site Improvements

Runoff from the proposed development will be conveyed across Farrington Highway through the existing culverts. On the makai side of the highway, runoff flows through the regional drainage system via natural channels through the Ko Olina Resort and Kapolei Site, before flowing across the railroad right-of-way and into the ocean. Figure 7 illustrates the Off-Site drainage routes through the Ko Olina and Kapolei West sites.

Capacity of the culverts across Farrington Highway and downstream through Ko Olina will be further examined during the preliminary design stage to assess whether pipe or channel improvements are required to convey peak flows from the Makaiwa Hills site. A review of the regional drainage system through Ko Olina and the Kapolei site is provided in the "Preliminary Engineering Report for the Proposed Kapolei Commons", prepared by Engineering Concepts in March 2006, and "Preliminary Engineering Report for the Proposed Kapolei West Development", prepared by Engineering Concepts in February 2005.

IV. GRADING AND SOIL EROSION

Grading

It is anticipated that grading within the project site will be limited to areas favoring development, such as the ridges and plateau areas where slopes are less steep. The grading concept for the residential lots will be to provide a level pad area for the home rather than leveling of the entire lot. The steep gulch areas will generally remain undeveloped. However, some grading in the gulches may be required to support bridges, culverts, and roadways between ridges.

An effort to balance earthwork quantities of cut and fill is expected to minimize the cost of purchasing offsite borrow material and disposing excess excavated material at an off site location. Grading operations will be in conformance with the applicable ordinances of the City and County of Honolulu.

More detailed soils investigations will be performed as planning of the project proceeds. The project's soils engineers will recommend mitigative measures as building types and locations are further defined. These may include the removal of unsuitable soils under foundations and/or special foundation designs.

Site Characteristics

The project site is divided into nine subareas for calculating soil erosion potential (see Figure ~~7~~ 8). These subareas represent sites that vary in soil erosion potential characteristics such as terrain and/or drainage network.

Subarea A occupies approximately 78 acres on the western side of the site. This subarea is a plateau formed between Waimanalo Gulch and an unnamed gulch. Runoff from subarea A generally flows overland toward Farrington Highway. The extreme southwest corner of the subarea has sustained steep, near vertical cuts as part of the Farrington Highway off-ramp/fly-over to Ko Olina. The cut area has been landscaped in an effort to reduce erosion potential. Grassland with scattered trees and shrubs, and eroded areas with sparse vegetation characterize the remaining undeveloped portion of subarea A. After development, approximately 25 percent will be zoned residential, 25 percent will be zoned low-density apartment, and 50 percent will be classified as preservation and remain undeveloped.

Subarea B occupies approximately 180 acres of the drainage area of a minor, unnamed gulch east of the subarea A and west of Makaiwa Gulch. The undeveloped subarea is similar to the vegetal characteristics of subarea A described in the above paragraph. In addition, the gulch area supports growths of kiawe trees with a subcanopy of koa-haole shrubs in some places. Approximately 40 percent of the area is planned for residential development, 10 percent is planned for low-density apartments, and the remaining 50 percent is planned for preservation.

The grassland and gulch area described in subareas A and B are typical of the existing conditions found in all subareas. A brief characterization of each subarea is included in Table 8.

TABLE 8
SUB-AREA CHARACTERISTICS

Sub Area	Gulch/Plateau	Acres	Percent Residential (%)	Percent Low Density Apartment (%)	Percent Commercial (%)	Percent Undeveloped (%)
A	Plateau	78	~~25~~ 5	~~25~~ 45	0	50
B	Minor, unnamed gulch	180	~~40~~ 6	~~10~~ 24	0	~~50~~ 70
C	Makaiwa Gulch	382	~~25~~ 18	~~5~~ 4	0	~~70~~ 78
D	Minor, unnamed gulch	222	~~45~~ 40	~~5~~ 4	0	~~50~~ 56
E	Plateau	155	~~25~~ 44	~~25~~ 29	0	~~50~~ 27
F	Minor, unnamed	320	~~55~~ 42	~~5~~ 11	0	~~40~~ 47
G	Palailai Gulch	245	~~55~~ 41	~~10~~ 17	0	~~35~~ 42
H	Awanui Gulch	115	~~30~~ 23	~~0~~ 15	15	~~55~~ 62
I	Plateau	83	~~5~~ 0	~~15~~ 17	~~70~~ 18	~~10~~ 65

Calculation of Soil Erosion Potential

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

$$A = RKLSCP$$

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

The rainfall factor (R) ~~is based on the U.S. Soil Conservation Service (SCS) Erosion and Sediment Control Guide for Hawaii~~ was determined using the map of Average Annual Values of Rainfall Factor included in Section 1-8 of the Department of Planning and Permitting, City and County of Honolulu Rules Relating to Soil Erosion Standards and Guidelines. The soil erodibility factor (K) for each subarea was selected after evaluating the U.S. Department of Agriculture Soil Survey and City and County of Honolulu Soil Erosion Standards and Guidelines, and is based upon the weighted average of all K values for soil types in each subarea. The cover and management factor (C) is also based on a weighted average for C values within each subarea and has been calculated to reflect conditions both before and after the development of the project. Both R and K factors will remain constant for the site before and after the proposed project is constructed.

The slope length factor (L) and slope gradient factor (S) are combined into an LS factor for calculations. LS factors are interpolated from Table 16 in Section 1-8 of the Department of Planning and Permitting, City and County of Honolulu Rules Relating to Soil Erosion Standards and Guidelines. The differences in LS factors between subareas reflect the differences in topography. The LS factors show a decrease with development due to site grading and construction of an underground drainage system, which is expected to reduce the slope and length of overland flow.

The erosion control practice factor (P) is the factor for use of mechanical or engineering erosion control measures. The selection of this factor depends on the grading and construction schedule, and the erosion control plan for the project. A value of 1.0 for P implies that no erosion control practices are applied, while a value less than 1.0 indicates erosion control measures such as filter inlets, berms, and sediment traps are employed. The calculations below use a P value of 1.0 for existing conditions and a P value of 0.8 for conditions during construction.

The existing soil erosion potential for the nine subareas was estimated using the USLE (see Table 9). The total estimated soil loss under existing conditions is ~~41,800~~ 42,500 tons/year.

The soil erosion potential of the project site after development is estimated to be ~~4,700~~ 20,220 tons/year. A breakdown of soil erosion potential for each subarea under developed conditions is presented in Table 10.

TABLE 9
ESTIMATE SOIL LOSS DUE TO STORM RUNOFF
(EXISTING CONDITIONS)

Sub Area	R	K	L (ft)	S (%)	LS	C *	P	A	Acres	Tons/Yr
A	200	0.28	1,927	11.94	~~14.14~~ 7.95	0.028	1	~~22.17~~ 12.47	78	~~1,700~~ 1,000
B	200	0.28	5,855	13.79	~~13.51~~ 17.41	0.028	1	~~21.18~~ 27.30	180	~~3,800~~ 4,900
C	200	0.29	5,493	16.85	~~20.70~~ 23.41	0.028	1	~~33.62~~ 38.02	382	~~12,800~~ 14,500
D	200	0.27	9,970	10.72	~~13.74~~ 15.31	0.028	1	~~20.77~~ 23.15	222	~~4,600~~ 5,100
E	200	0.27	3,542	9.45	~~13.05~~ 7.55	0.028	1	~~19.73~~ 11.42	155	~~3,100~~ 1,800
F	200	0.27	10,441	9.51	~~15.41~~ 13.08	0.028	1	~~23.30~~ 19.77	320	~~7,500~~ 6,300
G	200	0.28	1,408	17.33	~~10.43~~ 12.42	0.028	1	~~16.35~~ 19.47	245	~~4,000~~ 4,800
H	200	0.28	674	27.89	~~17.37~~ 19.58	0.028	1	~~27.24~~ 30.70	115	~~3,100~~ 3,500
I	200	0.30	817	11.15	~~8.73~~ 4.65	0.028	1	~~14.67~~ 7.82	83	~~1,200~~ 600
								TOTAL	**1,780**	**~~41,800~~ 42,500**

* Existing C factor was based on Table 20, Section 1-8 of the Department of Planning and Permitting, City and County of Honolulu Rules Relating to Soil Erosion Standards and Guidelines. Existing vegetation (canopy of tall weeds or short brush with 75% cover and 75% ground cover) is uniform throughout the site.

TABLE 10
ESTIMATE SOIL LOSS DUE TO STORM RUNOFF
(DEVELOPED CONDITIONS)

Sub Area	R	K	L (ft)	S (%)	LS	C *	P	A	Acres	Tons/Yr
	200	0.28	726	23.97	~~3.06~~ 15.56	~~0.0154~~ 0.0140	~~1~~ 0.8	~~2.64~~ 9.76	78	~~200~~ 800
B	200	0.28	1,446	19.89	~~3.06~~ 15.89	~~0.0156~~ 0.0196	~~1~~ 0.8	~~2.67~~ 13.96	180	~~500~~ 2,500
C	200	0.29	5,493	16.85	~~3.06~~ 23.41	~~0.0206~~ 0.0218	~~1~~ 0.8	~~3.66~~ 23.73	382	~~1,400~~ 9,100
D	200	0.27	3,000	10.30	~~3.06~~ 7.90	0.0157	~~1~~ 0.8	~~2.59~~ 5.35	222	~~600~~ 1,200
E	200	0.27	336	5.03	~~3.06~~ 0.99	~~0.0154~~ 0.0076	~~1~~ 0.8	~~2.54~~ 0.32	155	~~400~~ 100
F	200	0.27	5,534	10.84	~~3.06~~ 11.60	0.0132	~~1~~ 0.8	~~2.18~~ 6.60	320	~~700~~ 2,100
G	200	0.28	1,408	22.83	~~3.06~~ 19.90	~~0.0119~~ 0.0118	~~1~~ 0.8	~~2.04~~ 10.48	245	~~500~~ 2,600
H	200	0.28	674	27.89	~~3.06~~ 19.58	~~0.0132~~ 0.0174	~~1~~ 0.8	~~2.26~~ 15.23	115	~~300~~ 1,800
I	200	0.30	597	1.49	~~3.06~~ 0.28	~~0.0045~~ 0.0182	~~1~~ 0.8	~~0.83~~ 0.24	83	~~100~~ 20
								TOTAL	**1,780**	**~~4,700~~ 20,220**

* Developed C factor was determined by taking the Existing C factor and multiplying it by the approximate percentage of undeveloped area for each Sub-Area.

Impacts and Mitigation
Long Term Impacts
Based on the USLE, the soil erosion potential at the project site is estimated to decrease after the development of the proposed Makaiwa Hills project. This decrease in soil erosion results from a reduction of erodible surfaces (with an increase in buildings and pavement); a reduction of length and slope of overland flow due to site grading and the construction of a storm drain system; and an increase in landscaped area (reduction of bare ground). The estimated soil erosion potential for the project is estimated to decrease by ~~37,100~~ 22,280 tons/year; or ~~89~~ 52 percent after development. A comparison of the soil erosion potential for the existing and developed conditions is summarized in Table 11.P

TABLE 11
SUMMARY OF SOIL EROSION POTENTIAL

Subarea	Existing Conditions (ton/yr)	Developed Conditions (ton/yr)	Percent Decrease (%)
A	~~1,700~~ 1,000	~~200~~ 800	~~88~~ 20
B	~~3,800~~ 4,900	~~500~~ 2,500	~~87~~ 49
C	~~12,800~~ 14,500	~~1,400~~ 9,100	~~89~~ 37
D	~~4,600~~ 5,100	~~600~~ 1,200	~~87~~ 76
E	~~3,100~~ 1,800	~~400~~ 100	~~87~~ 94
F	~~7,500~~ 6,300	~~700~~ 2,100	~~91~~ 67
G	~~4,000~~ 4,800	~~500~~ 2,600	~~88~~ 46
H	~~3,100~~ 3,500	~~300~~ 1,800	~~90~~ 49
I	~~1,200~~ 600	~~100~~ 20	~~92~~ 97
TOTAL	**~~41,800~~ 42,500**	**~~4,700~~ 20,220**	**~~89~~ 52**

Short Term Impacts
The construction of the project will involve land disturbing activities that may result in soil erosion, such as the removal of existing vegetation (clearing and grubbing) and leveling, removing, and replacing soil.

The USLE can be used to estimate soil erosion potential based on these short-term construction impacts. For calculation purposes, it is assumed that construction will be in phases over a 15-year period. Based on approximately 1,200 acres to be developed, construction of 80 acres per year was assumed for estimating short-term soil erosion potential. This results in an estimated 38,000 tons per year of soil erosion from the project site during the grading period.

Short-term soil erosion may be reduced by implementing mitigative measures such as limiting grading to not more than 15 ~~consecutive~~ contiguous acres at a time and seeding half of the area. This will reduce estimated erosion potential for the site by 17,800 tons per year or 48 percent. Additional erosion control measures that would lessen construction impacts even further include:

1. Minimize time of construction.
2. Retain existing ground cover until the latest date before construction.
3. Early construction of drainage control features.
4. Use of temporary area sprinklers in non-active construction areas when ground cover is removed.
5. Station water truck on site during construction period to provide for immediate sprinkling, as needed, in active construction zones (weekends and holidays included).
6. Use temporary berms and cut-off ditches, where needed, for control of erosion.
7. Thorough watering of graded areas after construction activity has ceased for the day and on weekends.
8. Implementing Sedimentation basins

9. Sod or plant all cut and fill slopes immediately after grading work has been completed.
10. Use of slope stabilization materials where needed

Grading and Erosion Control Plans will be prepared in compliance with Chapter ~~23~~ 14, Articles 13-16, Revised Ordinances of Honolulu. Further, the contractor will be required to perform all grading and stockpiling operation in conformance with the applicable provisions of Chapter 54 (Water Quality Standards) and Chapter 55 (Water Pollution Control) of Title 11 Administrative Rules of the State Department of Health.

Sediment Yield

Sediment yield is the amount of material eroded from the land surface over a specific period. Construction activities within the project site are expected to contribute to sediment yield in the area. Sediment yield analysis was not performed as part of this report, since sediment yield is not currently part of the City & County of Honolulu Erosion Control Standards. However, erosion and sediment control measures will comply with the applicable standards in place at the time of design and construction. Sediment yield analysis will also be conducted if required by the applicable standards in place during design and construction.

V. ROADS

Existing Conditions

The project site is located north of Farrington Highway/H-1 Freeway. The Palailai Interchange is found in the southeast corner of the site. The State owned Old Farrington Highway winds its way through the lower portion of the site, connecting the Palailai Interchange on the east to Farrington Highway on the west. Palehua Road, a private two-lane roadway, forms the northern boundary of the site. Current access to the lower portions of the site is from the eastern end of Old Farrington Highway while the upper portions of the site can be accessed from Palehua Road. Nohona Street in the Makakilo development is found adjacent to the eastern boundary of the project.

Modifications After Development

A Traffic Impact Assessment Report has been prepared for this project by Wilbur Smith Associates. The TIAR outlines the requirements and impacts for access to the development and improvements to supporting infrastructure.

The initial access for the Project would be from the H-1 freeway at the Palailai Interchange with a mauka extension to Kalaeloa Boulevard from its present intersection with Farrington Highway. In addition, an interchange east of the Honokai Hale subdivision at the future junction with Kapolei West Road D would be required. This interchange is referred to herein as the Makaiwa Interchange.

Onsite roadways will consist of backbone or collector roads serving local roadways within the individual subdivisions. Old Farrington Highway will be replaced or upgraded and extended to the west along the makai side of the Project. There is also a collector road planned looping to the mauka side of the Project. These collectors will provide access to and be constructed during the

various phases of the Project. It is also planned to provide an interior road connection to the Makakilo development at Nohona Street.

Impacts and Mitigation

Impacts and mitigation are identified in the TIAR. The project will generate additional traffic on the roadways in the vicinity of the project site. Planned regional traffic improvements such as the Kapolei Interchange, expansion of the Palailai Interchange, and the addition of a proposed Makaiwa Interchange have taken the development into account. Old Farrington Highway is to be improved as an arterial and will be utilized and extended in a manner similar to a frontage road to minimize connections to Farrington Highway and the freeway. The only connection to Farrington Highway proposed is at the Makaiwa Interchange.

VI. WATER

Existing Conditions

The sources of water supply in the Ewa/Kapolei region are the Board of Water Supply's Hoaea Wells, Kunia Wells I, and Waipahu Wells located in Waipahu. Two transmission mains, 30-inch and 36-inch, along Farrington Highway transmit the water to various distribution systems west along the highway. Along the highway, the 30-inch and 36-inch transmission mains deliver potable water to a 4.0 MG Makakilo 440 Reservoir, and the 3.0 MG, 4.0 MG, and 5.0 MG Barbers Point 215 Reservoirs. At the Barbers Point reservoir site, a booster pump and 24-inch transmission main deliver potable water to Nanakuli. The project site is not currently served by a potable water distribution system. Figure 9 depicts the existing regional potable water system for the Ewa/Kapolei area.

Projected Demand

Water demand estimates for this project are based upon the BWS Water System Standards 2002.

TABLE 12
ESTIMATED POTABLE WATER USE DEMAND

Land Use	No. of Units	gpd/unit	Average Daily Demand (gpd)	Required Fire Flow Capacity (Flow (gpm)/Duration (hrs))
Single Family Residential	~~1,619~~ 1,594 homes	500	~~809,500~~ 797,000	1000/1
Duplex	~~232~~ 216 units	500	~~116,000~~ 108,000	1000/1
Low Density Apartment	~~2,249~~ 2,190 units	400	~~899,600~~ 876,000	1500/1
Educational	1,150 students	60	69,000	2000/2
~~Community Center/School~~	~~10 acres~~	~~4,000~~	~~40,000~~	~~2000/2~~
Town Center	~~115,000~~ 90,000 bldg. sq.ft.	0.12	~~13,800~~ 10,800	2000/2
Shopping Center	150,000 bldg. sq.ft.	0.10	15,000	4000/3
		TOTAL (MGD)	~~**1.94**~~ **1.88**	

Based on the development information in the above Table 12, the Average Daily Demand for the development is estimated to be ~~1.94~~ 1.88 MGD. The Maximum Daily Demand is estimated to be ~~2.91~~ 2.82 MGD and a Peak Hour Demand of ~~5.82~~ 5.64 MGD. The proposed system shall be able to accommodate both the above daily demand and the fire flow requirements. The purpose of Fire Storage is to store the volume of water required to meet the largest fire flow in the system.

Proposed Water System
Currently, BWS does not serve the project site with a potable water system. Therefore, a water storage and distribution system is proposed for Makaiwa Hills. The Board of Water Supply does own three potable water reservoirs within the site with a transmission main along Farrington Highway, which currently serves the Kapolei area.

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

The distribution system will draw off the existing 24-inch transmission main located in Farrington Highway on the west side of the Ko Olina Gulch/Stream and the existing 30-inch transmission main from the Barbers Point 215 Reservoirs on the east side of the project area. Each service will be connected where possible along proposed roads crossing the gulches. In

addition, because the proposed Makaiwa Hills service zones are based on the service zones already in place for the adjacent community of Makakilo, the potential for connecting the 440-ft tank elevation service zone to Makakilo exists, which could provide additional redundancy.

Refer to Figure 10 for the proposed potable water distribution system. Based upon conceptual design, the distribution systems will be comprised of water mains, 10 reservoirs, and 9 booster pump stations. This infrastructure shall be sized in accordance with BWS Water System Standards. Additional design efforts will seek to reduce the number of reservoirs and booster pump stations. Pipes shall be sized to accommodate maximum daily flow plus fire flow with a residual pressure of 20 psi at the critical fire hydrant; as well as peak hour flow with a minimum residual pressure of 40 psi. The greater of static or pumping pressure shall not exceed 125 psi. The minimum reservoir size shall be 0.1 MG.

Modifications After Development
Based upon initial discussions with the BWS, the wells that supply the Ewa area produce sufficient capacity to service the above mentioned potable water demand. BWS requires new, large developments to submit a potable and non-potable water master plan for review and approval, showing the necessary infrastructure to accommodate the development. The master plan will need to provide land use, site layout, phasing, water demands, and infrastructure including proposed source, storage, transmission, and treatment facilities with hydraulic analysis.

Impacts and Mitigation
Makaiwa Hills will impact the Ewa/Kapolei regional water system by increasing the demand for potable water. It is possible to reduce the potable water demand by introducing a dual water system; using non-potable water for irrigation. This is discussed in more detail later in this report (see Section VII for more on Recycled Water).

In addition to increasing demand on potable water supply, the Makaiwa Hills project will increase demand for potable water storage facilities. BWS has indicated that there is some capacity available at existing storage facilities. However, additional storage facilities will eventually be required at the Barbers Point 215 tank site and the Kapolei 215 tank site. Implementation of the improvements will be governed by development schedules of the proposed projects in the Kapolei region and will be coordinated with the Board of Water Supply.

The Estate of James Campbell and its affiliates have been working with the Board of Water Supply to help provide for the needs of the proposed developments in the area. The Estate completed construction of the 4 million gallon Kapolei 215 tank. In addition, the Estate provided the Board with wells EP 15 and 16 as an additional source of water for the developments. These wells were previously used for sugarcane cultivation.

BWS works to secure water supplies for potable and agricultural use. BWS's mission, in addition to water systems and services, is to ensure the sustainability of the island's water resources and to enhance the quality of life for the people of Oahu. They evaluate the water balance within a watershed and determine the available water supply, the water needed for various needs in that watershed, the seasonal cycles of water movement through the watershed and develop systems to store, treat, and convey water for various uses. Water is treated to achieve water quality objectives for the end uses. In the case of potable water supply, water is treated to minimize risk of infectious disease transmittal, risk of non-infectious illness, and create a palatable water flavor. Water distribution systems shall be designed and built to provide adequate water pressure and flow rates to meet various end-user needs such as domestic use, fire suppression, and irrigation.

VII. NON-POTABLE WATER

Existing Conditions

The Honouliuli Water Recycling Facility (HWRF) is located in Ewa and operates under the Honolulu Board of Water Supply (BWS) water-recycling program. HWRF produces R-1 recycled water for irrigation uses. The plant capacity is 10 million gallons per day (MGD) for R-1 recycled water. The current R-1 average daily demands range from 5 to 6 MGD.

The State of Hawaii Department of Health Wastewater Branch is the jurisdictional agency for the application of recycled water under HAR 11-62-27. According to the Guidelines for Treatment and Use of Recycled Water (hereinafter referred to as Recycled Water Guidelines), allowable R-1 irrigation uses include the following areas: golf courses, parks, playgrounds, schoolyards, athletic fields, residential property where managed by an irrigation supervisor, and roadside and medians.

The existing R-1 distribution system from the HWRF currently serves developments in the Ewa/Kapolei region. The west system generally feeds the Coral Creek, Barbers Point, and Kapolei Golf Courses, as well as the City of Kapolei in the near future.

The nearest connection point to the R-1 distribution system is approximately ¾ miles to the 16-inch line located along Roosevelt Road east of the Kalaeloa Boulevard intersection on the West side of the drainage channel. The regional recycled water distribution system within the vicinity of the project site is shown on Figure 11.

There is an existing BWS non-potable water tank located on the project site, which is referred to as the Barbers Point Non-Potable 215 reservoir. This tank is supplied by a brackish non-potable well with approximately 1 MGD pumping capacity.

BWS does not have any capital improvement projects in the near future to extend the R-1 distribution system.

There is also an existing EP-10 irrigation well cluster that taps the basal acquifer located outside of the project area. Based upon initial discussions with BWS, the future Kapolei West golf course is planned to be served by this existing irrigation well cluster (see Figure 11). EP-10 produces up to 5 MGD. Kapolei West golf course has been allocated 1 MGD. Therefore, 4 MGD of non-potable water may potentially be available for irrigation use provided the water rights can be transferred. .

Projected Demand

The potential non-potable water uses for this project include irrigation of schoolyards, commercial landscape, community parks, and roadway medians located in the southeast corner

of the project area.. This non-potable water demand is estimated to be 0.17 MGD. See table below:

TABLE 13
POTENTIAL NON-POTABLE WATER USE DEMAND

Land Use	Acre	gpd/acre	Daily Demand (gpd)
Elementary School	12 acre	4080	48,960
Roadway Median	1.5 acre	1440	2,160
Commercial	26 acres	1440	37,440
Park (potential)	20.3 acres	4080	82,824
		TOTAL	**171,384**
		CALL	**0.17 MGD**

Modifications After Development

There is an opportunity to transfer the unused portion of water allocation from the EP-10 wells to produce additional non-potable water for irrigation use at Makaiwa Hills. In the interim, Makaiwa Hills could use brackish water for irrigation from the Barbers Point Non-Potable 215 reservoir. This tank could be converted to receive non-potable recycled water from HWWTP when the R-1 distribution reaches the project area in the future or if the EP-10 water rights transfer is able to proceed.

Impacts and Mitigation

A water reuse plan will need to be developed if R-1 water is used for irrigation. This plan would include additional information about the irrigation, management, public education, and other required information per the Recycled Water Guidelines.

VIII. WASTEWATER

Existing Conditions

To date, there are no existing wastewater facilities within the project site. The Honouliuli Wastewater Treatment Plant provides wastewater treatment and disposal for developments within the Ewa/Kapolei region. The Honouliuli Wastewater Treatment Plant (WWTP) is located on Geiger Road approximately four miles east of the project site in Kapolei. The service area of the plant encompasses a total area of approximately 76,000 acres and ranges from Red Hill along its eastern boundary up to Mililani on its northern boundary, and extends to Makakilo, Honokai Hale, and Ko Olina on its Western Boundary. Much of the plant's primary treated effluent exits the plant via an 84-inch gravity line and is discharged at the Barbers Point Deep Ocean Outfall located approximately 1.7 miles off-shore from Oneula Park in Ewa Beach; while approximately 13 MGD is directed at a splitter box to the secondary treatment facilities. A portion of the secondary treated effluent is disposed of through the ocean outfall, diluting the primary effluent in order to comply with mass emission rate (MER). The remainder of the secondary treated effluent is treated further at the plant's water recycling facility. The plant, as a whole, presently has a design average dry weather flow liquid capacity of 38 MGD and a solids capacity of 28 MGD. At present, the solids side of the plant is at maximum capacity. The City and County of Honolulu Department of Environmental Services has commenced construction to expand the solids side of the plant by bringing additional aerobic digesters online by February 2009. In addition, there are plans to expand the overall plant capacity to 51 ~~mgd~~MGD. However, there is currently no timetable for this expansion.

The municipal sewer main near the project site is the 42-inch Ko Olina interceptor located south of the project along the O. R. & L. Railroad right-of-way and Renton Road. The Ko Olina interceptor is a force main/gravity sewer, which services Honokai Hale and the Ko Olina Resort and extends from the Ko Olina Resort to Fort Barrette Road. At Fort Barrette Road, the Ko Olina interceptor connects to the Makakilo interceptor, a 30-inch sewer that extends from Makakilo along Fort Barrette Road and Franklin D. Roosevelt Road to the Honouliuli WWTP on Geiger Road. To accommodate for increasing wastewater demand, a 42-inch Kapolei Interceptor was constructed sharing an the existing sewer easement with the Makakilo 30-inch interceptor along Franklin D. Roosevelt Road from Fort Barrette Road to Honouliuli WWTP. The existing regional wastewater facilities are shown on Figure 13.

Projected Wastewater Flows

Wastewater will be generated from the various facilities within the proposed Makaiwa Hills at an estimated average rate of ~~1.50~~ 1.37 MGD and design peak rate of ~~9.19~~ 7.42 MGD. The estimated wastewater design peak flow calculations are based on the City and County of Honolulu's Wastewater Standards which includes the estimated design maximum flow and wet/dry weather infiltration/inflow. ~~Listed below are~~ The following table lists the wastewater contributions for each of the proposed land uses of Makaiwa Hills.

TABLE 14
SUMMARY OF PROJECTED WASTEWATER FLOWS

Land Use	No. of Units	Capita/ Unit	Total Capita	GPD/ Capita	Average Wastewater Flow (MGD)	Peak Design Wastewater Flow (MGD)
Residential (home)	~~1,619~~ 1,579 units	4	~~6,476~~ 6,316	80	~~0.520~~ 0.505	3.11
Residential (apartment)	~~2,481~~ 2.421 units	2.8	~~6,947~~ 6,779	80	~~0.560~~ 0.542	2.87
Elementary School	12 acres	---	~~1,000~~ 550	25	~~0.025~~ 0.014	0.09
Middle School	18 acres	---	600	25	0.015	0.10
~~Community Business Center~~	~~10 acres~~	~~140~~	~~1,400~~	~~80~~	~~0.11~~	
Shopping Center	26 acres	140	3,640	80	~~0.290~~ 0.291	1.25
				TOTAL	~~1.50~~ 1.37	7.42

Modifications After Development

~~While there are a number of alternatives available for the on-site treatment of the wastewater generated by the development,~~ The preferred method of treatment and disposal ~~would be~~ is through the Honouliuli WWTP. On-site treatment options, ~~such as the use of aerobic treatment units,~~ are not available; as the project area is located within the "No Pass Zone." Property that is located within the "No Pass Zone" are required to connect to the County sewer service system. ~~are less desirable primarily due to the issues concerning the disposal of the treated effluent and the ongoing operation and maintenance of the plant, which would also require certified treatment plant operators. Disposing of the effluent onsite would be difficult because the majority of the project site is located above the Underground Injection Control line; in which only limited types of Injection wells are allowed.~~ Accordingly, this project will proceed with treatment and disposal of wastewater at the Honouliuli WWTP. With the anticipated completion of the solid waste handling improvements to Honouliuli WWTP in 2009, the plant should have sufficient capacity to accept the wastewater flows from this project.

At present, there is inadequate sewer line capacity to transmit the wastewater from the project site to the Honoluliuli WWTP. The Kapolei Interceptor Sewer was not sized to include the Makaiwa Hills project. Therefore, it is necessary to explore other alternatives to convey the wastewater. Discussions are continuing with the City and County of Honolulu regarding the sewer alignment from Ft. Barrette Road to Honouliuli WWTP. The project is exploring two options at this time.

The first option is to add a third interceptor adjacent to the Kapolei Interceptor. The second option is to work with the City and County of Honolulu to replace the existing Makakilo Interceptor, which is currently planned for rehabilitation.

~~The proposed~~ A conceptual on-site wastewater collection system for the project is illustrated on Figure 14. The collection system will consist of gravity sewers, force mains, sewage pumping stations, and sewer easements. Preliminary sizes range from 8" to 21" mains. The onsite wastewater collection system shall be dedicated to the City and County of Honolulu for operation and maintenance. Design and construction of the system will be in accordance with City and County Standards and applicable provisions of the Department of Health's Administrative Rules, Chapter 11-62, "Wastewater System.". Implementation of the proposed improvements is subject to approval from the City and County of Honolulu Department of Planning and Permitting (DPP). A sewer master plan and an Application for Sewer Connection will be submitted prior to the design phase for this project.

The concept collection system shown on Figure 14 eliminates the use of sewer pump stations in the upper reaches of the project site through use of easements that take advantage of the available gravity flow, it is anticipated that sewer lift stations and force mains will be required along Old Farrington Road.

It may be possible to reduce the number of sewer pump stations shown along Old Farrington Highway through the use of deep sewers and trenchless technologies. This will be explored in the sewer master plan.

Another alternative to reduce the amount of sewer pump stations would be to provide gravity mains crossing Farrington Highway at multiple locations that would connect to the proposed and/or existing developments.

Impacts and Mitigation
The City and County of Honolulu is increasing the solid waste capacity of the plant, which will address the plant capacity to accept the wastewater from Makaiwa Hills. The City and County is currently working to finalize the details of this expansion, and work is expected to be complete in the year 2009.

Efforts to upgrade the existing collection system will need to be coordinated with the City and County of Honolulu to increase sewer capacity along Franklin D. Roosevelt Road from Ft Barrett Road to the Honouliuli WWTP. It may be necessary to add a third interceptor line or replace the Makakilo Interceptor with a larger line. The Makakilo Interceptor would have a longer extended life from a replacement project compared to the currently planned rehabilitation project. Therefore this is recommended as the preferred option.

IX. SOLID WASTE

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

Projected Solid Waste Generation and Characteristics
The proposed project will generate solid waste during construction and after development. The construction wastes will primarily be made up of vegetation, rocks, and debris resulting from clearing the site prior to construction. Most of these wastes will be combustible. The typical range of per capita solid waste generation from a municipal source (residential and commercial) is 2.0 to 5.0 pounds per capita per day (lb/capita/day).

Municipal solid waste generation from the proposed development is estimated to be 54 tons/day based on an average per capita generation rate of 4.0 lb/capita/day. The solid waste composition is expected to be typical for a municipal source.

Modifications After Development
It is anticipated that refuse generated by the proposed Makaiwa Hills residential development will be collected by the City and County refuse collection service. Refuse from the proposed commercial area will be serviced by a private refuse collection company. It is estimated that municipal refuse collection from the site will necessitate ~~76~~ 9 truck trips per week. The number of truck trips is based on ~~manually loaded, 20 cubic yard compactor truck capable of achieving a typical compaction density of 500 pounds per cubic yard~~ automated truck collection of approximately 950 homes per day and refuse collection two times per week. Commercial refuse will be collected by a private service.

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

The City and County is currently operating a landfill site in Waimanalo Gulch and the H-POWER waste energy recovery facility on the leeward side of Oahu. The City has proposed extending the life of the Waimanalo Gulch landfill from its current 2008 permit expiration to 2015. The City is currently exploring alternative means of handling solid waste since it is an ongoing city-wide concern. Other programs being implemented are recycling and reuse of green waste.

X. POWER AND COMMUNICATIONS

Existing Conditions
Hawaiian Electric Company (HECO) has several transmission (138 kV) and subtransmission (46 kV) lines traversing the project site. Subtransmission (46 kV) lines and distribution (12 kV) lines coexist with Hawaiian Telcom (HTCOM) and Oceanic Time Warner Cable (OTWC) cables on joint wood poles along the roadways abutting the project site (see Figure 15). Following is a description of the utility lines that impact the project site:

A. Two parallel 100-foot wide easements originating from the Kahe Power Plant crosses the northwest portion of the project site in a northeasterly direction. The easements contain two 138 kV lines constructed on wooden structures on each easement and one 46 kV line on wood poles on the northernmost easement. At the uppermost portion of the project site, the 46 kV line continues directly eastward on its own 25-foot wide easement, then turns to the south to the Old Farrington Highway with a tap to serve the Makakilo Substation in the Makakilo Subdivision. The 46 kV line then continues east along the Old Farrington Highway on a joint pole line with 12 kV, HTCOM, and OTWC lines to the Kalaeloa Boulevard Interchange. At the interchange, the 12 kV, HTCOM, and OTWC lines continue east on joint poles along Farrington Highway fronting the water park and the 46 kV line crosses the H-1 Freeway and continues along Kalaeloa Boulevard to the James Campbell Industrial Park.

B. Another pair of parallel 60-foot wide easements originating from the Kahe Power Plant traverses the project site first in an easterly direction, turns south towards Farrington Highway, then continues east, paralleling Farrington Highway. At the intersection of Farrington Highway and Old Farrington Highway, the two easements split, one on each side of Old Farrington Highway. Both easements continue east along Old Farrington Highway, then turn south and terminate at the James Campbell Industrial Park (JCIP) Substation. Only the makai-most easement contains two 138 kV lines on steel poles. The mauka-most easement does not have any 138 kV lines, but is reserved for future 138 kV lines. There are currently no immediate plans to build on this mauka-most easement.

C. There is an existing wood joint pole line along the mauka side of the Farrington Highway and Old Farrington Highway road right-of-way that abuts the project site. All the poles contain HECO 12 kV, HTCOM, and OTWC lines. The segment of pole line along Farrington Highway from the western-most boundary of the project site to the Honokai Hale Subdivision also contains one 46 kV line, and the segment of pole line along Old Farrington Highway from the Board of Water Supply reservoir to the Kalaeloa Boulevard Interchange contains a second 46 kV line (also described in section "A" above). HECO has plans to rebuild the segment of pole line along Old Farrington Highway from Honokai Hale to the Board of Water Supply reservoir to add a 46 kV line to the pole line.

Modifications After Development

It is anticipated that HECO, HTCOM, and OTWC will provide the necessary electrical, telephone, cable TV, and high-speed internet services to the project site. The total diversified electrical demand for the entire development is estimated to be ~~28.6~~ 29.1 MVA. Power is planned to be supplied initially to the site via existing substations at Kahe Power Plant, James Campbell Industrial Park (JCIP) Substation, Makakilo Substation, or Ko Olina Substation. Ultimately, the project site will require its own substation.

All electrical utilities will be placed underground within the right-of-way of the proposed development roads except for the major transmission and subtransmission lines. New easements for padmounted transformers, switchgears, telephone switches, and cable TV power supplies will be required at selected locations within the proposed development. Offsite work may require undergrounding of the existing wood pole line along Old Farrington Highway.

Impacts and Mitigation

The proposed Makaiwa Hills will place additional demands on the utility systems. Continued coordination will be required among the developer, its consultants, and the utilities for timely design and construction of the utility infrastructure and delivery of the required services. A substation site will be selected early in the planning stages. Ideally, the site should be at the center of the load density, near existing 46 kV lines, clear of floodwater runoff, and on relatively flat land. Routes for the 46 kV feeders to the substation site should be coordinated with the outgoing 12 kV feeders and with the HTCOM and OTWC lines to minimize trenching, excavation, and installation of the underground infrastructure. A potential substation site is noted on Figure 15.

The existing transmission and subtransmission line easements have building and electrical clearance restrictions. Homes, businesses, schools, and recreational facilities will be sited so as not to encroach within the easement areas. Roads and parking lots may be allowed within the easement areas provided there are proper clearances to the poles, anchors, and conductors. Any relocation of easements or existing poles, anchors, and conductors will be at the expense of the developer. Should HECO decide to build new 46 kV or 138 kV lines on the currently vacant 60-foot wide easement, HECO will go through its transmission line routing, permitting, and approval process for new transmission lines. This will include a routing study, possibly preparation of an Environmental Impact Statement if required, and a public hearing and consequent approval/denial by the Public Utilities Commission.

The existing transmission and subtransmission lines will have a visual impact on the view planes of the residences at the lower levels. The steel poles range in height from 90 to 120 feet above ground, and the lowest conductor level is approximately 50 feet above ground. The wood poles

are shorter, ranging in height from 40 to 60 feet above ground, and the lowest conductor level (HTCOM) is approximately 20 feet above ground. At this time, no consideration is being given to underground the transmission and subtransmission lines due to the prohibitive cost of undergrounding high voltage lines. Portions of the wood pole line along Old Farrington Highway may be placed underground as part of the offsite and road improvement work.

HECO must be allowed 24-hour access to its poles, anchors, and conductors for construction and maintenance purposes. Construction equipment may include trucks, trailers, 4-wheel drive vehicles, and occasional use of helicopters to ferry crews to sites inaccessible by vehicles and for stringing of conductors. Upon completion of its work, HECO will restore the area to as close to its original condition as possible. HECO will also be advised of the approved archaeological preservation sites identified in the Preservation Plan prepared by Cultural Surveys Hawaii, Inc. The Preservation Plan calls for interim and long term fencing around the preservations sites with a 20-foot buffer area. As these sites will be clearly identified, HECO crews and equipment will be able to avoid these preservation sites during their construction and maintenance activities.

XI. PHASING PLAN

The conceptual phasing plan is shown on Figure 16, which shows two phases for planning purposes only. Phase 1 consists of open park areas, an elementary school, amongst ~~1578~~ 1503 multi-family and ~~707~~ 785single-family dwelling units. Phase 2 consists of open park areas and shopping areas amongst 903 multi-family and ~~912~~ 909 single-family dwelling units of varying densities.

XII. PERMITS

The following is a summary of some of the anticipated permits requirements.

Grading Permit

All grading will need to be done in conformance with the City and County of Honolulu Grading ordinance and a grading permit obtained.

Sewer Connection Permits

A sewer connection permit will be required from the City and County of Honolulu.

Storm Water Connection Permits

Storm water connection permits will be required from the State of Hawaii Department of Transportation.

National Pollution Discharge Elimination Permit (NPDES)

National Pollution Discharge Elimination System (NPDES) permits will be required for this project. The following are the anticipated NPDES permits that will be required.

Form C: More than 1 acre of land will be disturbed during construction. Therefore, a NPDES General Permit Coverage Authorizing Discharges of Storm Water Associated with Construction Activities will be required for this project. Since the project site is classified as a Class 2 area (Water Quality Standard Maps published by the Office of Environmental Planning, Department of Health October 1987) and none of the waterways appears to run through State Parks, it is anticipated that the general application can be used, and an individual application will not be required.

Form F: NPDES General Permit Coverage Authorizing Discharge of Hydrotesting Waters will be required if the hydrotesting waters will be discharged on site and allowed to enter the storm drainage system.

Form G: NPDES General Permit Coverage Authorizing Discharges of Associated with Construction Activity Dewatering. This permit may not be required if groundwater is not likely be encountered, which will need to be confirmed when the geotechnical investigations are completed.

Clean Water Act Section 401 Water Quality Certification (WQC)
This permit, which is issued by the State of Hawaii Department of Health, Environmental Management Division, Clean Water Branch, is required for any applicant which may conduct activity, including the construction or operation of facilities which may result in any discharge into navigable waters. This project will need to obtain a determination from the Clean Water Branch as to whether a WQC will be required.

Clean Water Act Section 404 Department of Army Permit
Section 404 of the Clean Water Act requires authorization from the Secretary of the Army, acting through the Corps of Engineers, for the discharge of dredged or fill material into all waters of the United States, including wetlands. This project will need to obtain a determination from the Army Corp of Engineers of whether a Department of the Army permit is required for the gulch road crossings.

Stream Channel Alteration Permit (DLNR)
The Department of Land and Natural Resources (DLNR) has been consulted to determine whether a Stream Channel Alteration Permit is required. DLNR has made the preliminary determination that the watercourses at the project site are not perennial streams and road crossings over them do not require stream channel alteration permits from the Commission on Water Resource Management for the following reasons (per declaratory rule DEC-MO94-S3):

1. The gulches do not have natural sources of fresh water such as springs, seeps, and frequent or continuous rainfall. They are dry gulches, which convey run-off in insufficient quantities or frequencies to support in stream uses.

2. The gulches do not have aquatic resources in the form of fish or aquatic plant communities from the points of alteration or diversion to their upstream sources of water. They do not provide for the migration and movement of aquatic life. The term "aquatic life" includes indicators of aquatic life such as aquatic plant communities and perennial pools.

XIII. REFERENCES

Design Standards of the Department of Wastewater Management, Volume I, Department of Wastewater Management, City and County of Honolulu, Honolulu, Hawaii, July 1993.

Water System Standards, Board of Water Supply, City and County of Honolulu, Hawaii, 2002.

Rules Relating to Storm Drainage Standards, Department of Planning and Permitting, City and County of Honolulu, Honolulu, Hawaii, January 2000.

Rules Relating to Soil Erosion Standards and Guidelines, Department of Planning and Permitting, City and County of Honolulu, Honolulu, Hawaii, April 1999.

Guidelines for Treatment and Use of Recycled Water, State of Hawaii Department of Health Wastewater Branch, May 15, 2002.

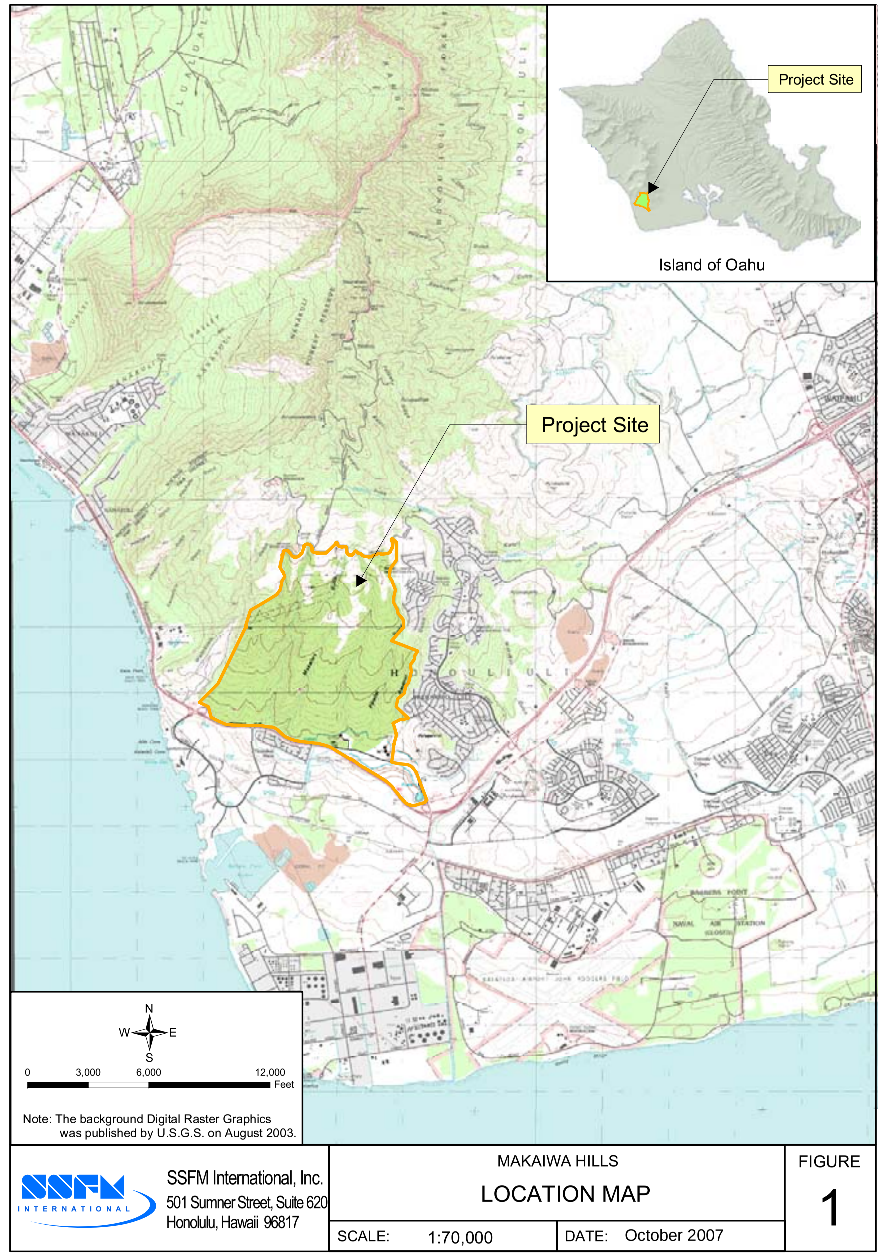
Preliminary Engineering Report Update for the Makaiwa Hills Development, Ewa, Oahu, Hawaii, Engineering Concepts, Inc., March 2005.

Engineering Report for the Kapolei Interceptor Sewer, Ewa, Oahu, Hawaii, Community Planning, Inc., prepared for The Estate of James Campbell, September 2003.

Preliminary Engineering Report for the Proposed Kapolei West Development, Kapolei, Oahu, Hawaii, Engineering Concepts Inc., February 2005.

Preliminary Engineering Report for the Proposed Kapolei Commons, Kapolei, Oahu, Hawaii, Engineering Concepts, Inc., March 2006.

FIGURES


Project Site
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Project Site
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Note: The background Digital Raster Graphics was published by U.S.G.S. on August 2003.
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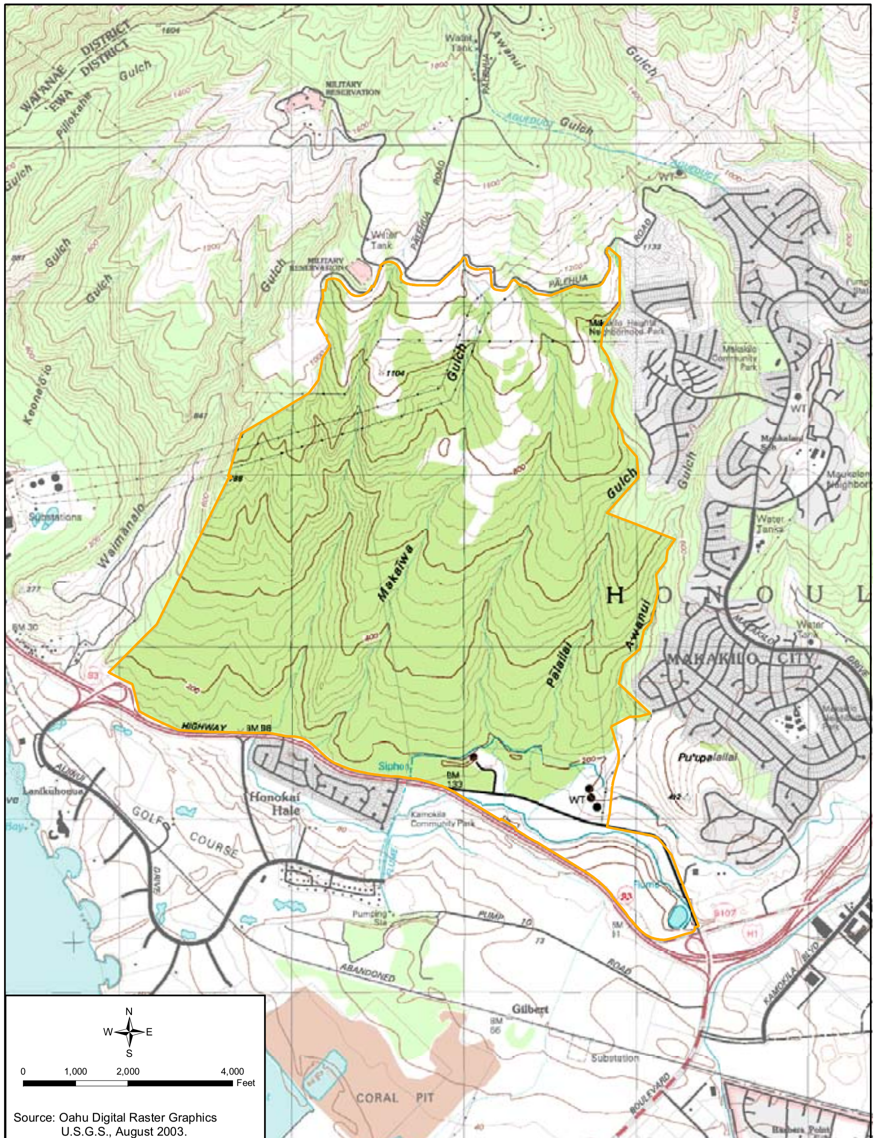
501 Sumner Street, Suite 620
Honolulu, Hawaii 96817
MAKAIWA HILLS
LOCATION MAP
SCALE: 1:70,000
DATE: October 2007
FIGURE
1



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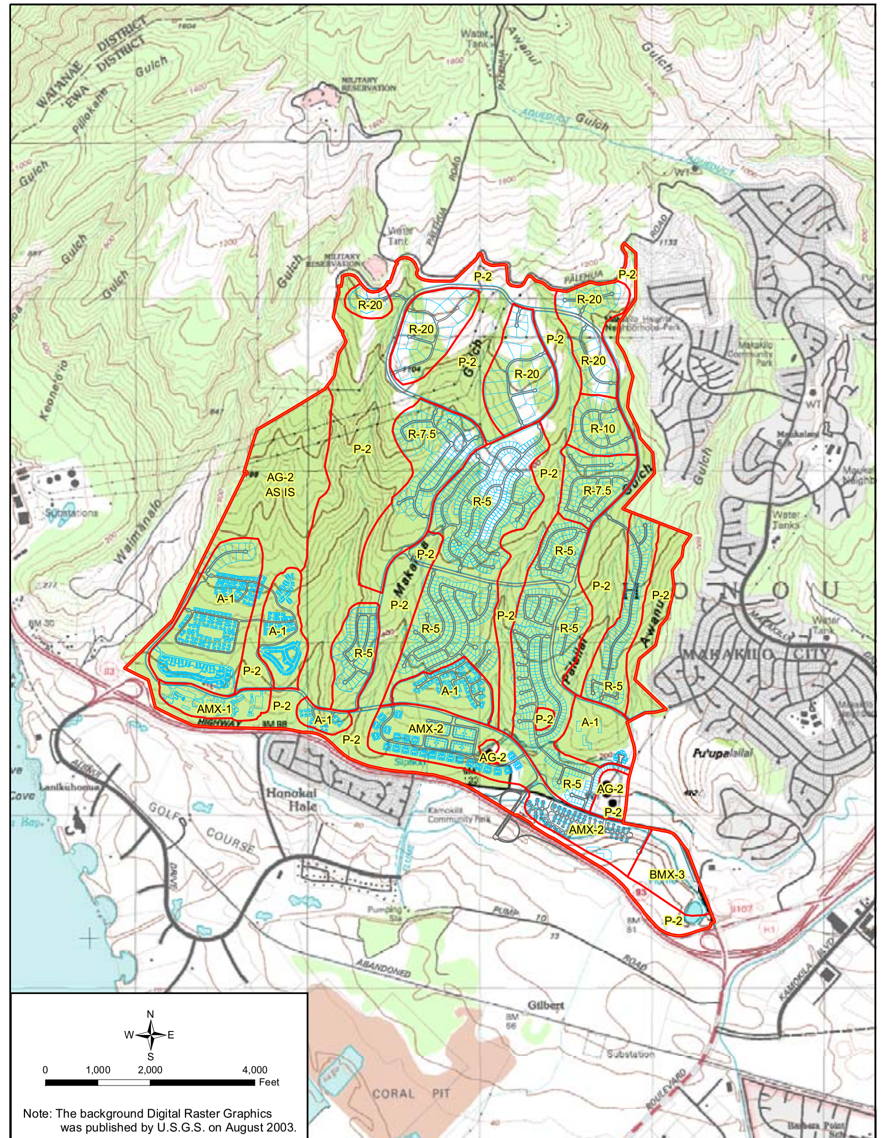
MAKAIWA HILLS
TOPOGRAPHIC MAP

SCALE: 1:27,000 | DATE: October 2007

FIGURE
2



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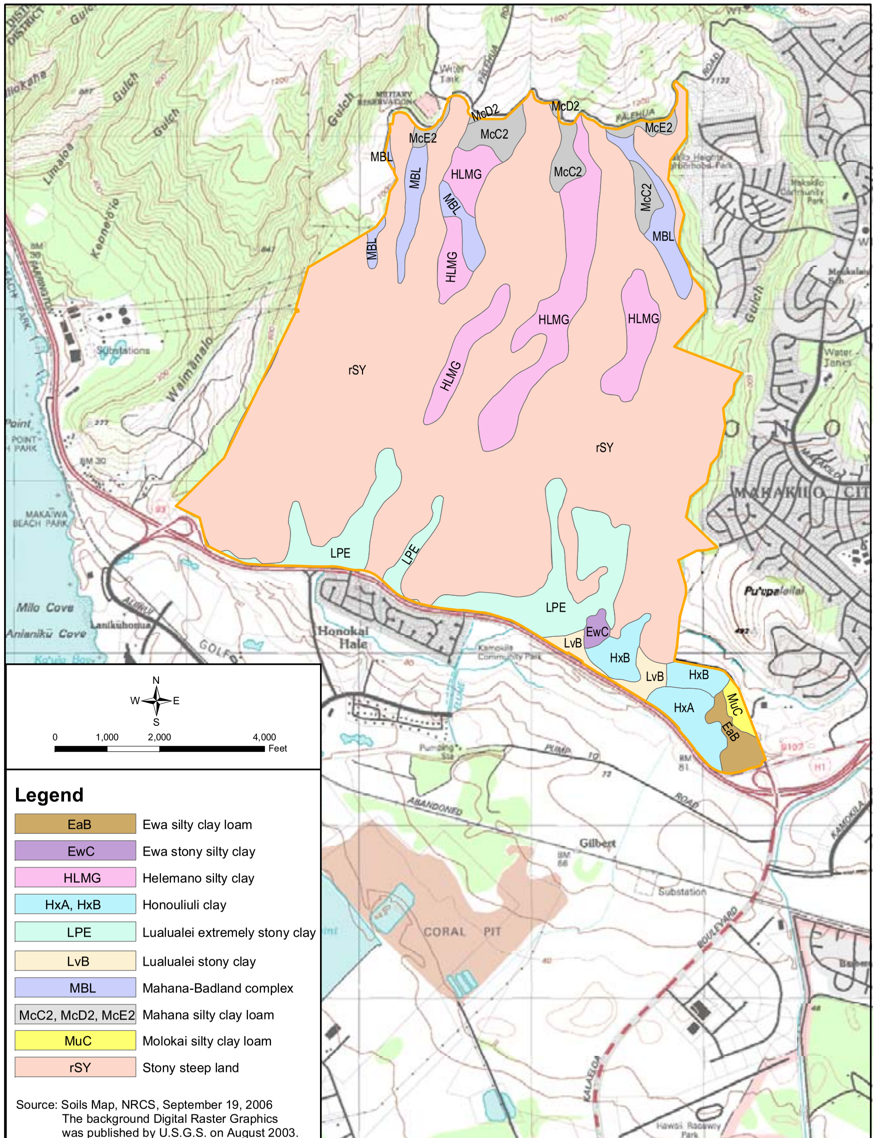
MAKAIWA HILLS
ZONING PLAN

SCALE: 1:27,000 | DATE: October 2007

FIGURE
3



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MAKAIWA HILLS

SOILS MAP

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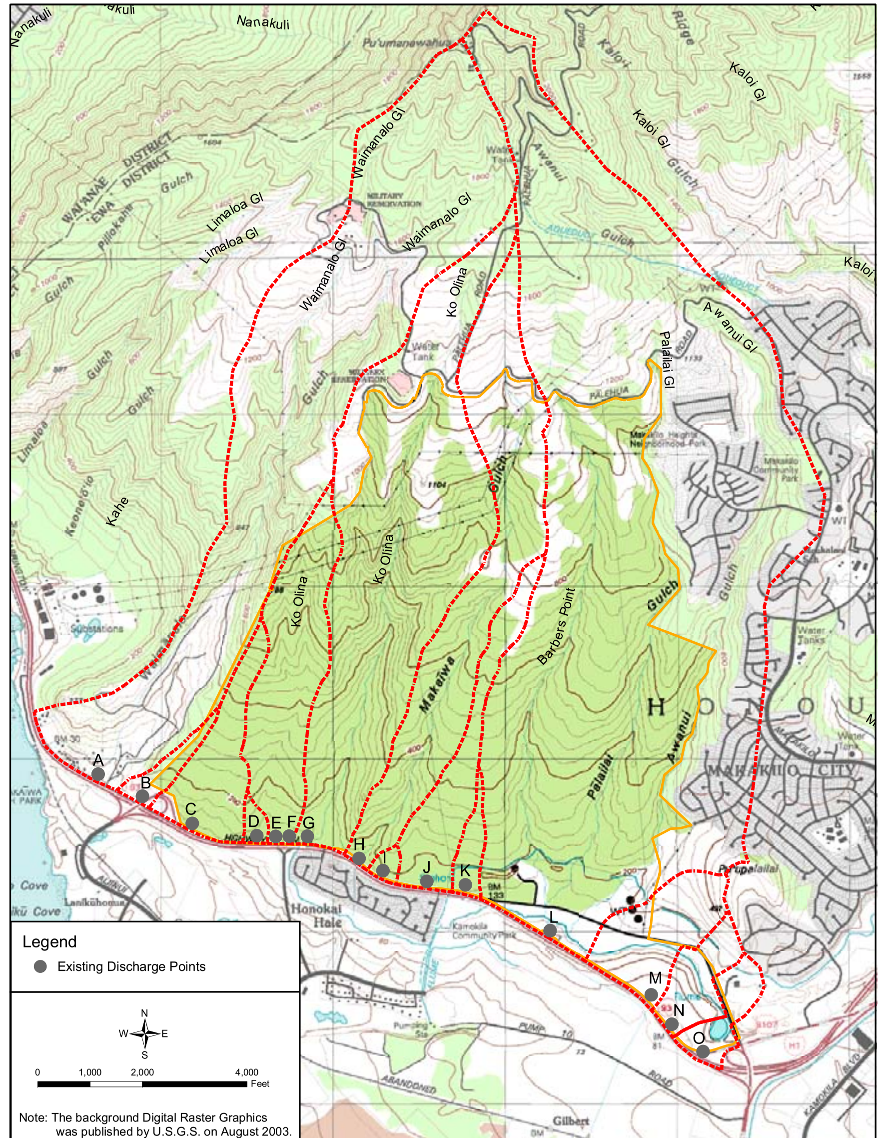
FIGURE 4



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MAKAIWA HILLS

DRAINAGE PRE-DEVELOPMENT CATCHMENT AREAS

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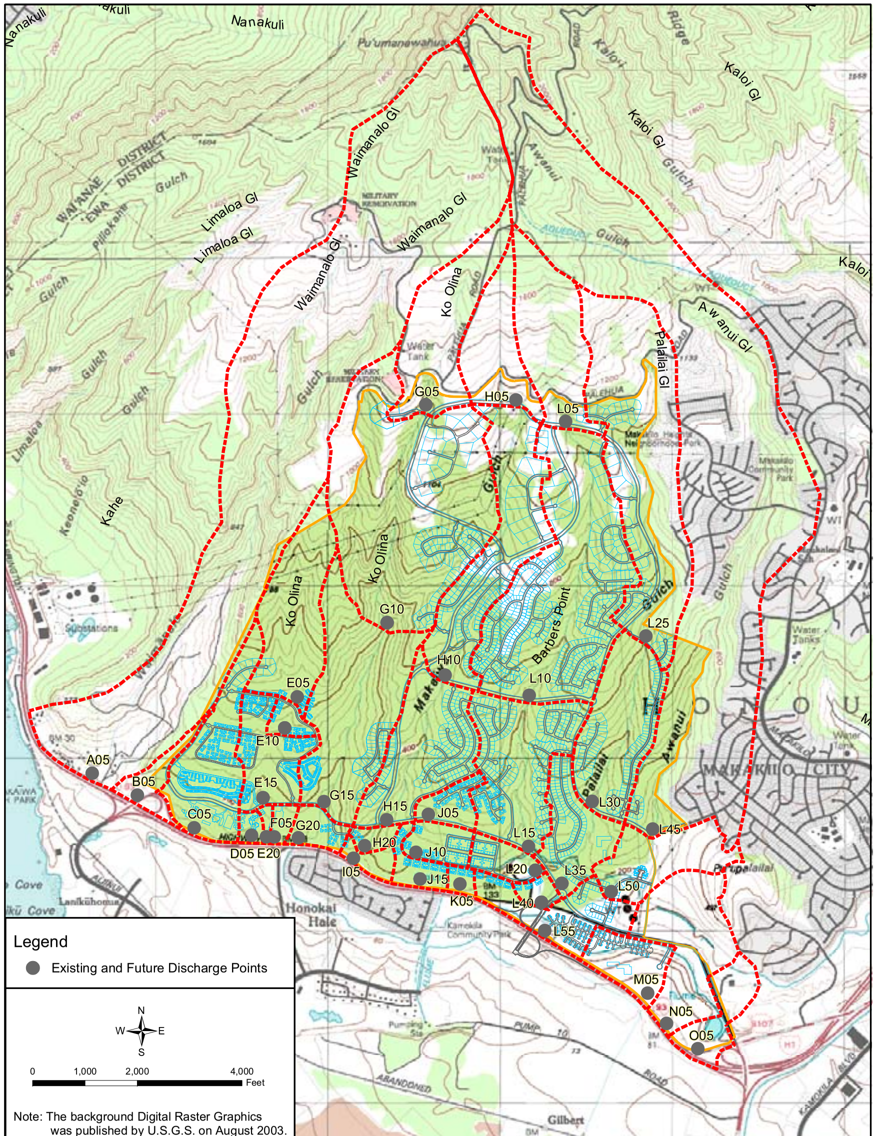
FIGURE 5



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MAKAIWA HILLS
DRAINAGE POST-DEVELOPMENT CATCHMENT AREAS

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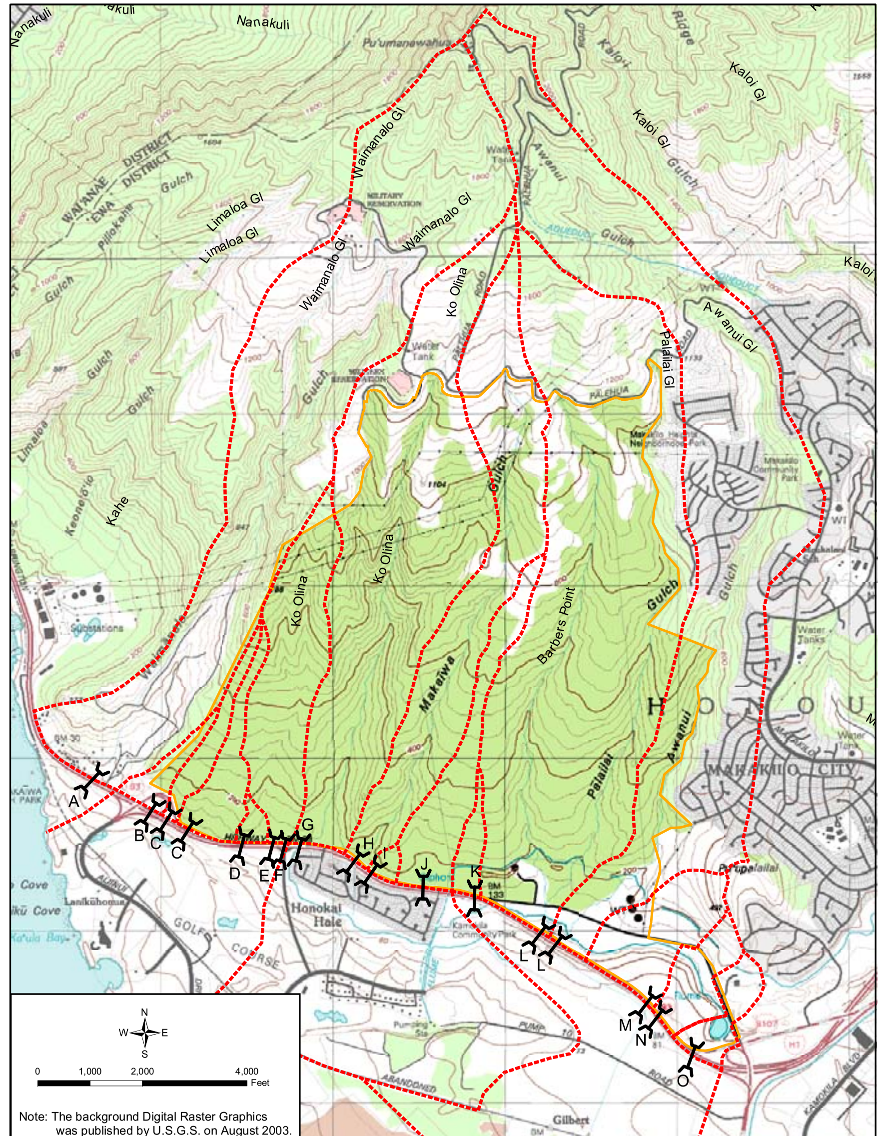
FIGURE
6



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MAKAIWA HILLS
OFF-SITE DRAINAGE CATCHMENTS
AND ROUTES

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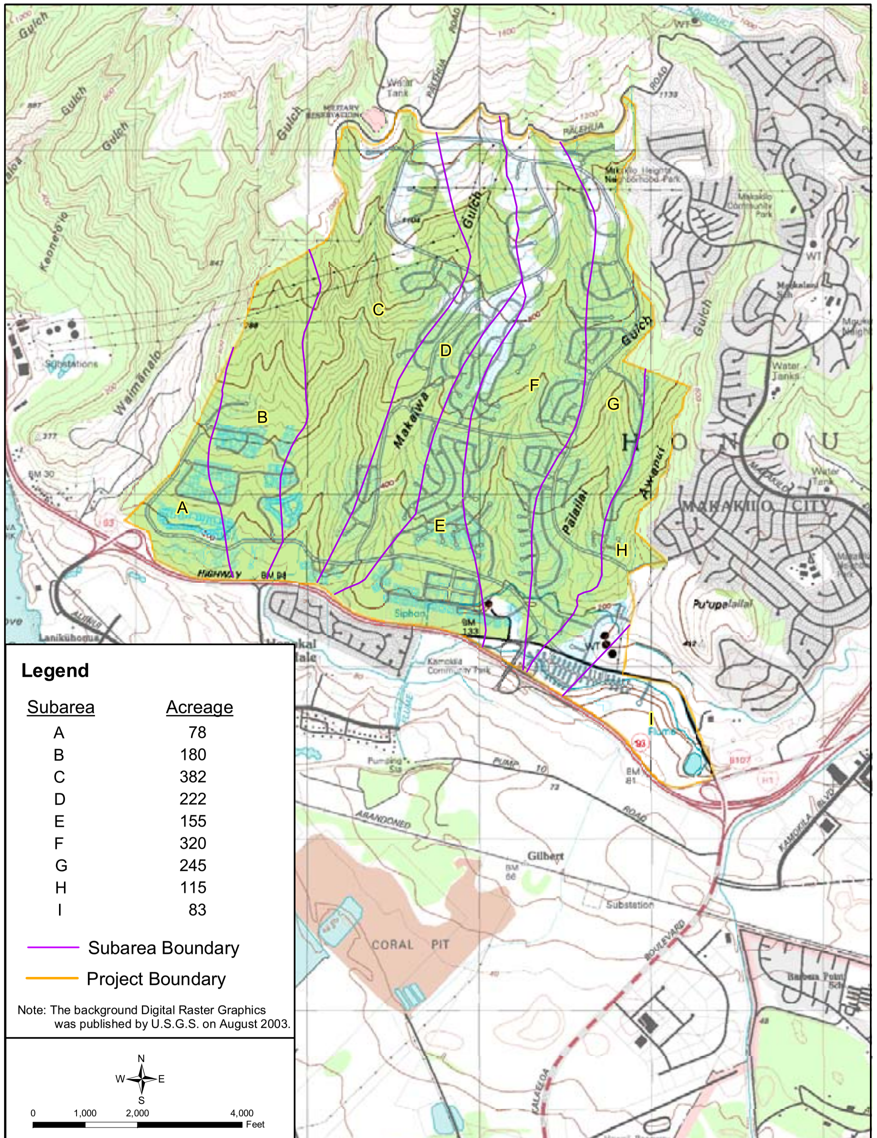
FIGURE
7



Legend

Subarea	Acreage
A	78
B	180
C	382
D	222
E	155
F	320
G	245
H	115
I	83

Subarea Boundary

Project Boundary

Note: The background Digital Raster Graphics was published by U.S.G.S. on August 2003.

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MAKAIWA HILLS
SUBAREAS FOR CALCULATION OF SOIL EROSION POTENTIAL

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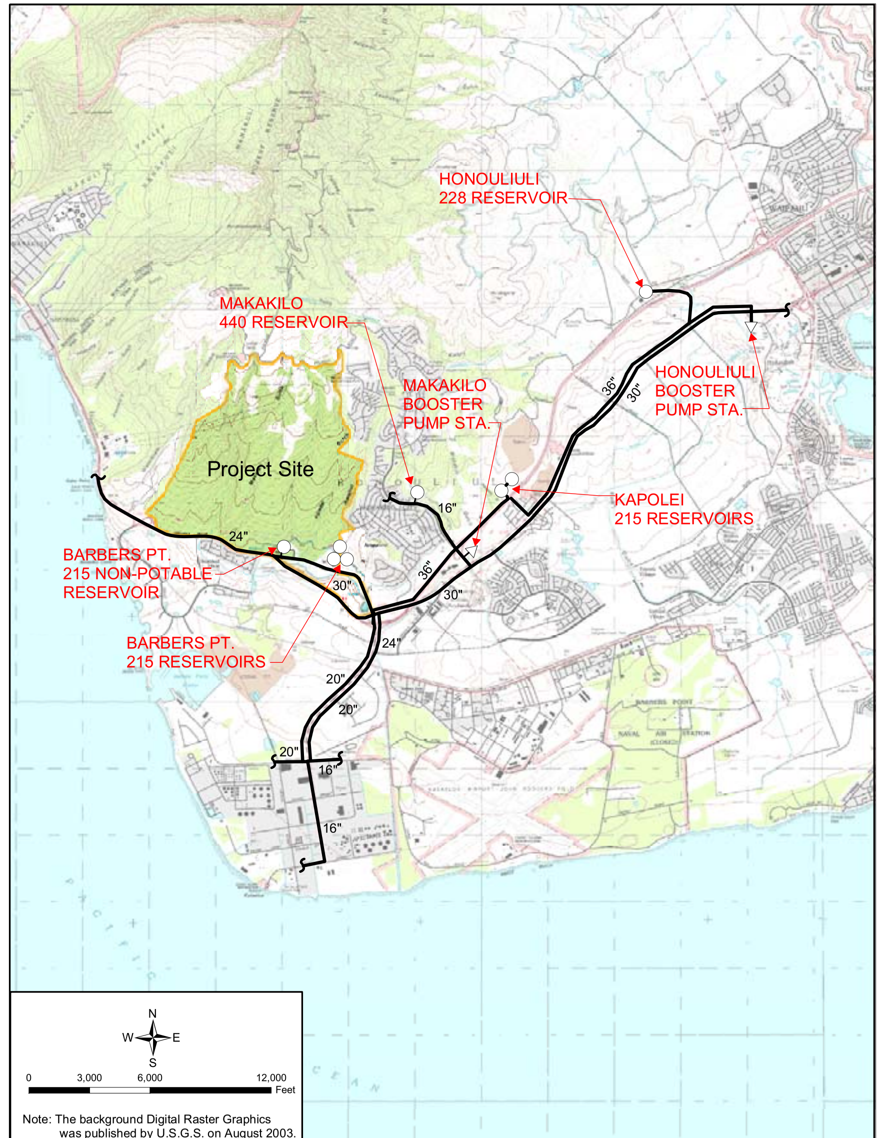
FIGURE 8



N W E S

0 3,000 6,000 12,000 Feet

Note: The background Digital Raster Graphics was published by U.S.G.S. on August 2003.

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MAKAIWA HILLS
WATER TRANSMISSION AND STORAGE SYSTEM MAP

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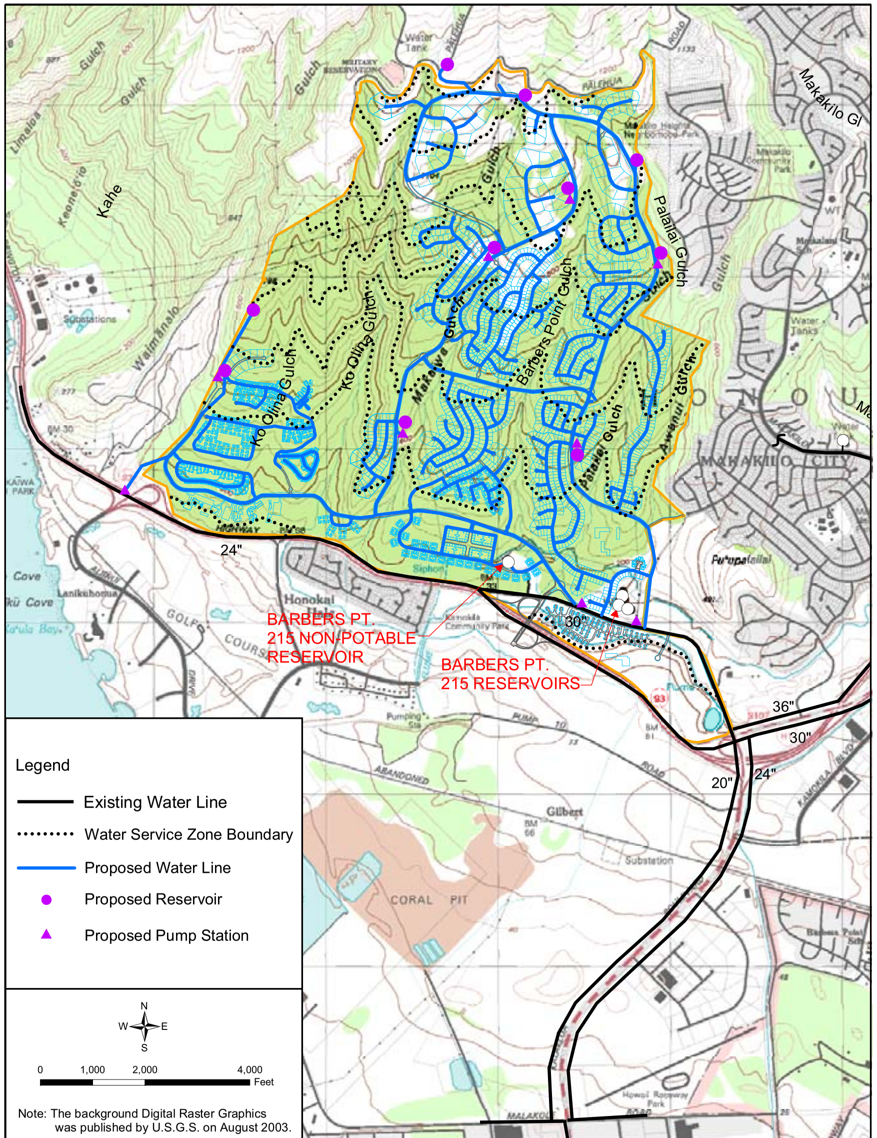
FIGURE 9



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MAKAIWA HILLS
PROPOSED POTABLE WATER DISTRIBUTION SYSTEM

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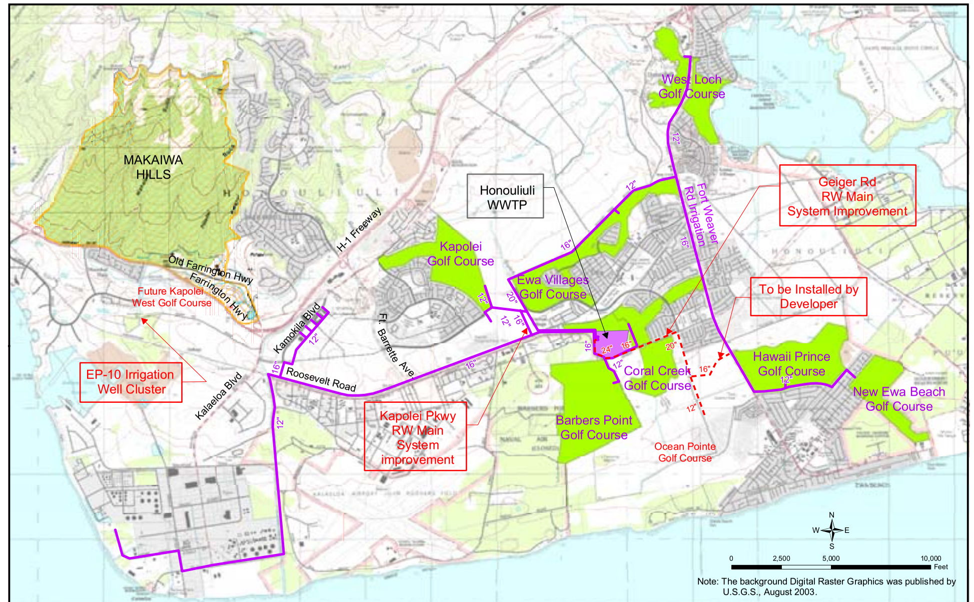
FIGURE 10



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MAKAIWA HILLS
REGIONAL R-1 RECYCLED WATER DISTRIBUTION SYSTEM

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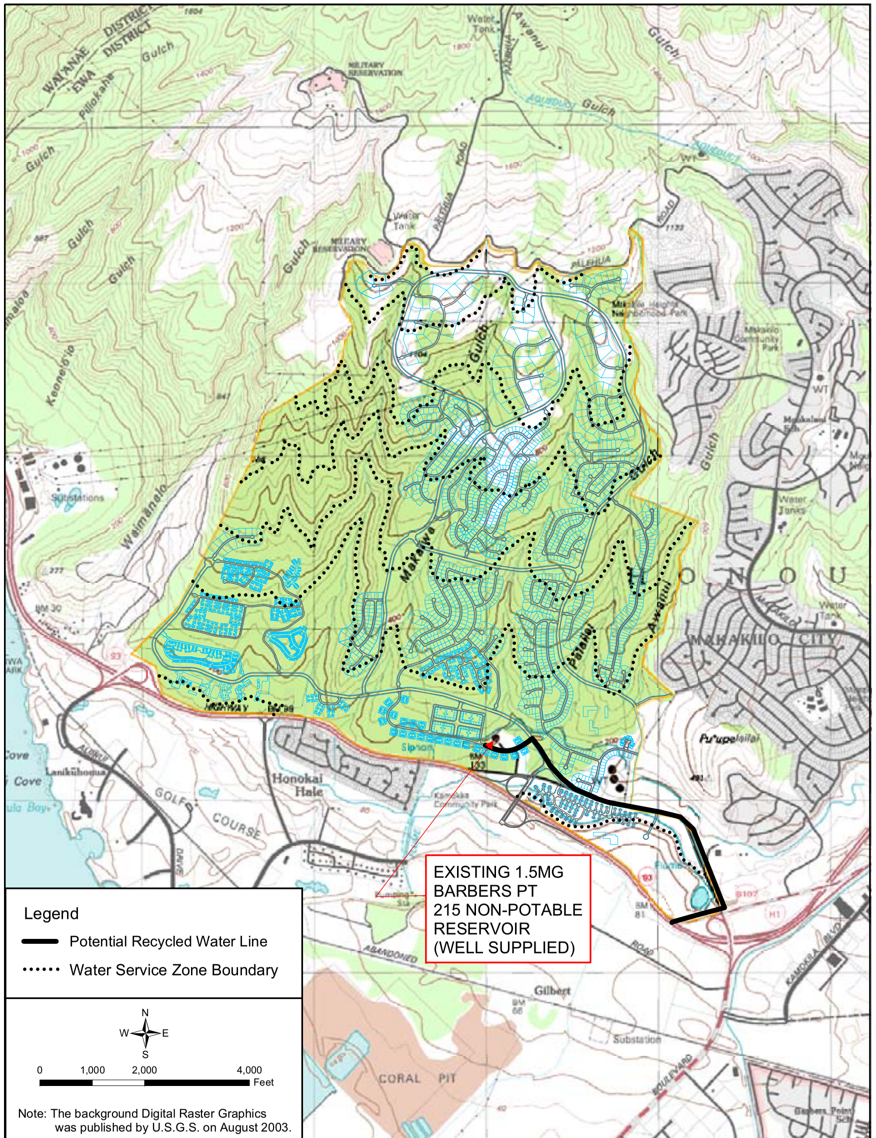
FIGURE 11



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MAKAIWA HILLS
PROPOSED NON-POTABLE WATER DISTRIBUTION SYSTEM

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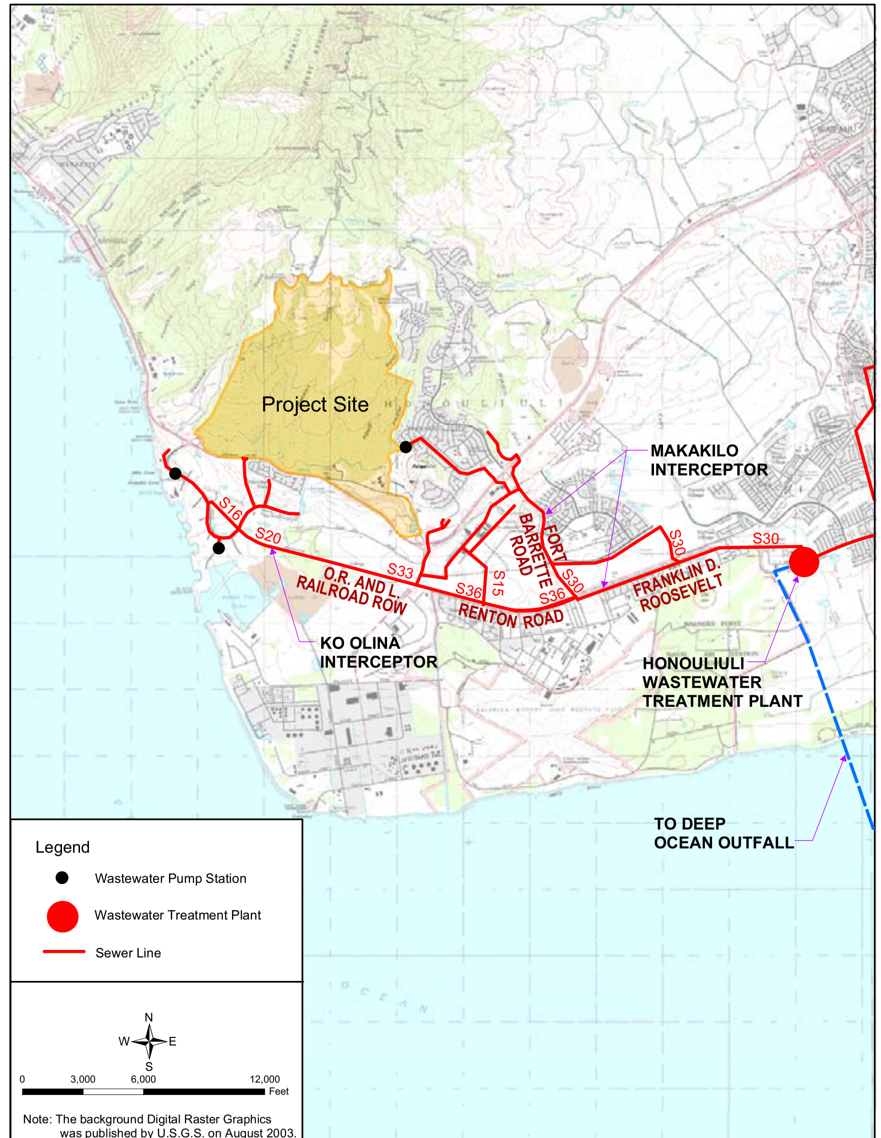
FIGURE 12



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MAKAIWA HILLS
REGIONAL WASTEWATER FACILITIES

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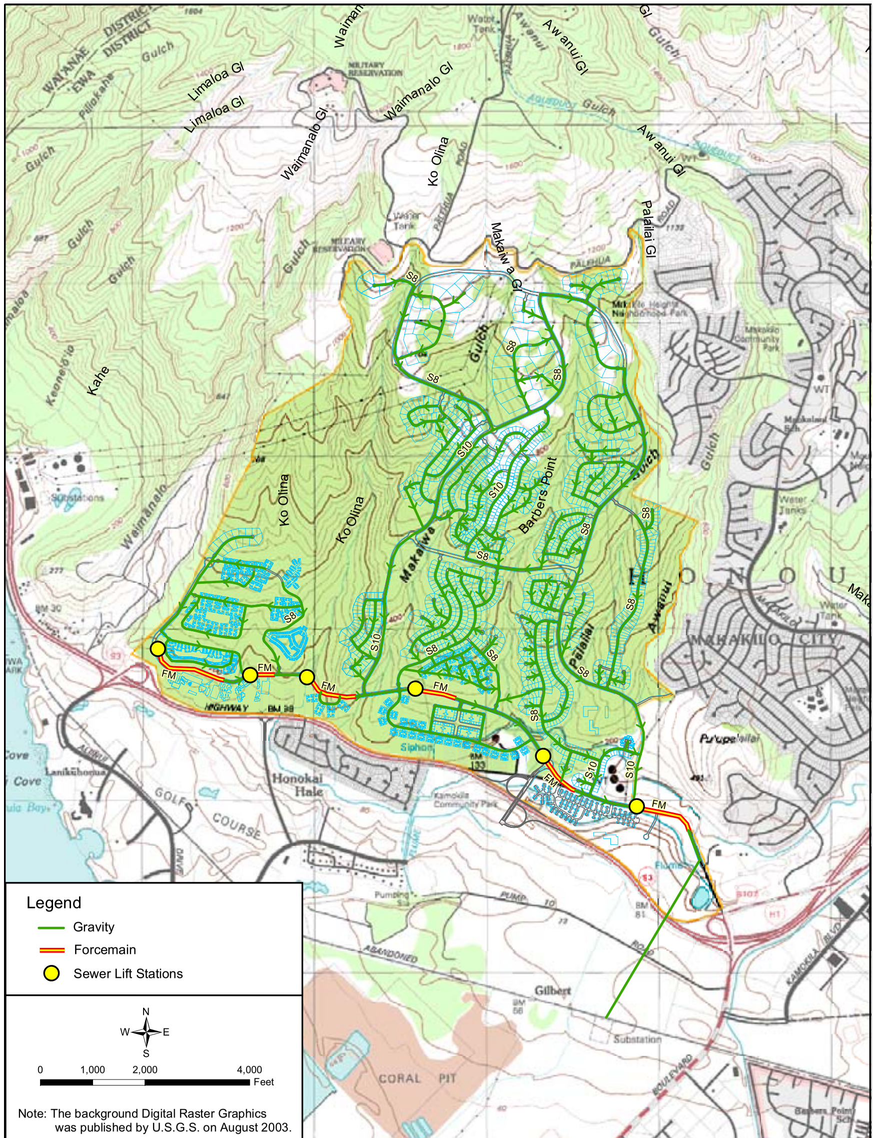
FIGURE 13



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MAKAIWA HILLS
PROPOSED WASTEWATER COLLECTION SYSTEM

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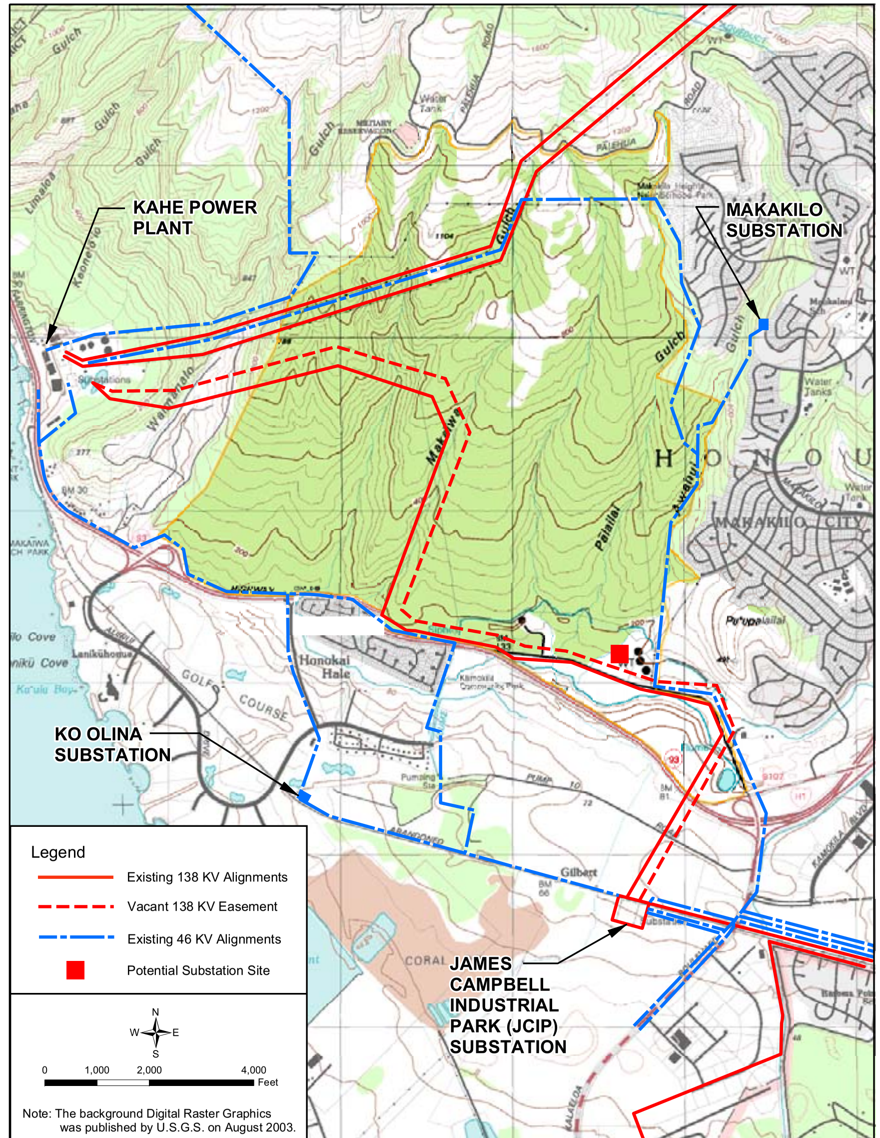
FIGURE 14



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MAKAIWA HILLS
HECO TRANSMISSION LINES

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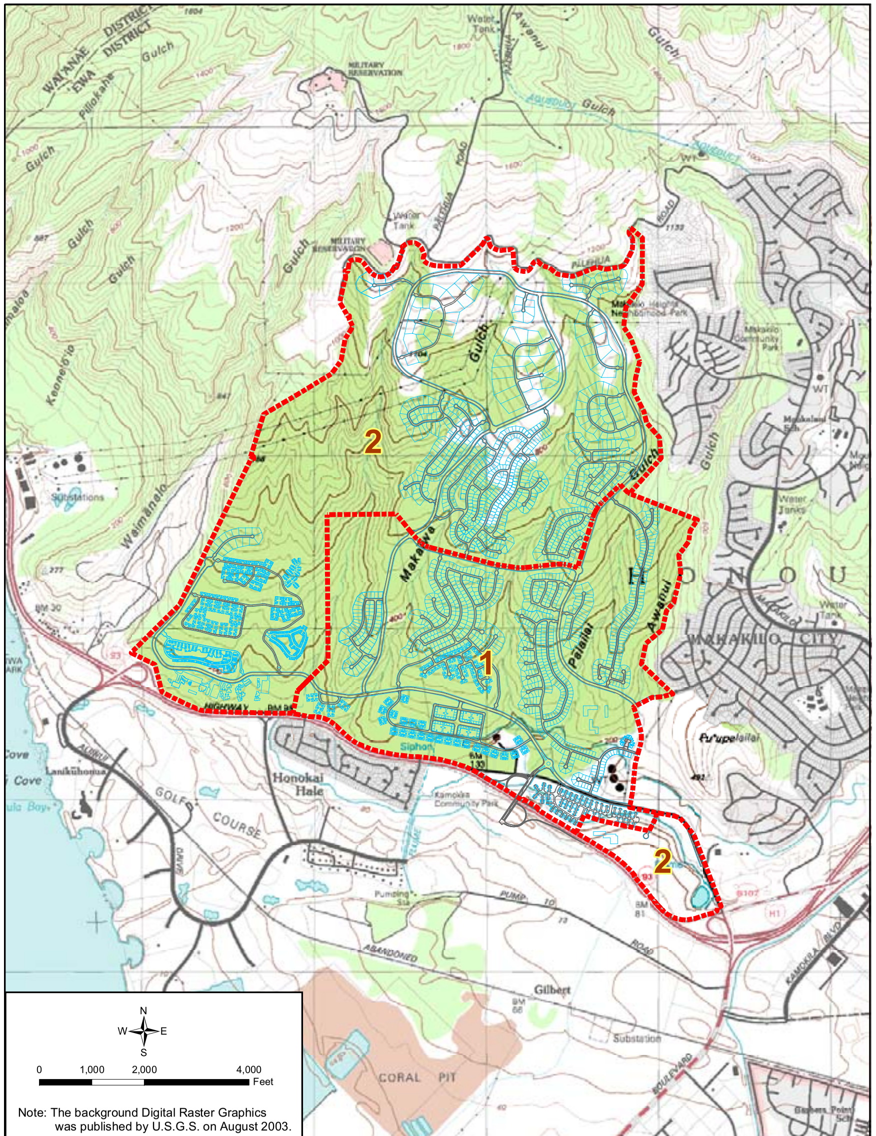
FIGURE 15



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MAKAIWA HILLS

PHASING PLAN

SCALE: 1:27,000

DATE: October 2007

FIGURE 16

Appendix D
Traffic Impact Assessment Report

MAKAIWA HILLS
TRAFFIC IMPACT ASSESSMENT REPORT

CITY OF KAPOLEI

Prepared For:

MAKAIWA HILLS LLC
1001 Kamokila Boulevard
Kapolei, Hawaii 96707

Prepared By:

WILBUR SMITH ASSOCIATES
421 Fayetteville Street, Suite 1303
Raleigh, NC 27601
(919) 755-0583

February 8, 2007

(WSA Project No. A30949)

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EXECUTIVE SUMMARY

Makaiwa Hills LLC is planning the development of approximately 1,780 acres of vacant land along the mauka side of Farrington Highway between Kalaeloa Boulevard in the City of Kapolei and the Ko Olina Interchange. The development would be bordered by the Makakilo community to the east; the existing Honokai Hale and the Kapolei West and Ko Olina development areas to the south; and the Waimanalo Gulch land fill and Kahe Point power plant to the west.

The Makaiwa Hills development (the Project) is proposed to include a mix of residential, commercial, and public land uses. The Project is planned to include about 4,100 residential units plus supporting commercial, education, and recreational uses.

The development of the Project is planned to begin in the southeast area of the site along a mauka extension of Kalaeloa Boulevard. The Project development is planned to continue westward through the makai areas of the Project site, with later development extending mauka. Full development of the Project is anticipated in 2020.

PROJECT DESCRIPTION

The Project is proposed to include a mix of residential and supporting uses:

- Approximately 4,100 residential units encompassing a range of housing types from single-family to condominium buildings of three to four floors. The higher residential densities will be located in the makai areas of the site with development densities decreasing in the mauka portions of the site.
- A community shopping center with an estimated 150,000 square feet of commercial building space
- A Village Center with about 65,000 square feet of mostly ground floor commercial uses located within the higher-density core residential area adjacent to Farrington Highway
- A western community commercial center along Farrington Highway near the western end of the Project
- An elementary school planned for about 950 students
- Active parks and passive natural areas.

Initially, the Project access would be provided to the H-1 Freeway at the Palailai Interchange via an extension of Kalaeloa Boulevard mauka from its present intersection with Farrington Highway. Later, a second primary access would be provided to Farrington Highway to the east of the Honokai Hale community at the future junction with Kapolei West Road D. The major internal Project roadways would extend mauka and west from the major east-west roadway that

would connect these two regional access points, with this roadway referred to within this report as Road A.

PROJECT TRIP GENERATION

At full build-out, the land uses within Makaiwa Hills development are estimated to generate a total of about 37,900 vehicle trips to and from the site on a typical weekday. The Project is estimated to generate 2,560 and 3,554 vehicle trips in the weekday morning and afternoon peak hours, respectively. The estimated numbers of peak hour trips by area are presented for the major development phases of the Project site in Table S-1.

Table S-1
VEHICLE TRIP GENERATION
FOR 2020 PROJECT BUILD-OUT

Areas	Morning Peak Hour			Afternoon Peak Hour		
	Total	Enter	Exit	Total	Enter	Exit
1 Southeast	892	361	531	1,230	696	534
2 Central Makai	794	224	570	1,016	600	417
3 Southwest	298	111	187	524	280	244
Mauka Areas 4 through 9	577	156	420	784	494	290
Totals	**2,560**	**852**	**1,708**	**3,554**	**2,070**	**1,485**

Wilbur Smith Associates; November 30, 2006

2020 TRAFFIC CONDITONS WITHOUT THE PROJECT

The 2020 forecasts without the Project include the build-out of the Kapolei West area; the completion of most of the commercial and industrial areas along Kalaeloa Boulevard and Hanua Street. The forecasts reflected build-out of the City of Kapolei area east of Kalaeloa Boulevard as well as most of the Ko Olina development.

The major portion of the roadway projects planned for the area was assumed to be in place by yearend 2020. Key roadways relative to this study include:

- Completion of the Kapolei Parkway from Ewa Beach to Ko Olina
- Completion of the improvements at the Makakilo, Kapolei, and Palailai interchanges

- Widening of Kalaeloa Boulevard to six lanes between the Palailai Interchange ramps and the OR&L track line
- Construction of Road D within the Kapolei West development between the Kapolei Parkway and Farrington Highway, with only right-turns into and out of Road D permitted at Farrington Highway
- Construction of the Hanua Street Extension and the extension of Malakole Street eastward to connect to the Kalaeloa Redevelopment Area roadways to increase access to the Kalaeloa Boulevard corridor land uses

The regional transportation plan includes the widening of Farrington Highway to six lanes from the Palailai Interchange to the Waianae Coast between 2016 and 2030. Since it is not known whether the widening will be completed by 2020, the 2030 analyses were made both with the existing four-lane and planned six-lane roadways.

Morning peak hour traffic along Farrington Highway west of the Palailai Interchange is projected to increase from the existing 3,100 vehicles to 4,800 in 2020; the increase in the afternoon peak hour is projected to increase from 4,050 to 6,100 vehicles.

The projected traffic growth with the planned roadway system would approximate or exceed the capacity of several key intersections:

- Farrington Highway (four lanes)-Koio Drive mauka-bound right turn in afternoon peak hour based on right-in/out with YIELD control
- Farrington Highway(four lanes)-Waiomea Street in afternoon peak hour
- Farrington Highway(four lanes)-Laaloa Street in afternoon peak hour

The traffic conditions at the Farrington Highway at-grade intersections would be improved to acceptable levels of capacity use and overall traffic delays with the planned widening of Farrington Highway to provide three through lanes in each direction.

The analysis of 2020 traffic conditions at the ramp junctions along the H-1 Freeway/Farrington Highway at the freeway weaving sections and ramps near the Project site indicated the merge area for the westbound on-ramp from Hanua Street at the Palailai Interchange would operate at LOS D conditions in the afternoon peak hour with Farrington Highway remaining a four-lane roadway. The high volume of traffic entering the westbound freeway would reduce speeds to an estimated 49.6 mph in the freeway lanes along the merging section.

2020 TRAFFIC CONDITONS WITH PROJECT BUILDOUT

With the full development of the Makaiwa Hills Project, the Road D Interchange would provide the major access for the Project and accommodate most of the travel to areas outside the Project vicinity. With the Project, the Road D Interchange ramps would be used by about 1,530 vehicles in the morning peak hour as compared to 40 vehicles using the makai-side right-in/right-out connection without the Project. In the afternoon peak hour, the traffic volumes using the ramps

are projected at approximately 1,630 vehicles with the Project as compared to the 72 vehicles using the right-in/right-out connection without the Project.

Project traffic is estimated to increase volumes along the H-1 Freeway through the City of Kapolei by 820 vehicles (+12%) in the morning peak hour and 1,050 vehicles (+13%) in the afternoon peak hour.

Key Intersection Conditions

The peak hour traffic conditions at the key intersections in the vicinity of the Project are summarized in Table S-2. The conditions Without (No) and With the Project in the table reflect the planned roadway projects by 2020, with the traffic conditions for the intersections along Farrington Highway shown both with the existing four lanes and the planned six lanes.

The addition of the Project traffic, without the widening of Farrington Highway, would adversely impact several of the key intersections as described in the following paragraphs:

- The Project traffic traveling to/from the Waianae Coast and Ko Olina along Farrington Highway would worsen the long delays forecast for traffic turning right out of Koio Drive during both peak hours, with the delays at LOS F with or without the Project.

- The projected traffic along Farrington Highway would exceed capacity of the Waiomea and Laaloa Street intersections by 14% to 15% in the afternoon peak hour, versus 10% without the Project. The overall average traffic delays at both intersections would be at LOS F, with very long delays for traffic turning left into and out of the side streets.

- With STOP sign control, the forecast traffic turning left from the Eastbound Off-ramp onto Road D during both weekday peak hours would exceed the estimated gaps available in the traffic along Road D, with extremely long delays (LOS F) for the ramp traffic. The estimated peak hour volumes and delays would satisfy warrants to allow consideration of a traffic signal.

- Traffic at the Kalaeloa Boulevard intersection with the Kapolei Parkway would amount to 97% of capacity in the afternoon peak hour, with average overall delay at an acceptable LOS D, with the Project adding to through traffic along the Kapolei Parkway and to the turns between the east leg of the Kapolei Parkway and the mauka leg of Kalaeloa Boulevard.

- Traffic at the Wakea Street-Kamokila Boulevard intersection would exceed capacity in the afternoon peak hour with the Project, versus approximating capacity without the Project. The Project would add to traffic on both Wakea Street approaches and to the turns between the mauka leg of Wakea Street and the east leg of the Kamokila Boulevard.

Table S-2
2020 TRAFFIC CONDITIONS AT KEY INTERSECTIONS WITH MAKAIWA HILLS BUILDOUT

Intersection	Scenario	Morning Peak Hour			Afternoon Peak Hour		
		V/C	ADPV	LOS	V/C	ADPV	LOS
Farrington Hwy.-	No Project/4 Lanes	0.97	120.0	F	1.02	127.1	F
Koio Dr.	With Project/4 Lanes	1.08	159.9	F	1.20	197.7	F
NB Right Turn	No Project/6 Lanes	0.50	28.2	D	0.55	28.7	D
with YIELD	With Project/6 Lanes	0.54	31.6	D	0.62	35.0	D
Farrington Hwy.-	No Project/4 Lanes	0.88	22.7	B	1.10	71.2	E
Waiomea St.	With Project/4 Lanes	0.93	31.5	C	1.14	88.2	F
	No Project/6 Lanes	0.65	14.9	B	0.77	12.4	B
	With Project/6 Lanes	0.68	14.8	B	0.80	13.4	B
Farrington Hwy.-	No Project/4 Lanes	0.88	9.6	A	1.10	67.0	E
Laaloa St.	With Project/4 Lanes	0.93	17.9	B	1.15	83.8	F
	No Project/6 Lanes	0.63	5.2	A	0.77	11.1	B
	With Project/6 Lanes	0.66	5.0	A	0.80	9.3	A
Road D - EB	No Project		NA			NA	
Farrington Ramp	With Project (STOP)	1.19	375.7	F	1.18	303.4	F
Road D - WB	No Project		NA			NA	
Farrington Ramp	With Project (Signal)	0.48	14.0	B	0.45	17.2	B
Koio Dr.-	No Project (STOP)	0.08	16.3	C	0.18	33.2	D
Aliinui Dr.	With Project (STOP)	0.10	19.4	C	0.24	44.7	E
Road D-	No Project	0.36	30.5	C	0.39	29.9	C
Kapolei Pkwy	With Project	0.50	32.0	C	0.71	33.9	C
Hanua St.-	No Project	0.91	44.6	D	0.80	44.1	D
Kapolei Pkwy.	With Project	0.92	40.5	D	0.92	41.5	D
Kalaeloa Blvd.-	No Project	0.35	22.0	C	0.53	27.9	C
Farrington Hwy.	With Project	0.46	28.9	C	0.69	37.5	D
Kalaeloa Blvd.-	No Project	0.75	30.8	C	0.90	40.1	D
Kapolei Pkwy.	With Project	0.87	33.4	C	0.97	50.8	D
Wakea St.-	No Project	0.37	5.0	A	0.52	9.8	A
Farrington Hwy.	With Project	0.43	8.3	A	0.59	13.2	B
Wakea St.-	No Project	0.65	30.4	C	0.99	43.3	D
Kamokila Blvd.	With Project	0.66	30.5	C	1.07	50.6	D

V/C = Ratio of the traffic volume to the theoretical capacity of the intersection.
ADPV = Average delay per vehicle, in seconds.
LOS = Level of service.
NA = Not Analyzed

Wilbur Smith Associates; February 8, 2007.

The planned widening of Farrington Highway to six lanes would improve traffic conditions to acceptable conditions at the Koio Drive, Waiomea Street, and Laaloa Street intersections, both without and with the Project.

Although not included in Table S-2, the traffic conditions at most of the intersections along the major circulation roadway within the Project should operate at acceptable conditions with STOP sign controls. The Road A intersection with Road C would satisfy the MUTCD Warrant #3 for consideration of traffic signal control.

Freeway Conditions at Ramps

The 2020 peak hour traffic conditions were assessed for the weaving sections between the Road D and Palailai Interchanges as well as the westbound weaving lane between the H-1 Freeway ramps between the Makakilo and Kapolei Interchanges. Also analyzed were the freeway merge/diverge sections for the Palailai Interchange ramps that would be located within the four-lane section of Farrington Highway closest to Project and should be most affected by the Project traffic

Weaving Sections between Road D and Palailai (Hanua Street) Interchanges –These two weaving sections would be created with the construction of the Road D Interchange. The weaving section in each direction would be about 2,000 feet in length between the on-ramp entry point and off-ramp exit point. A single-lane entry and exit ramp was assumed at each end of the weaving sections. However, the high volume of traffic estimated to use the Westbound On-ramp (1,500 vehicles) in the afternoon peak hour would merit a two-lane ramp entry to the freeway, either without or with the Project.

With Farrington Highway remaining a four-lane highway in 2020, the traffic using the westbound weaving section is projected to result in LOS D conditions in the morning peak hour (Table S-3). This would compare to LOS C conditions at the Hanua Street On-ramp merge area without the Project. In the afternoon peak hour, the traffic conditions along the westbound weaving section are estimated at LOS F with the existing two westbound through lanes, which would likely reduce the average speed along this freeway section by about 5 mph from conditions without the Project.

The planned Farrington Highway widening project would provide an additional through lane in each direction through this section. With the additional through lane, the conditions in the westbound weaving section would improve to LOS C and LOS D in the morning and afternoon peak hours, respectively.

The morning traffic conditions in the eastbound weaving section would operate at very good LOS B conditions both with Farrington Highway remaining a four-lane roadway and widened to six lanes in 2020. In the afternoon peak hour, conditions along the eastbound weaving section are estimated at LOS C with the existing two westbound through lanes, LOS B with the addition of a third through lane.

Table S-3
2020 TRAFFIC CONDITIONS AT
FREEWAY RAMP WEAVING SECTIONS

Year and Development Scenarios	Morning Peak Hour				Afternoon Peak Hour			
	Density	Weave Speed	Thru Speed	LOS	Density	Weave Speed	Thru Speed	LOS
Westbound Weaving from Makakilo On-ramp to Wakea Off-ramp (Kapolei Interchange)								
No Project 6 Lns	25.37	41.78	48.63	C	19.57	43.89	50.72	B
With Project 6 Lns	27.34	41.03	47.78	C	24.04	42.15	48.98	C
Westbound Weaving from Hanua Street (Palailai) On-ramp to Road D Off-ramp								
With Project 4 Lns	18.92	35.39	53.17	B	44.82	27.80	44.73	F
With Project 6 Lns	13.34	38.52	55.07	B	30.82	30.50	48.25	D
Eastbound Weaving from Road D On-ramp to Hanua Street (Palailai) Off-ramp								
With Project 4 Lns	30.15	32.6	50.44	D	21.04	45.87	50.82	C
With Project 6 Lns	21.05	35.66	52.95	C	15.65	39.89	55.88	B

Density = Passenger car equivalents per mile per lane in analyses section.
Weave Speed = Average speed in miles per hour of weaving traffic through analysis section.
Thru Speed = Average speed in miles per hour of non-weaving traffic through analysis section.
LOS = Level of service in weaving area.
Wilbur Smith Associates; November 30, 2006.

Westbound Weaving Section between Makakilo and Kapolei (Wakea Street) Interchanges – This weaving section would be used by Makaiwa Hills traffic exiting the H-1 Freeway onto Farrington Highway to use the mauka extension of Kalaeloa Boulevard (as Project Road A) to enter Makaiwa Hills. The 1,400-foot long weaving section is planned to have a single-lane on-ramp from Makakilo Drive and a single-lane off-ramp at the Kapolei Interchange.

The Project is estimated to have minimal effect on the westbound traffic conditions along this weaving section of the freeway in the morning peak hour, with an estimated 0.8 mph reduction in average freeway speeds. In the afternoon peak hour, the Project traffic is estimated to reduce average speeds along this section by about 1.75 mph. The afternoon conditions are estimated at LOS C with the Project versus LOS B without the Project traffic, as summarized in Table S-3.

Palailai (Hanua Street) Interchange Ramp Junctions – The planned Eastbound On-ramp from the Hanua Street extension to the H-1 Freeway and the planned Westbound Off-ramp to Hanua Street would be the closest independently operating ramps to the Makaiwa Hills Project, although Project traffic would not normally use either of these ramps. These two ramp junctions

are analyzed because each of the ramp junctions would be affected by the addition of the Project traffic in the through lanes, and both ramp junctions are located within the existing four-lane section of the H-1 Freeway beyond the lane drops at the existing Palailai Interchange ramps.

The addition of Project traffic in the eastbound freeway through lanes passing the entry of the Hanua Street Eastbound On-ramp would result in a speed reduction of about 1.0 mph in the morning peak hour and minimal change in the afternoon peak hour, as summarized in Table S-4. The traffic conditions in the freeway lanes near the merge point are estimated at LOS C in both peak hours both without and with the addition of the Project traffic.

The westbound freeway lanes near the future Off-ramp to Hanua Street are estimated to operate at LOS B in the morning peak hour with or without the Project. In the afternoon peak hour, conditions are estimated at LOS C both with and without the Project as summarized in Table S-4. The Project is not projected to significantly affect speeds in either peak hour.

Table S-4
2020 FREEWAY TRAFFIC CONDITIONS AT
KEY RAMP MERGE/DIVERGE SECTIONS

Freeway Section at Ramp	Scenario	Morning Peak Hour			Afternoon Peak Hour		
		Density	Speed	LOS	Density	Speed	LOS
Eastbound Freeway							
At On-Ramp from Hanua St.	No Project	20.6	50.1	C	21.8	50.6	C
	With Project	25.0	50.1	C	24.9	50.6	C
Westbound Freeway							
At Loop Off-Ramp to Hanua St.	No Project	13.9	49.8	B	20.3	50.6	C
	With Project	16.3	49.8	B	25.7	50.6	C

Density = Passenger car equivalents per mile per lane in analyses section.
Speed = Average speed in miles per hour through weaving area.
LOS = Level of service in weaving area.
Wilbur Smith Associates; November 30, 2006

2015 TRAFFIC CONDITONS WITH PARTIAL PROJECT DEVELOPMENT

The initial three development areas in the southeast and central portions of the Makaiwa Hills Project area are expected to be nearing completion by the end of 2015, with the exception of the community shopping center located near the Palailai Interchange. The Areas 1 through 3 development (less the shopping center) was expected to approximate the traffic level that could be accommodated by the combination of the initial access to Kalaeloa Boulevard-Farrington Highway intersection plus the addition of the Project access to an at-grade Road D intersection with Farrington Highway. Therefore the 2015 traffic analyses were based on the provision of an initial at-grade full-movement intersection at the junction of Road D with Farrington Highway to test the adequacy of the at-grade connection through the Area 3 development.

Planned Roadways

The planned area roadway system described for 2020 is expected to be largely in place by 2015 with the exception of two projects:

- The Road D junction with Farrington Highway was analyzed as an at-grade intersection rather than the planned future interchange; and
- Farrington Highway was analyzed only with the four existing through lanes since the present OMPO Regional Transportation Plan identifies the widening project as occurring after year 2015.

Project Trip Generation

The Project Areas 1, 2, and 3, less the community shopping center, are estimated to generate a total of 1,444 and 1,662 vehicle trips to or from the land uses within the Project in the weekday morning and afternoon peak hours, respectively. The 2015 vehicle trips amount to 56.4% of the total Project trips for the morning peak hour and 50.0% of the afternoon peak hour trips. The Project in 2015 would generate an estimated 17,600 vehicle trips to or from the various land uses on a typical weekday.

An estimated 960 and 950 vehicles are projected to use the section of Road D mauka of Farrington Highway in the morning and afternoon peak hours, respectively. About 40% to 50% of these vehicles would be traveling on Farrington Highway/H-1 Freeway to/from areas east of the Project, about 20% would be accessing Farrington Highway west of Road D, and the remainder would be using Road D to travel to the Kapolei Parkway.

Traffic volumes along Road A mauka of Farrington Highway are estimated at 440 vehicles in the morning peak hour and 570 vehicles in the afternoon peak hour. This section of roadway would be primarily used by Project trips to/from the City of Kapolei and by travel from the southeast portion of the Project to/from the Honolulu direction via the Kapolei Interchange ramps.

Key Intersection Conditions

Traffic conditions for the key intersections near the Project site are summarized for the 2015 weekday morning and afternoon commute peak hours in Table S-5. The addition of the Project traffic would adversely impact several key intersections as described in the following paragraphs:

- The initial analysis of the Road D intersection with Farrington Highway was based on each roadway having two through lanes in each direction, double left-turn lanes, and separate right-turn lanes. With these lanes the forecast 2015 traffic would exceed intersection capacity by 30% in the afternoon peak hour.
- Traffic at the Wakea Street intersection with Kamokila Boulevard would approximate capacity in the afternoon peak hour, versus 92% without the Project. Average delay is estimated at LOS D with or without the Project.
- The projected traffic along Farrington Highway would slightly worsen the capacity problems and delays anticipated at the intersections with Koio Drive, Waiomea Street, and Laaloa Street.

The Road D junction with Farrington Highway would eventually be reconstructed as a grade-separated interchange, and Farrington Highway is planned for future widening to six lanes. Several alternative at-grade intersection configurations were assessed that would restrict the left-turns at the Road D-Farrington Highway intersection with the left turns accommodated through "jug-handle" movements, and with a short section of auxiliary through lane added through this intersection. For the options with the left-turn restrictions, the left turns would be accommodated by the construction of several of the future ramp connections that would be constructed for the graded-separated interchange, but with Road D continuing to cross Farrington Highway at-grade. The accommodation of the left turns through jug-handle connections would avoid the provision of separate turn phases and green-time for the left-turn movements at the Road D-Farrington Highway intersection.

This analysis indicated that the projected 2015 peak hour traffic could be accommodated by the following modifications to the "conventional" at-grade Road D-Farrington Highway intersection:

- Prohibit left turns on all four approaches at intersection
- Construct Eastbound On- and Off-ramps to provide the "jug-handle" to accommodate the left turns
- Construct Westbound On- and Off-ramps to provide the "jug-handle to accommodate left turns

Table S-5
2015 TRAFFIC CONDITIONS AT KEY INTERSECTIONS
MAKAIWA HILLS PARTIAL DEVELOPMENT

Intersection	Scenario	Morning Peak Hour			Afternoon Peak Hour		
		V/C	ADPV	LOS	V/C	ADPV	LOS
Farrington Hwy.-Koio Dr. NB Right Turn	No Project With Project	0.68 0.72	56.7 64.4	F F	0.78 0.85	66.3 83.2	F F
Farrington Hwy.-Waiomea St.	No Project With Project	0.80 0.82	14.6 15.1	B B	1.01 1.04	41.3 47.9	D D
Farrington Hwy.-Laaloa St.	No Project With Project	0.80 0.82	6.0 13.4	A B	1.01 1.04	38.8 49.1	D D
Farrington Hwy.-Road D	No Project (RIRO) With Project (Signal)	0.45 0.93	44.5 58.3	E E	0.55 1.30	48.3 125.9	E F
Koio Dr.-Aliinui Dr.	No Project (STOP) With Project (STOP)	0.05 0.06	13.0 14.1	B B	0.10 0.17	22.6 27.1	C D
Road D-Kapolei Pkwy.	No Project With Project	0.20 0.30	30.8 30.4	C C	0.20 0.38	30.0 31.1	C C
Hanua St.-Kapolei Pkwy.	No Project With Project	0.60 0.64	29.9 28.9	C C	0.65 0.62	27.5 27.6	C C
Kalaeloa Blvd.-Farrington Hwy.	No Project With Project	0.33 0.36	21.7 26.8	C C	0.50 0.56	26.2 29.0	C C
Kalaeloa Blvd.-Kapolei Pkwy.	No Project With Project	0.65 0.73	28.1 29.1	C C	0.74 0.76	31.1 32.6	C C
Wakea St.-Farrington Hwy.	No Project With Project	0.37 0.41	4.9 10.3	A B	0.46 0.52	11.3 15.8	B B
Wakea St.-Kamokila Blvd.	No Project With Project	0.63 0.64	30.3 30.1	C C	0.92 1.02	40.6 44.6	D D
Road D-Road A	With Project	0.45	27.4	C	0.37	29.9	C
Road A-School Dwy.	With Project (STOP)	0.09	13.7	B	0.02	11.7	B
Road A-Road C	With Project (STOP)	0.27	14.3	B	0.36	18.8	C
Road B-Village Center Main Rd.	With Project (STOP)	0.53	19.8	C	0.19	9.2	A

V/C = Ratio of the traffic volume to the theoretical capacity of the intersection.
ADPV = Average delay per vehicle, in seconds.
LOS = Level of service.
NA = Not Analyzed

Wilbur Smith Associates; February 7, 2007.

- Widen Road D through the intersection to provide three lanes in each direction, with the lanes dropped as left-turn lanes at the intersections with the two jug-handle ramps

- Provide a third westbound lane on Farrington Highway through the intersection, with the lane ending about 500 feet or more beyond the intersection.

The proposed jug-handle modifications to the Road D-Farrington Highway intersection, with the auxiliary lanes, would result in afternoon peak hour traffic at 79% of capacity if the auxiliary lane were fully used. Approximately 20% of the westbound traffic would need to use the auxiliary lane to provide acceptable conditions for the overall intersection in 2015.

Therefore, the Project proposes the initial construction of the Road D junction with Farrington Highway as an at-grade intersection with left-turns restricted and the future ramps added to provide jug handle routes to accommodate the left turns.

PROPOSED ROADWAY MITIGATIVE ACTIONS

The following actions are proposed to accommodate future roadway needs in the Makaiwa Hills Project study area.

Proposed Actions to Mitigate Project Impacts

The following paragraphs identify transportation improvements to mitigate the impacts at those locations substantially affected by the projected Makaiwa Hills traffic at buildout in 2020.

Road D Junction with Farrington Highway

- Construct initially as at-grade intersection and upgrade to full interchange in incremental phases

- With the interim at-grade intersection, construct the planned ramps to accommodate the left turns via "jug-handle maneuvers, with no left-turns permitted at the at-grade crossing of Road D with Farrington Highway

- With the interim at-grade intersection, construct a short section of three traffic lanes in each direction on Road D to increase capacity through the intersection, with these added lanes serving as left-turn lanes onto the jug-handle on-ramps

- With the interim at-grade intersection, construct a short section of a westbound auxiliary lane along Farrington Highway to increase capacity through the intersection

Farrington Highway/H-1 Freeway

- When the Road D junction is upgraded to an interchange, construct an auxiliary lane in both travel directions to provide weaving sections between the Palailai and Road D Interchange ramps

Road D-Eastbound Farrington Highway Ramps

- Monitor and install traffic signal when warranted by traffic conditions
- Provide separate left- and right-turn lanes to minimize delays
- Provide sufficient median width to allow the provision of dual left-turn lanes from makai-bound Road D onto the On-ramp if needed for future conditions.

Road D- Westbound Farrington Highway Ramps

- Install traffic signal
- Provide double left-turn lanes on the Off-ramp approach

Road D-Road A-Road B

- Install traffic signal
- Provide double left-turn lanes on Road D approach

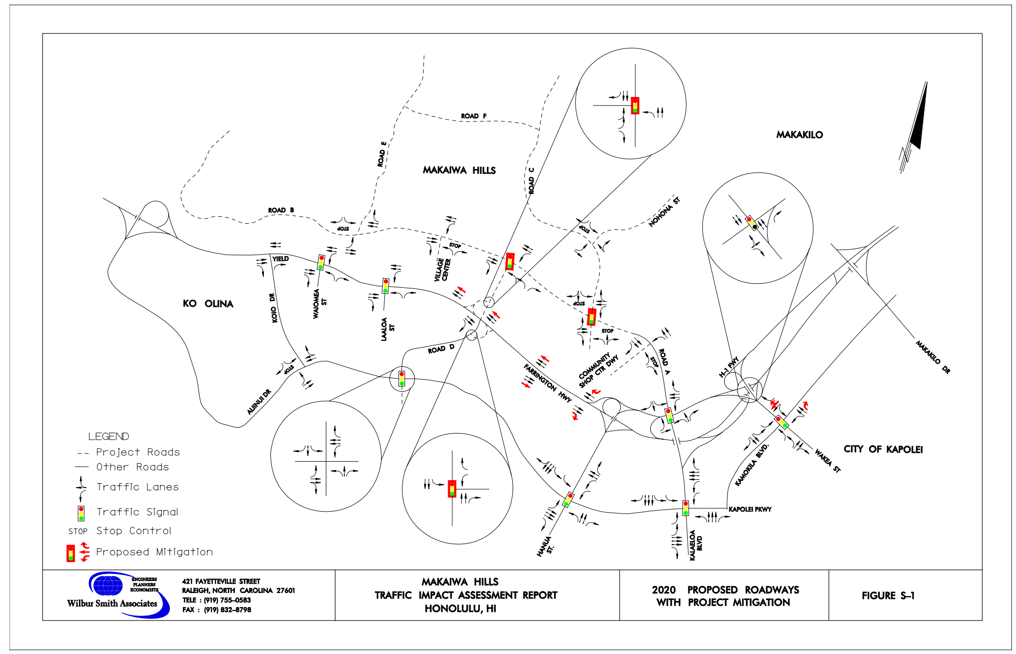
Kalaeloa Boulevard-Kapolei Parkway

- Provide long signal cycle length, similar to those currently used along Fort Barrette Road, to increase green time and reduce lost time during the peak traffic periods.

Wakea Street-Kamokila Boulevard

- Provide separate right-turn lane on mauka-bound Kamokila Boulevard
- Re-stripe existing outside through lane on westbound Kamokila Boulevard to provide a shared right-turn/through lane, which would allow right turns to be made from two lanes onto mauka-bound Wakea Street.

Figure S-1 depicts the proposed roadway lanes and traffic controls anticipated at full Project build-out in 2020.



Proposed Actions By Others

The following roadways and/or modifications would be needed to provide access at Project build-out and are planned as actions by others without the development of the Makaiwa Hills Project:

- Construct the Kapolei Interchange complex
- Construct the section of Road D between the Kapolei Parkway and Farrington Highway
- Construct the Kapolei Parkway
- Widen Kalaeloa Boulevard to six lanes at the Kapolei Parkway intersection
- Construct the Hanua Street extension and new ramps at Palailai Interchange.

PUBLIC TRANSIT AND BICYCLE TRAVEL

The concept plan for the Makaiwa Hills development provides a generally continuous network of major collector roadways for circulation within the community and access to the various development parcels. The street network would provide a framework for bus routes and bicycle travel although the increasing elevation mauka through the Project site and the resultant relatively steep grades along the mauka-makai roadways would affect both bus and bicycle travel on these roadways.

The City and County of Honolulu is planning to construct a public transit guideway that could extend from the central Honolulu area as far west as Kapolei West development area. The presence of a guideway transit station and park-and-ride facility near the Kapolei Parkway-Hanua Street intersection would likely increase public transit usage by Makaiwa Hills residents and workers, which could result in lower vehicle trip generation, particularly for trips via the H-1 Freeway to the central Honolulu area.

The concept plan includes a bicycle path paralleling Farrington Highway to encourage use of bicycles for transportation purposes as well as for recreation. The bicycle path would begin within the commercial area at the west end of the Project area and extend eastward as a separate facility to the Village Center. Bicycle lanes would be provided through the Village Center and the separate bicycle path would resume east of the Village Center to extend to Road D/Road A where it ends in the preliminary concept plan. This planned facility would provide access to the elementary school and the community center.

Sidewalks would be provided along the major collector roadways and local streets in conformance with City and County of Honolulu guidelines and standards.

The following proposed actions could encourage use of these travel modes for travel within the Project.

Public Transit

- The Project Team should meet with City DTS and TheBus staffs in early stages of Project design to identify potential routes for TheBus within the Makaiwa Hills area so that the community layout and design can facilitate access to public transit.
- The Project Team should coordinate the potential location of bus stops with the City DTS and TheBus staffs.
- The community design should provide direct pedestrian linkages between each residential area and the likely bus stop location(s) serving that area to allow convenient access and encourage bus use.
- Bus shelters should be provided at the potential high-use stop locations, such as those serving the commercial areas, the school, and the community center.

Bicycles

- The makai bicycle path should be continued east of Road D to provide access at least as far east as the Makaiwa Hills community shopping center. The crossing could be provided at the signal-protected Road D-Road B intersection.
- Bicycle lanes should be provided along Road D between Makaiwa Hills and the Kapolei Parkway to provide a regional linkage. Road D between Farrington Highway and Road A within the Project should be constructed with bicycle lanes to allow this linkage.
- The collector streets within the Project site should be planned to accommodate bicycle use, and should provide a network of continuous street connections to allow use for bicycle travel by those who prefer not to travel along the major streets.

Chapter 1
INTRODUCTION

The Makaiwa Hills development is planned for the approximately 1,780 acres of vacant land along the mauka side of Farrington Highway between Kalaeloa Boulevard in the City of Kapolei and the Ko Olina Interchange. As depicted in Figure 1-1, the development would be bordered by the Makakilo community to the east; the existing Honokai Hale and the Kapolei West and Ko Olina development areas to the south; and the Waimanalo Gulch land fill and Kahe Point power plant to the west.

The Makaiwa Hills development (the Project) is proposed to include a mix of residential, commercial, and public land uses, with the conceptual plan depicted in Figure 1-2. The planned uses include:

- Approximately 4,100 residential units encompassing a range of housing types from single-family to three- to four-level condominiums
- A community commercial area with an estimated 150,000 square feet of building space
- A village center with about 65,000 square feet of commercial uses located within the higher-density core residential area adjacent to Farrington Highway
- A community commercial center along Farrington Highway near the western end of the Project
- An elementary school planned for about 950 students
- Active parks and passive natural areas.

The development of the Project is planned to begin in the southeast area of the site near the 69 acres that have previously received zoning approval for R-5 development. The development is planned to continue westward through the makai areas of the Project site, with later development extending mauka. Full development of the Project is anticipated in 2020.

Initially, the Project access would be provided to the H-1 Freeway at the Palailai Interchange via an extension of Kalaeloa Boulevard mauka from its present intersection with Farrington Highway. Later, a second primary access would be provided to Farrington Highway east of the Honokai Hale community at the future junction with Kapolei West Road D. The major internal Project roadways would extend mauka and west from the major east-west roadway that would connect these two regional access points, with this roadway referred to within this report as Road A.

Preliminary traffic assessments have indicated that the initial Kalaeloa Boulevard access could accommodate Project traffic from the planned start of development in 2009 through the 2011-2012 period when approximately 800 to 900 residential units would have been completed and occupied within the Project.

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MAKAIWA HILLS
TRAFFIC IMPACT ASSESSMENT REPORT
HONOLULU, HI

PROJECT CONCEPT PLAN

FIGURE 1-1

The second access point would be developed after the completion of the initial 800 to 900 residential units, with this second access point expected to be implemented around 2012. The second Makaiwa Hills access would connect to Farrington Highway east of the Honokai Hale community and would connect to the "Road D" link proposed to provide access to the Kapolei West development area. The traffic analysis indicates that this connection could initially function as an at-grade intersection through development of about 2,300 to 2,400 residential units, which is expected to occur around 2015. This access is referred to as the Road D intersection or interchange with Farrington Highway.

This study provides an analysis of the traffic impacts in 2020 with the anticipated buildout of the Project. The study also provides analysis of the interim development in 2015 based on development of about 2,400 housing units with the provision of an at-grade intersection at the second access connection (Road D linkage to Farrington Highway). This report:

1. Provides the estimated numbers of vehicle trips that would be generated by the Project.

2. Provides the resultant weekday morning and afternoon commute peak hour traffic volumes on the adjacent streets and traffic conditions at key intersections and freeway ramps in year 2020 with Project Buildout.

3. Provides the resultant weekday morning and afternoon commute peak hour traffic volumes on the adjacent streets and traffic conditions at key intersections and freeway ramps in year 2015 with Phases 1 and 2 of the Project.

4. Identifies roadway modifications that may be appropriate to mitigate Project transportation impacts on the adjacent streets, based on the 2015 and 2020 analyses.

This traffic study for the Makaiwa Hills Development Project focuses on those roadways near the site that would be most directly affected by the Project traffic and would be most likely to need improvements to accommodate the Project traffic.

METHODOLOGY AND ASSUMPTIONS

The general methodology and assumptions used in the forecasting and analysis of traffic impacts with the Makaiwa Hills Development Project are outlined in the following sections.

Analysis Scenarios

The traffic study examines the traffic needs at an interim stage of the development (about 2,400 housing units in 2015) and at full buildout of the Project site, which are reflected in the following traffic analysis scenarios:

- **Year 2015 Without Project** – These forecasts and analysis reflect the anticipated development and roadway projects that are expected to occur within the study area

without the Makaiwa Hills Project. This scenario provides a baseline from which to assess the impacts of the Project development with an at-grade Road D intersection with Farrington Highway.

- **Year 2015 With Project** – The traffic conditions were analyzed for 2015 with development of eastern and central Project areas near the H-1 Freeway/Farrington Highway. The community commercial development, planned near the Palailai Interchange, is not included in the 2015 scenario since the planned development of a number of other retail developments in the nearby areas would likely delay this community commercial development after 2015 when the increasing number of Makaiwa Hills residents would likely be more likely to provide adequate market support for this additional commercial development.

- **Year 2020 Without Project** – These forecasts and analysis reflect the anticipated development and roadway projects that are expected to occur within the study area without the Makaiwa Hills Development Project. This scenario provides a baseline from which to assess the impacts of the Project Buildout.

- **Year 2020 With Makaiwa Hills Buildout** – The traffic conditions were analyzed for 2020 with full buildout of the Project.

Forecast Methodology and Assumptions

The traffic growth *without* the Project was forecast for years 2015 and 2020 through the use of a TRAFFIX trip generation and assignment model developed by Wilbur Smith Associates (WSA) for the City of Kapolei and the adjacent areas. The general assumptions regarding the new development and roadway improvements in the area are outlined in the following section. The numbers of new trips generated by new development within and near the City of Kapolei were based on standard trip generation rates compiled by the Institute of Transportation Engineers (ITE).[1] The origins and destinations of the new trips were based on the trip distribution percentages developed from the Oahu Metropolitan Planning Organization (OMPO) regional travel forecasting model.

Non-Project Developments by 2015 – A substantial amount of new development is expected within the City of Kapolei between 2006 and 2015. The additional development near the Project site is expected to include the following areas:

- The build-out of the commercial and residential areas within the City of Kapolei between Fort Barrette Road and Kalaeloa Boulevard.

- Development of about 55% of the planned Kapolei West area, including the combined zoned and un-zoned portions of the development.

[1] *Trip Generation, Seventh Edition*, Institute of Transportation Engineers, 2003.

- Development of the Kapolei Commons mixed-use development and the Costco store along Kalaeloa Boulevard, as well as the 14-acre commercial site across Farrington Highway from the Hawaii Waters Adventure Park.

- Continued development of the industrial lands along Kalaeloa Boulevard makai of the Kapolei Parkway.

- Continued development of hotels, residences, and the aquarium within the Ko Olina development area.

Future Roadways by 2015 – The traffic assignments and intersection analyses reflect the construction of a number of roadway projects that would affect traffic conditions in the vicinity of the Project. The new roadways expected by 2015 that would most affect the Project area traffic conditions include:

- Construction of the new Kapolei Interchange with this including an on-ramp from Wakea Street to the eastbound H-1 Freeway and a westbound off-ramp connecting to Farrington Highway that would provide access to the Makaiwa Hills Project.

- Reconstruction of the Palailai Interchange to include the new ramp connections for the Hanua Street Extension.

- Construction of a Westbound On-ramp from Makakilo Boulevard to the H-1 Freeway.

- The extension of the Kapolei Parkway west of Kalaeloa Boulevard to connect to Aliinui Drive in Ko Olina.

- Construction of the Kapolei West Road D from the Kapolei Parkway to connect to Farrington Highway with an at-grade intersection allowing only right turns to/from Road D.

Non-Project Developments by 2020 – The new development near the Project site by 2020 would include the development listed for 2015 plus the following areas:

- The completion of the Kapolei West development, to include both the zoned and un-zoned portions.

- The near completion of the development of the industrial lands in the Kalaeloa Boulevard corridor.

- Continued development of additional hotels and residential areas within the Ko Olina area.

Future Roadways by 2020 – The traffic assessment reflects the roadway projects identified for 2015 as well as the following roadway projects:

- The at-grade right-in/right-out connection of Road D to Farrington Highway is shown for year 2020 since previous analyses had indicated that this type of connection would be adequate to serve the Kapolei West development. Therefore, the grade-separated interchange at the Road D connection to Farrington Highway is included only when needed to provide access to the Makaiwa Hills Project.

- The section of Farrington Highway fronting the Project is planned for widening to six lanes during the 2015 to 2030 period. The intersections and ramps along this section were analyzed both with the existing four lanes and with the planned six lanes.

Intersections and Freeway Ramps Analyzed in Traffic Study

Since the combined residential and commercial uses within the Project should result in highest traffic generation in the weekday morning and afternoon commute peak ours, the traffic study focuses on traffic conditions within these weekday peak hours. Traffic conditions were analyzed for those existing and planned intersections and freeway ramps near the Project site where the Project traffic might be expected to substantially affect traffic conditions:

Table 1-1
Analysis Locations for Traffic Study

Locations	Analyzed for Years		
	2006	**2015**	**2020**
Off-Site At-Grade Intersections			
Wakea Street-Kamokila Boulevard	Yes	Yes	Yes
Wakea Street- Farrington Highway		Yes	Yes
Farrington Highway-Kalaeloa Boulevard	Yes	Yes	Yes
Kapolei Parkway- Kalaeloa Boulevard	Yes	Yes	Yes
Farrington Highway-Road D		Yes	Yes
Farrington Highway-Laaloa Street	Yes	Yes	Yes
Farrington Highway-Waiomea Street	Yes	Yes	Yes
Farrington Highway-Koio Drive		Yes	Yes
Ramp Junctions with H-1 Freeway/Farrington Highway			
Makakilo-Wakea WB Weaving Section		Yes	Yes
Hanua Street WB Off-Ramp		Yes	Yes
Kalaeloa Blvd.-Hanua Street WB On-ramp	Yes	Yes	Yes
Kalaeloa Blvd.-Hanua Street EB Off-ramp	Yes	Yes	Yes
Hanua Street EB On-ramp		Yes	Yes
Road D EB On-ramp			Yes
Road D WB Off-ramp			Yes

Wilbur Smith Associates; July 24, 2006

Intersection Analysis Methodology

Traffic conditions at intersections controlled by traffic signals or STOP signs were analyzed using the methodology set forth in the *2000 Highway Capacity Manual*, as summarized in Appendix A, and the Synchro 6.0 analysis software. The analyses of traffic signal-controlled intersections were based on the following operational assumptions:

- Use of 4-second yellow clearances and 1-second all-red intervals.
- On major through roadways, left-turns allowed only with protected left-turn phases.
- Optimized split of signal timing among the signal phases for future years.

Traffic conditions at ramp junctions with freeway lanes were analyzed using the methodology set forth in the *2000 Highway Capacity Manual*, as summarized in Appendix A, and the McTrans HCS analysis software.

REPORT ORGANIZATION

This traffic impact analyses for the Makaiwa Hills Development Project has been organized into the following chapters:

1. Introduction
2. Existing Conditions – Describes the existing roadway facilities, public transportation services, traffic volumes, and traffic conditions in the vicinity of the Project.
3. 2015 and 2020 Conditions without the Project – Describes the traffic increases on area roadways and traffic conditions at key intersections and freeway ramps in years 2015 and 2020 without the Project
4. 2020 With Project Buildout – Describes the traffic increases on area roadways and traffic conditions at key intersections in year 2020 with the full development of the entire Project site.
5. 2015 With Partial Project – Describes the traffic increases on area roadways and traffic conditions at key intersections in year 2015 with the development of the Project Areas 1 and 2 land uses, minus the community commercial center.

Chapter 2
EXISTING CONDITIONS

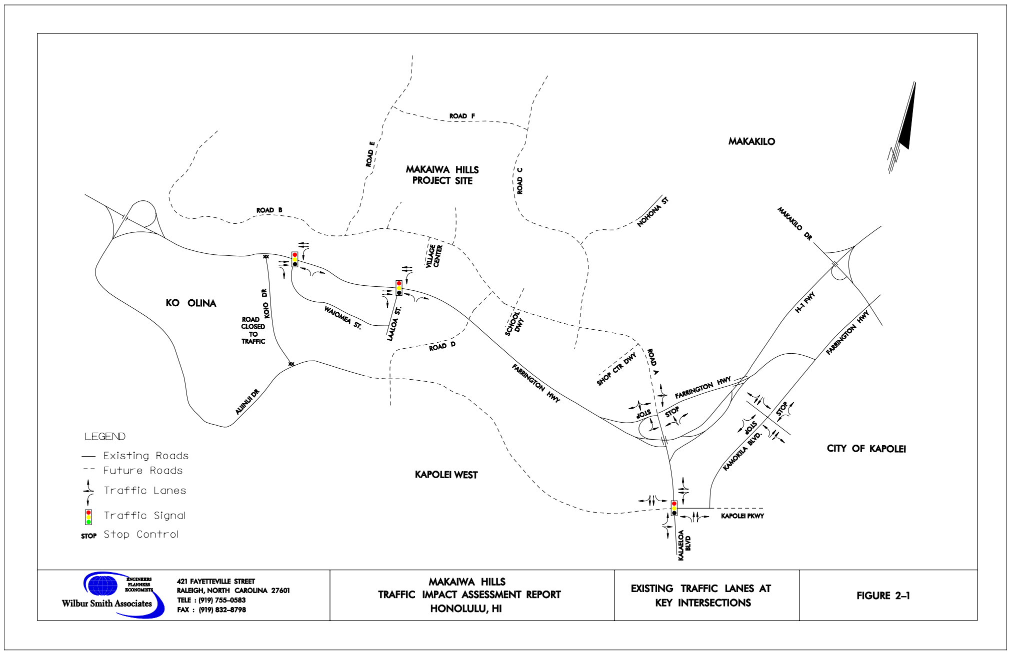
At the time of the traffic surveys in May 2005 and January 2006, the Honolulu Advertiser was the only development west of Kalaeloa Boulevard in the City of Kapolei area. East of Kalaeloa Boulevard, the Home Depot, Ace Hardware, and Outback Steakhouse facilities had each opened within the past year along Kamokila Boulevard near the Kalaeloa Boulevard intersection with the Kapolei Parkway.

Construction was underway on the extension of Kamaaha Avenue and Manawai Street to provide a second entry into the City of Kapolei from Fort Barrette Road.

EXISTING ROADWAY SYSTEM

The major roadway system near the Makaiwa Hills development (the Project) area is depicted in Figure 2-1. The major roadways within the western City of Kapolei-to-Ko Olina area are discussed in the following paragraphs.

- **H-1 Freeway** - This freeway is the major east-west roadway in the Ewa District and connects the Ewa area to central Honolulu and other areas of Oahu. City of Kapolei traffic access to the freeway is via the Makakilo (Makakilo Drive-Fort Barrette Road) and Palailai (Kalaeloa Boulevard) interchanges H-1 Freeway has six travel lanes east of the Palailai Interchange and four lanes west of the interchange to its terminus east of the Honokai Hale community.
- **Farrington Highway** - This State highway parallels the H-1 Freeway and serves east-west travel through the Ewa District from the Waipahu area to the Palailai Interchange. Farrington Highway serves as the major regional route west from the terminus of the H-1 Freeway just east of the Honokai Hale residential area. The section between Kamokila Boulevard and Kalaeloa Boulevard is a two-lane roadway. Farrington Highway continues west of the H-1 Freeway terminus as a four-lane divided highway to connect to the Ko Olina and Waianae coast areas.
- **Kalaeloa Boulevard** – This major roadway provides access from the H-1 Freeway at the Palailai Interchange to the Kapolei Business Park, Campbell Industrial Park, and Barbers Point Harbor. The roadway also provides access to the City of Kapolei area via the Kapolei Parkway connection to Kamokila Boulevard. Kalaeloa Boulevard is a four-lane divided roadway from the H-1 Freeway to Malakole Road, and is a two-lane street within the Campbell Industrial Park area makai of Malakole Street. Traffic signal controls are provided at the intersection with the Kapolei Parkway.



- **Wakea Street** – The existing street extends only one-block south of Kamokila Boulevard. North of Kamokila Boulevard, the street right-of-way is being used temporarily as the transit terminal for TheBus routes serving the Kapolei area. This roadway is planned for extension southward to serve as a key north-south arterial within the commercial core area of the City of Kapolei.

- **Kamokila Boulevard** - This major roadway connects Farrington Highway to the Kapolei Parkway and Kalaeloa Boulevard and provides access to the center of the City of Kapolei. Kamokila Boulevard provides two through lanes in each direction. The roadway has a landscaped median area for most of its length and has left-turn lanes at the intersections with cross streets and driveways.

- **Kapolei Parkway** - This major roadway is planned to be a major traffic artery connecting the City of Kapolei to the Ko Olina area to the west and to the Villages of Kapolei and other communities to the east. Within the Kapolei area, the only completed portions of the roadway are the one-block segment between Kalaeloa and Kamokila Boulevards and a short section on the Honolulu side of Fort Barrette Road that provides access to the Kapolei Middle and High Schools, as well as the Villages of Kapolei. These segments have a median-divided roadway with two or more traffic lanes and a bicycle lane in each direction.

- **Laaloa Street** – This neighborhood collector street provides access to Farrington Highway for the eastern portion of the Honokai Hale residential community. Parking is permitted along both sides of the two-lane street. The street extends to the makai boundary of the community.

- **Waiomea Street** – This neighborhood collector street provides access to Farrington Highway for the western portion of the Honokai Hale (Nanakai Gardens) residential community. Parking is permitted along both sides of the two-lane street.

- **Koio Drive** – This four-lane roadway with a landscaped median is intended to connect Aliinui Drive to Farrington Highway. The roadway has been barricaded and used only by construction traffic. The connection to Farrington Highway has been constructed to permit only right-in/right-out movements.

- **Aliinui Drive** – This four-lane highway with landscaped median provides access to the Ko Olina area from Farrington Highway. The junction with Farrington Highway is a trumpet-type interchange. The cross street approaches to Aliinui Drive are controlled by STOP signs. At present, a guard booth is located near Farrington Highway to monitor access into Ko Olina. STOP signs are posted along Aliinui Drive at the two OR&L rail crossings as the means of crossing protection.

EXISTING TRAFFIC VOLUMES

Wilbur Smith Associates (WSA) conducted special turning movement counts at the key intersections in the City of Kapolei, Ko Olina, and along Farrington Highway during the weekday morning and afternoon peak commute traffic periods in 2005 to early 2006. Traffic counts were made for each 15-minute period between 6:00 and 8:30 AM, and between 3:30 and 6:30 PM. The 15-minute counts were used to identify the peak one-hour volumes at the study intersections in the morning and afternoon commute periods. The peak one-hour volumes generally started at 7:00 or 7:15 AM in the morning commute period, and 4:15 to 4:30 PM in the afternoon peak period.

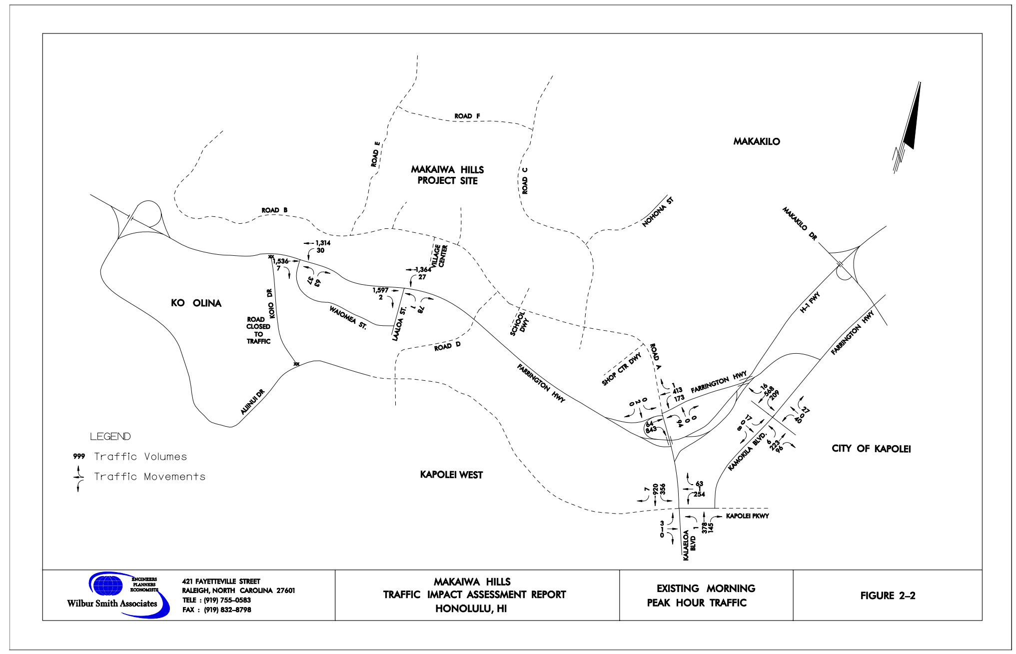
The dates of the various traffic counts used in this study as follows:

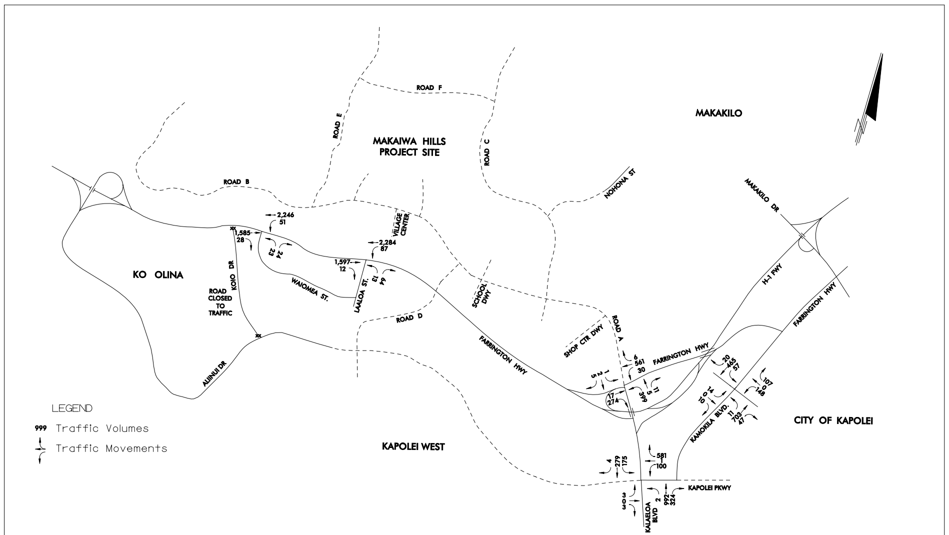
Farrington Highway at Laaloa Street	2/3/2005
Farrington Highway at Waiomea Street	2/3/2005
Kalaeloa Boulevard and Farrington Highway	5/24/2005
Kalaeloa Boulevard and Eastbound Off-ramp	5/24/2005
Kalaeloa Boulevard and Kapolei Parkway	5/24/2005
Wakea Street at Kamokila Boulevard	2/8/2005

Peak hour traffic volumes on the H-1 Freeway were based on traffic counts made by WSA on Farrington Highway at the Laaloa and Waiomea Street intersections on February 3, 2005. The WSA May 2005 traffic survey included counts at the H-1 Freeway on- and off-ramps at the Palailai Interchanges. The Farrington Highway and H-1 Freeway ramp traffic counts were used to derive the traffic volumes along the Freeway through the City of Kapolei.

The existing weekday morning peak one-hour traffic volumes are depicted in Figure 2-2 and the peak weekday afternoon volumes are depicted in Figure 2-3. At most locations along Farrington Highway, the afternoon peak hour two-way traffic volumes are higher than those in the morning peak hour. The peak hour counts used in this study generally reflect the 6:30-7:30 AM although the peak hour at intersections along Kamokila Boulevard are from 7:00 AM to 8:00 AM. The afternoon peak hour is generally for the 4:30-5:30 PM period, which is the peak hour for the traffic within the City of Kapolei, with an earlier peak hour along Kalaeloa Boulevard and later peak hour along the H-1 Freeway/Farrington Highway.

The section of Farrington Highway adjacent to the Project site accommodates high volumes of traffic in the Honolulu-bound direction in the morning peak period, with a volume of about 1,680 eastbound and 1,390 westbound vehicles along the section between the Palailai Interchange and Honokai Hale. The afternoon peak hour volumes along this section are about 30% higher than the morning volumes with traffic heavier in the Waianae-bound direction in the afternoon peak period (2,370 westbound versus 1,660 eastbound vehicles).





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MAKAIWA HILLS
TRAFFIC IMPACT ASSESSMENT REPORT
HONOLULU, HI

EXISTING AFTERNOON
PEAK HOUR TRAFFIC

FIGURE 2-3

The traffic volumes at the Palailai Interchange are highest on the Westbound and Eastbound Off-ramps in the morning peak hour and higher for the Eastbound On-ramp in the afternoon peak hour. The highest volumes on the weaving section between the Eastbound Off-ramp to Farrington Highway and the Eastbound On-ramp from Kalaeloa Boulevard occur in the afternoon peak hour.

Traffic for 6:30-7:30 AM is shown along Kalaeloa Boulevard for morning peak hour in Figure 2-2. This period included a high volume of left turns (189 vehicles) from makai-bound Kalaeloa Boulevard onto Kapolei Parkway, although this left-turn movement peaks from 7:00-8:00 AM with about 350 vehicles when the high volume of vehicles turning left resulted in the queue of vehicles stacking from the turn lane to the H-1 Freeway eastbound off-ramp. The long queue lasted for about 20 minutes starting a little after 7:30 AM.

In the 4:30-5:30 PM peak hour, the Kalaeloa Boulevard-Kapolei Parkway intersection accommodates a high volume of vehicles mauka-bound on Kalaeloa Boulevard as well as right-turns from westbound Kapolei Freeway. Traffic volumes in this hour include both employees leaving work in both the Campbell Industrial Park and City of Kapolei areas as well as persons traveling to the City of Kapolei commercial area.

At the Kalaeloa Boulevard intersection with Farrington Highway, approximately 400 vehicles turn left from mauka-bound Kalaeloa Boulevard onto the H-1 Freeway westbound on-ramp in the afternoon peak hour. This resulted in a long queue of vehicles waiting to turn left from this STOP sign-controlled approach to the intersection.

EXISTING TRAFFIC CONDITIONS

Traffic conditions were analyzed for the weekday morning and afternoon peak one-hour traffic volumes. The analyses were made for the key intersection near the Project site, and for the key H-1 Freeway ramps at the Palailai Interchange. The methodology and criteria used in analyzing the traffic conditions at the intersection and on the freeway are described in Appendix A.

Existing Intersection Conditions

The overall traffic conditions at each of the key intersections are summarized in Table 2-1 for the weekday morning and weekday afternoon peak traffic hours.

The existing peak hour traffic volumes at the Farrington Highway intersections with Laaloa and Waiomea Streets amount to approximately 58% of intersection capacity in the morning peak hour and 75% of capacity in the afternoon peak hour. The overall levels of vehicle delay are at very acceptable conditions (LOS A or B). However, the vehicles waiting to turn left into or out of the two side streets typically experience long delays (LOS D or E).

Table 2-1
EXISTING TRAFFIC CONDITIONS AT KEY INTERSECTIONS

Intersection	Type of Traffic Control	Morning Peak Hour			Afternoon Peak Hour		
		V/C	ADPV	LOS	V/C	ADPV	LOS
Farrington Hwy.-Waiomea St.	Signal	0.58	14.1	B	0.74	6.3	A
Farrington Hwy.-Laaloa St.	Signal	0.58	9.1	A	0.75	12.6	B
Kalaeloa Blvd.-Farrington Hwy.	STOP sign LOS for NB Left Turn	0.44	31.6	D	1.29	181.2	F
Kalaeloa Blvd.-Kapolei Pkwy.	Signal	0.64	20.8	C	0.93	42.2	D
Wakea St.-Kamokila Blvd.	STOP sign LOS for NB Left Turn	0.32	42.8	E	0.70	49.1	E

V/C = Ratio of the traffic volume to the theoretical capacity of the intersection.
ADPV = Average delay per vehicle, in seconds.
LOS = Level of service.

Wilbur Smith Associates; August 2, 2006.

The traffic turning left from the STOP sign-controlled Kalaeloa Boulevard approach onto the Westbound On-Ramp at the Farrington Highway intersection experienced long delays in the weekday afternoon peak hour. The traffic analysis indicates an average delay of about 3 minutes per vehicle. Field observations noted the occasional formation of queues of up to 10-12 vehicles at times in the weekday afternoon peak hour. The average delays during the weekday morning and Saturday peak hours were at acceptable levels (LOS D).

The overall traffic conditions at the signal-controlled Kalaeloa Boulevard intersection with Kapolei Parkway were at very acceptable overall levels in the weekday morning peak hour with the morning peak hour traffic approximating 64% of the intersection capacity and the average delay for all traffic passing through the intersection at an acceptable LOS C. The afternoon peak hour volumes approximated 93% of the estimated intersection capacity with the primary conflict between the high volume of mauka-bound traffic and the makai-bound left-turn along Kalaeloa Boulevard. Overall average delay was LOS D in the afternoon peak hour, with LOS E for the left-turn from makai-bound Kalaeloa Boulevard.

Palailai Interchange Ramp Conditions

Existing traffic conditions were assessed for the weaving section of the eastbound H-1 Freeway ramps on the east side of the Palailai Interchange and for the merge/diverge sections of the Palailai Interchange ramps with the H-1 Freeway through lanes.

Eastbound Weaving Roadway between Kalaeloa Boulevard and Wakea Street – The HCS weaving analysis has limited applicability for collector-distributor roadways. The assessment was made to indicate the relative level of change in the traffic conditions along the 1,200-foot long, three-lane weaving section for the single-lane exit from the freeway (Ramp PC) and the two-lane ramp from Kalaeloa Boulevard (Ramp PC-1). The off-ramp traffic must cross through the Kalaeloa Boulevard traffic to reach the lanes exiting to Wakea Street while almost all of the Kalaeloa Boulevard traffic must weave through the off-ramp traffic to access the lane exiting the weaving roadway onto the eastbound freeway.

The resulting traffic density indicates that the weaving section provides very acceptable LOS B conditions in the morning peak hour with the much higher weaving volumes in the afternoon period indicating acceptable LOS C conditions. The afternoon weaving volume amount to about 40% of the estimated capacity for the weaving section. The HCS 2000 warns that three-lane weaving sections with volume-to-capacity ratios of 0.45 or greater may encounter operational problems due to the limited usefulness of the third lane. Existing afternoon peak hour volumes are approaching this level.

Table 2-2
2005 WEAVING SECTION TRAFFIC CONDITIONS

Peak Hour	Average Speed (mph)			Density (vplph)	Level of Service
	All Traffic	Non-Weave	Weaving		
Eastbound Separate Weaving Roadway Kalaeloa Blvd.-Wakea St. (Existing)					
Morning	29.5	42.5	29.2	11.1	B
Afternoon	25.5	37.6	25.0	23.0	C

vplph = vehicles per lane per hour

Wilbur Smith Associates; March 28, 2006

Palailai Interchange Ramp Junctions with Freeway Lanes – Each on-ramp merge or off-ramp diverge area along the freeway was analyzed using HCS 2000, with the results summarized in Table 2-3. Eastbound On-ramp KC-1 from the Eastbound Weaving Roadway and westbound Off-ramp PD to Kalaeloa Boulevard are not included in the analysis since freeway through lanes are added or reduced via these ramps.

The HCS analysis estimates the average vehicle density and travel speeds along the 1,500-foot section of freeway through lanes affected by traffic entering or exiting the freeway, with the density also used to identify the level of service within this ramp influence area along the freeway mainline. The analysis is made for the two outside lanes that are most directly affected by the traffic entering/exiting the ramps and, for sections with three or more through freeway lanes, the conditions in the other lanes that are less affected by the ramp traffic.

LOS C or better conditions are estimated for each of the ramp merge/diverge areas for the Palailai Interchange for both peak hours. The merge or diverge of each of the ramps with the freeway through lanes presently operate at very acceptable densities and with little impact on traffic speeds. .

Table 2-3
TRAFFIC CONDITIONS ALONG FREEWAY AT RAMP MERGE AND DIVERGE AREAS

Ramp Junction	Peak Hour	Average Speed (mph)		Traffic Density (vplph)	Level of Service
		Near Ramp	Other Lanes		
Eastbound Freeway					
Off-ramp PB to Kalaeloa	AM	50.8	NA	20.4	C
Blvd.	PM	50.9	NA	20.3	C
Off-ramp PC To	AM	50.4	NA	17.8	B
EB Weaving Roadway	PM	50.6	NA	18.8	B
Westbound Freeway					
On-ramp PA from	AM	51.1	NA	14.9	B
Kalaeloa Blvd.	PM	50.6	NA	23.2	C

Near Ramp is the 1,500-foot section of the 2 lanes closest to ramp.
Other lanes are lanes closest to median if 3 or more lanes on freeway.
Vplph = vehicles per lane per hour for 2 lanes near ramp.
Level of Service is for 2 lanes near ramp.
Wilbur Smith Associates; March 28, 2006

Traffic conditions are not presented for the junction of On-ramp KC-1 from Kalaeloa Boulevard since it joins the eastbound freeway as an added through lane and no merge maneuver is necessary. The on-ramp from the Eastbound Weaving Roadway has an estimated potential capacity of about 2,100 vehicles per hour. The afternoon peak hour volumes amount to about one-half of the capacity.

Similarly, the westbound freeway drops from three lanes to two lanes with the drop of the outside lane as the entry to the loop Off-ramp PD. This off-ramp for westbound traffic exiting from the H-1 Freeway to Kalaeloa Boulevard and Farrington Highway has an estimated capacity of about 1,800 vehicles per hour. The morning peak hour volume of just over 900 vehicles amounts to about half of the potential ramp capacity.

PUBLIC TRANSPORTATION

The City and County of Honolulu provides public transportation services to the City of Kapolei and along Farrington Highway adjacent to the Makaiwa Hills development area. TheHandiVan provides door-to-door service for persons who have difficulty in accessing the fixed route service.

Kapolei Transit Center – The City and County of Honolulu has constructed a temporary Transit Center on the alignment of the future extension of Wakea Street mauka of Kamokila Boulevard. The Transit Center provides a transfer site for all of TheBus local and regional routes that serve the City of Kapolei and the surrounding communities. Upon commencement of the construction of the Kapolei Interchange, the Transit Center will be relocated, with the planned future site near the intersection of the Kapolei Parkway and Kamaaha Avenue.

TheBus Stops – Bus stops for the existing TheBus routes are located along both sides of Farrington Highway at the intersections with Laaloa Street and Waiomea Street. There is also a TheBus stop located within the Hawaiian Waters Adventure Park along the driveway that connects the East and West Water Park entry/exit driveways.

TheBus Routes – The existing bus routes that provide service along Farrington Highway near the Makaiwa Hills project site include the following:

> **Route C Country Express** – Route C provides an express/limited stop service through the City of Kapolei area, with the route extending to the Honolulu Downtown area and Ala Moana Center to the east and along the Waianae Coast to Makaha to the west. Route C buses use the freeway east and west of the City of Kapolei and enters/exits the freeway at the Makakilo and Palailai Interchanges to provide service along Farrington Highway and Kamokila Boulevard between the two interchanges. The service operates seven days a week from about 4:30 AM to 11:00 PM. Route C travels along Farrington Highway past the Project site with a stop at Laaloa Street near the site.

Route 40 Makaha-Honolulu – This trunk route provides regular service between the Waianae Coast and the central areas of Honolulu, with the route following Farrington Highway through the City of Kapolei and Waipahu areas. This route travels past the Project site along Farrington Highway between the Kapolei Transit Center and the Waianae Coast. Buses travel mauka on Kalaeloa Boulevard, turn east on Farrington Highway, and turn left into the Water Park East Driveway to access the bus stop within the park. The buses exit the Water Park West Driveway and return to Kalaeloa Boulevard to travel to Waianae or the Kapolei Transit Center. These buses also service the bus stops at Honokai Hale. The route provides service at a 30-minute frequency through the daytime and evening and hourly service through the night.

BICYCLES AND PEDESTRIANS

There are no bicycle lanes provided along the sections of Farrington Highway or Kalaeloa Boulevard near the Project site. There are bicycle lanes located along Farrington Highway east of the Kamokila Boulevard intersection, with a continuation of the bicycle lanes along Kamokila Boulevard west of the intersection. Bicycle lanes are also provided along the block of Kapolei Parkway between Kamokila and Kalaeloa Boulevards.

The section of Farrington Highway extending eastward from the Kalaeloa Boulevard intersection to the freeway overpass has a 4- to 8-foot wide paved shoulder along each side of the roadway. Bicyclists using this section of roadway would be expected to ride along the paved shoulder.

Along most other major roadways near the Project site, bicycles would use paved shoulder areas, wide outside lanes, or travel within the regular traffic lane.

There are no sidewalk facilities and few marked crosswalks provided along the sections of Farrington Highway and Kalaeloa Boulevard near the Project site. There are marked crosswalks across Farrington Highway at Laaloa and Waiomea Streets intended primarily for use by bus passengers to access the bus stops on the mauka side of the highway. There are sidewalks along Kamokila Boulevard and along the Kapolei Parkway with marked crosswalks provided at the intersection.

Chapter 3
FUTURE CONDITIONS WITHOUT PROJECT

Future travel on the area roadways without the Makaiwa Hills development (the Project) was forecast by estimating traffic to/from new developments in the City of Kapolei-Ko Olina area, and then adding these new trips to the existing travel volumes. Traffic was also forecast to/from new development anticipated in the other areas near the City of Kapolei that would travel through the Project area. The overall methodology used to estimate future traffic for years 2015 and 2020 without the Project was as follows:

- Aina Nui Corporation staff provided the location, type and general timing of future development in the City of Kapolei.
- The property owners and/or developers in the areas adjacent to the City of Kapolei were contacted to identify the general description and timing of additional development in those areas.
- Wilbur Smith Associates (WSA) staff estimated the peak hour vehicle trip generation for each of the potential developments.
- The origin/destination of trips for the new developments were based on a trip distribution for the Kapolei area as developed from the OMPO regional model.
- The traffic to/from the new developments was assigned to the area roadway system using a TRAFFIX traffic model.
- An annual growth factor was used to increase through traffic along the H-1 Freeway.

Traffic conditions were then analyzed for the key intersections and roadways that would be affected by traffic generated by the Makaiwa Hills Project.

FUTURE DEVELOPMENT ASSUMPTIONS

Most of the lands within the City of Kapolei area are expected to be developed by 2015, with development of most of the Kalaeloa Boulevard corridor-Ko Olina area, including the Kapolei West development, anticipated by 2020.

Development Within Makaiwa Hills

A 69-acre parcel located adjacent to the southeast section of the Makaiwa Hills area has received City and County of Honolulu zoning approval as R-5 residential lands. Present plans are to develop about 33 single-family homes and 98 multi-family housing units within the zoned area, with development expected before 2010. The development within this previously zoned parcel is not considered part of the "Makaiwa Hills Project" and therefore the traffic estimated for these units is included within the Without Project scenario for both 2015 and 2020.

Development Within City of Kapolei

The entire central area of the City – between Fort Barrette Road and Kalaeloa Boulevard – is expected to be completed and occupied by the 2015 forecast year. Where there are no specific plans as yet, the Campbell Estate staff has identified the types of uses anticipated for the vacant properties. The anticipated developments include the following:

- **Kapolei Public Library** – Completion of the book/periodical distribution and storage area.
- **Kapolei Park Square** – Development of the 2-acre vacant parcel at the south end of Kapowai Place with office space.
- **Kapolei Senior Village** – Full occupancy of the retirement village is planned for the 40-acre area along the west side of Fort Barrette Road between the future Kamaaha Avenue and Kapolei Parkway.
- **Island Pacific Academy** – The second phase of the private school is under construction on block on the southeast corner of Haumea and Wakea Streets. The school is planned to expand from the present enrollment of about 500 students to a total of 900 students by 2009.
- **Kamokila Blocks between Wakea and Uluohia Streets –** These two blocks on the makai side of Kamokila Boulevard are expected to be developed with a mix of restaurant, retail, and office uses in the next several years.
- **Kapolei Power Center** – The remaining portions of the site are expected to be developed with a mix of retail, mini-storage, restaurant, and office uses.
- **Costco** – A Costco store and service station is planned for the parcel on the southeast corner of the intersection of Kalaeloa Boulevard and the Kapolei Parkway.
- **Mehana at Kapolei** – Full development of the planned 1,156 residential units are anticipated by 2015.
- **Kapolei Mauka Residential Area –** A townhouse development is planned for the area just mauka of the H-1 Freeway on the west side of Makakilo Drive with about 350 townhouses. Access would be provided to the Mauka Frontage Road.
- **Kapolei Rezoning Parcel 1** – Full development of the other undeveloped areas along Kamokila Boulevard, Kamaaha Avenue and the Kapolei Parkway is anticipated to include a mix of office, commercial, and residential uses.
- **Kapolei Rezoning Parcel 2** – This retail development, located makai of the Hawaiian Water Adventures Park, is expected to be developed with retail uses.
- **Kapolei Rezoning Parcel 3** – The commercial development located on the northeast corner of the intersection of Farrington Highway and Makakilo Drive is expected to be developed with a discount store and small shops and restaurants.

Traffic to/from each of these developments is included in both the forecast year 2015 and 2020 traffic volumes.

Additional Development Along the Kalaeloa Boulevard Corridor

Most of the vacant lands along Kalaeloa Boulevard that have already received zoning approval from the City and County of Honolulu are expected to be fully developed by 2015. In addition, development was assumed to be underway on several planned projects that have not yet received full zoning approval, such as the planned Kapolei Harborside Center development. Most of the area is anticipated to be fully developed by 2020. The additional development in the corridor between 2006 and 2020 reflected in the traffic forecasts are outlined in the following sections.

2006-2015 Development – The new developments or additions to existing development, expected between the 2006 traffic counts and the end of 2015 include the following projects:

- **Kapolei Commons –** The mixed use development is expected to be completed in 2010 with retail, office, theater, and condominium uses.
- **Kapolei Business Park Phases 1 and 2 –** An average of about 9 to 10 acres of new warehouse, services, and light industrial areas are expected to be developed each year.
- **Kalaeloa Industrial Areas –** Full development of the vacant zoned I-2 area along the west side of Kalaeloa Boulevard is anticipated by end of 2015 with typical warehousing and light industrial uses as well as the Kapolei Studios project.
- **Barbers Point Harbor –** Traffic forecasts for the harbor uses were based on continued 2.2% annual growth in vehicles accessing the facilities.
- **Kapolei West** –About 1,350 housing units are anticipated by yearend 2015 as well as the golf course, school, and commercial uses.
- **Harborside Center** – Initial development is expected in the areas adjacent to the planned Hanua Street extension with about half of the area developed by the end of 2015.

2016-2020 Development – Much of the major development near the Makaiwa Hills area is expected to be developed by 2020. The development is expected of the following:

- **Kapolei Business Park Phases 1 and 2 –** The entire area is expected to be built out with warehouse, services, and light industrial by 2020.
- **Kapolei West** – Full development is anticipated by yearend 2020.
- **Harborside Center** – Full development of the net 250 acres is expected by 2020.
- **Kalaeloa Maritime Industrial Areas –** Development of about 75 acres is anticipated in 2011.
- **Hawaii Raceway Industrial Park –** The entire 66-acre area is expected to be built out with warehouse, services, and light industrial by 2020.
- **Makaiwa Hills** – Development of about 130 housing units within the 69-acre zoned R-5 area is expected prior to 2015, with these units not included as part of the Project.
- **Barbers Point Harbor –** Traffic forecasts for the harbor uses were based on continued 2.2% annual growth in vehicles accessing the facilities.

Other Developments Near the Makaiwa Hills Site

Additional development, or occupancy of previously completed development, is expected in several areas that would directly add traffic on the roadways and through the key intersections that are the subject of this study. The amount of development was estimated for most of these areas from telephone discussions with representatives of either the developer or property owner.

Makakilo Development - Contacts with D. R. Horton Schuler Division and GE Capital Hawaii indicated that most of the Makakilo area should be developed by 2015. The new development is expected to add:

- 746 single-family homes
- 329 condominiums
- 64 apartments.

Villages of Kapolei and Kapolei Knolls – D. R. Horton Schuler Division and the Housing and Community Development Corporation Hawaii (HCDCH) indicated that Kapolei Knolls and most of the Villages areas should be developed by 2015, with some development possibly extending beyond 2015. All of the area is expected to be developed by the end of 2020. An estimate of the remaining housing units in Kapolei Knolls was provided by Schuler Homes. For the Villages of Kapolei, HCDCH provided the acreages and types of uses for the remaining undeveloped areas, while the numbers of housing units of each development were estimated by WSA.

Kalaeloa Redevelopment Area - Based on discussions with the Hawaii Community Development Authority (HCDA) and the Department of Hawaiian Home Lands (DHHL), very limited additional development was assumed to occur in the near term due to the availability and competition from other development areas, as well as the uncertainties regarding the potential return of Navy airfield uses.

WSA assumed that approximately one-quarter of the development included in the OMPO regional forecasts for year 2030 would occur by the end of 2015, and one-half of the OMPO 2030 development assumptions would occur by 2020. This included partial development of the "downtown" commercial/residential area and other residential areas, as well as development of the regional park areas.

Ko Olina Development - Representatives of the Ko Olina Community Association and the Marriott Corporation were contacted regarding the planned general type and timing of development for the Ko Olina area. Based on available information and these discussions, WSA estimated the following levels of new development:

2006-2015
- 990 new hotel rooms
- 470 new timeshare units
- 60 additional single-family homes (Centex)

- 390 additional townhouses (Coconut Plantation and Centex)
- 174 additional low density houses (Hillside Villas across from Fairways Villas)
- 110 additional medium density houses
- Aquarium

2016-2020
- 600 additional hotel rooms
- 180 new timeshare units
- 190 additional medium density houses

GROWTH OF H-1 FREEWAY THROUGH TRAFFIC

A growth factor was applied to existing traffic volumes on the H-1 Freeway to reflect increased travel between the Waianae Coast areas west of Ko Olina and the areas of Oahu east of the Kapolei area that pass through but do not stop within the Kapolei-Ko Olina area. The growth factor was determined from the traffic counts for the State DOT count station located on the H-1 Freeway west of Makakilo Drive (count station #H10-A). The historic counts indicated an average annual growth rate of 0.5% per year between January 1999 and January 2002.

The 0.5% annual growth rate was assumed to continue through the study period. With this rate, the 2005 freeway volumes are estimated to increase 5.1% by 2015 and 7.8% by 2020. These volumes are further increased by the forecast trips to/from the new development within and near the City of Kapolei as identified in the preceding sections of this chapter.

PLANNED ROADWAYS

A number of transportation projects have been planned for the Ewa District that would affect travel to and within the City of Kapolei. Most of these projects have been identified and/or confirmed through the Oahu Metropolitan Planning Organization (OMPO) transportation planning process[1], as well as the Ewa Highway Impact Fee Program studies and plans[2]. The OMPO process identifies a Regional Transportation Plan (Oahu RTP) to address the transportation needs over the next 20 or more years, and also selects a high-priority short list of projects and programs for funding within the next three years as covered by the adopted Transportation Improvement Program (TIP). The Ewa Highway Impact Fee Program (Ewa HIFP) addresses the travel needs through 2010 and establishes a developer-funded source to pay for 20% of the regional roadways needed in the Ewa District.

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[1] *Oahu Regional Transportation Plan 2030*, Mid-Range and Long-Range Plan Project List, as approved April 4, 2006.
[2] *Ewa Highway Impact Fee Program*, prepared for State of Hawaii Department of Transportation by Kaku Associates, Inc. July, 2002.

A number of roadway improvements are anticipated by the year 2015 and 2020 analyses years, either as regional highway improvements are as part of area developments. The roadway improvements assumed to be in place *without* the Makaiwa Hills development are discussed in the following sections.

2015 Roadway Improvements

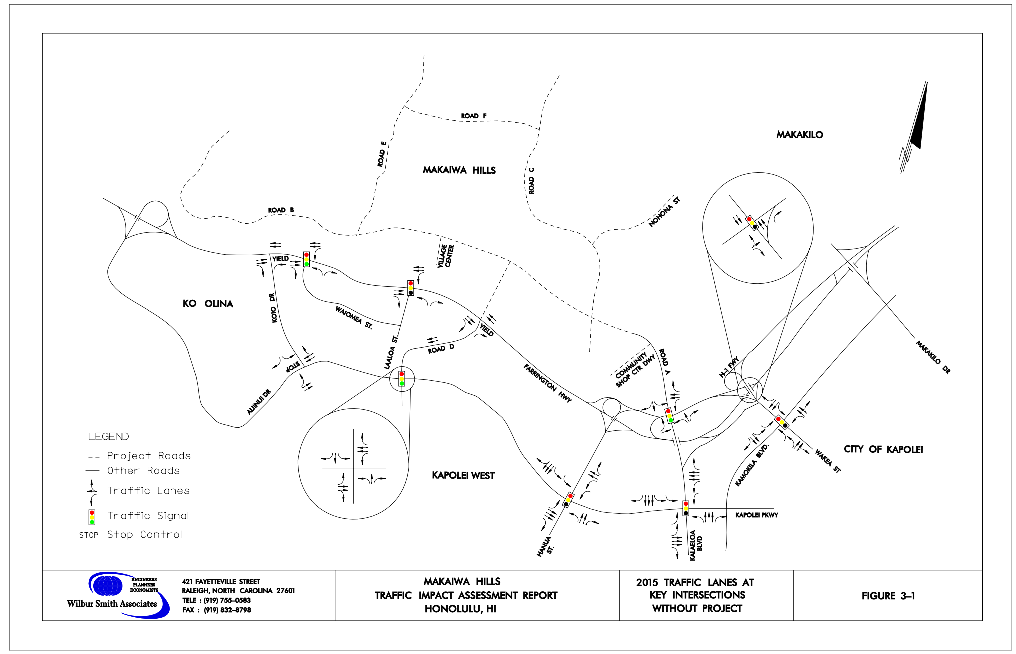
The new Kapolei Interchange, expansion of the Palailai Interchange, and the connection of the Kapolei Parkway between Fort Barrette Road and Aliinui Drive are the key area roadway improvements anticipated near the Makaiwa Hills area during the 2006-2015 period. The anticipated roadway network and numbers of traffic lanes near the Project site in 2015 are depicted in Figure 3-1. Descriptions of those roadway improvements that most directly affect the Makaiwa Hills study area are included in the following paragraphs.

Kapolei Interchange - A new interchange is planned for construction between the Makakilo and Palailai Interchanges to increase the access between the City of Kapolei and the H-1 Freeway. The interchange would initially connect to Wakea Street, but in the future it would also connect to the Mauka Frontage Road. The new interchange is included in the Ewa HIFP for 2010. The planning and environmental process is currently underway, with phased construction of the interchange anticipated between 2008 and 2011.

The Kapolei Interchange is planned to provide additional on- and off-ramps for travel to/from the Honolulu direction of the H-1 Freeway. Wakea Street will be extended mauka to connect to Farrington Highway and cross over the Freeway to access the new Westbound Off-ramp and future Mauka Frontage Road. The existing Farrington Highway section between the Freeway overpass east to the Kamokila Boulevard intersection would be abandoned.

Kalaeloa Boulevard Modifications - The section of Kalaeloa Boulevard between the Palailai Interchange and Malakole Street is planned for improvements prior to 2015. This is expected to include the widening of the mauka portion to a six-lane roadway with additional turn lanes. At the intersection with the Kapolei Parkway, it is expected that the widening project would provide double left-turn lanes to accommodate the high volume of left- turns from makai-bound Kalaeloa Boulevard and both approaches of the Kapolei Parkway. Similarly, it would be appropriate for the widening to provide a right-turn lane on each approach to accommodate the high volume of right turns.

Kalaeloa Boulevard will be extended mauka of Farrington Highway to provide access to the new residential development planned for the 69-acre section of Makaiwa Hills that has been previously received R-5 zoning approval. The visitor parking area for the Hawaiian Waters Adventure Park, located in the northeast quadrant of the Kalaeloa Boulevard-Farrington Highway intersection, was allowed to have a temporary exit driveway connection to Farrington Highway. When Kalaeloa Boulevard is extended mauka along the west side of the parking area, it is anticipated that the existing temporary exit driveway to Farrington Highway will be closed and a new driveway connection provided to the Kalaeloa Boulevard extension. For the purpose



of this study, the existing entry driveway for the Hawaiian Waters Adventure Park is assumed to remain on Farrington Highway.

Kapolei Parkway – The section of the Kapolei Parkway between Fort Barrette Road and Kamokila Boulevard is expected to be completed by 2015, which would both improve east-west traffic circulation through the City of Kapolei and provide improved access to the new development within the City of Kapolei. The connection is planned as a six-lane roadway with a landscaped median and turn lanes at cross streets and major driveways.

The section of the Kapolei Parkway between Kalaeloa Boulevard and the eastern end of Aliinui Drive is expected to be completed by 2015. This connection would provide an alternative to Farrington Highway and increase east-west traffic capacity through the area. The section between Kalaeloa Boulevard and Hanua Street is planned as a six-lane roadway and the section west of Hanua Street is planned as a four-lane roadway with a landscape median and turn lanes at cross streets and major driveways.

Road D (Kapolei West) – Road D is planned to connect the Kapolei Parkway to Farrington Highway within the western portion of the Kapolei West development with the roadway expected to have four travel lanes with landscaped median and turn lanes at cross streets. The Kapolei West development plans envision the roadway providing only a right-in/right-out (RIRO) connection to Farrington Highway, with preliminary analyses indicating that this right-in/right-out connection would be adequate to serve the Kapolei West development traffic through 2020. The Road D connection to Farrington Highway would be expanded to a full intersection or to a grade-separated interchange when needed to provide access to the Makaiwa Hills Project.

Hanua Street Extension and Palailai Interchange Modifications – Hanua Street is an existing two-lane mauka-makai roadway within the Campbell Industrial Park parallel to and one block west of Kalaeloa Boulevard, with the present street ending at Malakole Street. The Oahu RTP includes the extension of existing Hanua Street mauka to connect to the future Kapolei Parkway and to the Palailai Interchange. The Hanua Street Extension would likely be constructed as a four-lane roadway with landscaped median and separate turn lanes at the major cross streets.

The project would include the reconstruction of the Palailai Interchange to provide an eastbound on-ramp to the freeway, and provide an overpass to connect Hanua Street to the westbound on-ramp to the freeway and to a new loop off-ramp from the westbound freeway lanes. To provide adequate merging distance for the Hanua Street eastbound on-ramp traffic, the existing eastbound off-ramp connection to Kalaeloa Boulevard would be removed and this movement accommodated by the construction of a new eastbound off-ramp connection to the Hanua Street Extension.

The Palailai Interchange modifications and the construction of Hanua Street between the Interchange and Malakole Street are expected by the 2015 analysis year.

Malakole Street Connection – The master plan[3] for the Kalaeloa Redevelopment Area (former Barbers Point NAS lands) include the extension of the east end of Malakole Street into the redevelopment area to connect with the major roadways planned within that area. Telephone discussions with Stanton Enemoto of the Hawaii Community Development Authority (HCDA) staff[4] indicated this extension is one of the highest priority roadway improvements within the redevelopment area and should be completed early in the Phase 1 improvements, which are planned from 2007 to 2015. The extension would use the existing culvert crossing of the major drainage channel that forms the west boundary of the Redevelopment Area, but would require right-of-way from the private business located just west of the drainage channel. Mr. Enemoto indicated that Malakole Street would likely remain a two-lane roadway during this initial connection, with the existing roadway improved to standards and turn lanes added at key cross streets and driveway connections.

Makakilo Interchange Westbound On-Ramp - A westbound on-ramp and an eastbound off-ramp are planned for the Makakilo Interchange to reduce traffic circulation through the City of Kapolei. Traffic between the Villages of Kapolei and Makakilo areas must currently travel through the City of Kapolei on Farrington Highway to access the H-1 Freeway at the Palailai Interchange for travel to/from areas west of the City of Kapolei. The new ramps are included in the OMPO long-range plan and within the Ewa HIFP. The Aina Nui Corporation recently approved funding for the design and construction of a westbound on-ramp for this interchange, and the location and design of this ramp is now under study. For this study the westbound on-ramp is assumed to be completed and open to traffic by 2015. The ramp is assumed to be a "slip ramp" from the Mauka Frontage Road, with access provided via the intersection with Makakilo Drive.

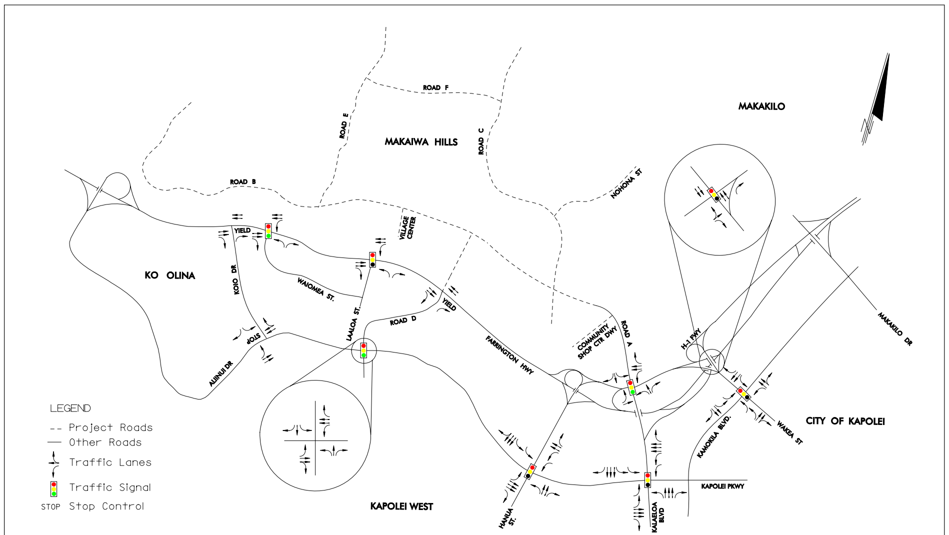
Kalaeloa Boulevard Extension - The initial development of the previously zoned lands within the Makaiwa Hills development will be accessed by the extension of Kalaeloa Boulevard mauka from Farrington Highway intersection. This initial extension is proposed as a two-lane roadway to access the approximately 131 residential units planned for the zoned lands.

2020 Roadway Improvements

The key new roadway improvement that could occur near Makaiwa Hills Project site between 2015 and 2020 is planned widening of Farrington Highway to a six-lane roadway. The development of a grade-separated interchange at the Road D connection to Farrington Highway is expected only with the development of the Makaiwa Hills Project.

The resultant roadway network and numbers of traffic lanes near the Project site in 2020 are depicted in Figure 3-2.

[3] *Kalaeloa Master Plan*, prepared for Hawaii Community Development Authority by Belt Collins et al, March 1, 2006.
[4] Telephone conversation with Stanton Enemoto, March 16, 2006.



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MAKAIWA HILLS
TRAFFIC IMPACT ASSESSMENT REPORT
HONOLULU, HI

2020 TRAFFIC LANES AT
KEY INTERSECTIONS
WITHOUT PROJECT

FIGURE 3-2

Farrington Highway Widening – The OMPO RTP includes the widening of Farrington Highway from the present four through lanes to six lanes between the Palailai Interchange and Hakimo Road in the Nanakuli area on the Waianae Coast. The widening project is indicated in the adopted OMPO plan as occurring between 2016 and 2030. Therefore, the section of Farrington Highway along the Makaiwa Hills Project between the Palailai and Ko Olina Interchanges may remain four lanes or be widened to six lanes by 2020, dependent upon the evolving local transportation improvement priorities over the next decade.

For this study, Farrington Highway is analyzed with four lanes as a “base case” in 2020 without and with the Makaiwa Hills Project. A year 2020 analysis is also presented with Farrington Highway widened to six lanes for the key intersections and freeway ramps along the Makaiwa Hills section.

Road D Junction with Farrington Highway – The Kapolei West development plans envision the roadway providing only a right-in/right-out (RIRO) connection to Farrington Highway, with preliminary analyses indicating that this right-in/right-out connection should be adequate to serve the Kapolei West development traffic through 2020. The Road D connection to Farrington Highway would be expanded to a full intersection or to a grade-separated interchange when needed to provide access to the Makaiwa Hills Project.

PUBLIC TRANSPORTATION

The City and County of Honolulu provides public transportation services along Farrington Highway and Kalaeloa Boulevard near the Makaiwa Hills Project development area. These include a number of TheBus bus routes between the Waianae Coast and the Kapolei Transit Center in the City of Kapolei via the Palailai Interchange. TheHandiVan provides door-to-door service for persons who have difficulty in accessing the fixed route service.

TheBus Routes – The fixed-route bus network for the area is expected to be modified to increase coverage west of the City of Kapolei as development occurs in new areas, and service increased as the employment and number of residents increase. Candidates for new TheBus fixed-route service would include:

- Extension of bus service along the section of Kapolei Parkway between Kalaeloa Boulevard and Ko Olina once this extension is complete.

- Extension of bus service along the Wakea Street extension and Farrington Highway to the Palailai Interchange once the new Wakea Street overpass is complete.

Kapolei Area Transit Centers – The Kapolei Transit Center will be relocated when the Kapolei Interchange is constructed, as an extension of Wakea Street will be used to connect the City of Kapolei to the new interchange. The new Transit Center is planned for a site along the Kapolei

Parkway near Kamaaha Avenue, with the facility serving as a transfer point between area routes as well as providing park-and-ride spaces for use by transit patrons.

A second area transit center is planned for the area immediately west of the Honolulu Advertiser facility that will also accommodate transfers between area transit routes as well as provide park-and-ride spaces. This second facility would be developed on the Kapolei West Parcel L in conjunction with the mixed use development planned for that site.

Honolulu Transit Fixed-Guideway System – The City and County of Honolulu is planning to develop a public transit guideway that will extend from the central Honolulu area as far westward as the planned City of Kapolei transit centers in the City of Kapolei and the Kapolei West Parcel L. The initial sections of the guideway are expected to be in operation prior to 2015. At the time of the Makaiwa Hills traffic study, the phasing of the construction of the guideway was under consideration by the City and County of Honolulu. Therefore, it was unknown whether the guideway section serving the Kapolei or Parcel L transit centers would be in service by 2015 or 2020. Therefore, the 2015 and 2020 traffic forecasts for the Makaiwa Hills Project reflect only the completion of the two transit centers as bus facilities.

BICYCLE AND PEDESTRIAN FACILITIES

The Kapolei Parkway is planned for construction with bicycle lanes through the Kapolei West area, thus extending the existing and planned bicycle lanes along the roadway to provide a bicycle route connecting the Kapolei West, City of Kapolei, and East Kapolei areas.

The Kapolei Parkway and Road D within the Kapolei West area adjoining the Makaiwa Hills Project site are expected to be constructed with sidewalks.

2015 PEAK HOUR TRAFFIC CONDITIONS

The weekday peak hour traffic volumes were forecast for 2015 without the Makaiwa Hills Project based on the new developments and roadways described in the preceding sections. The peak hour traffic conditions were analyzed for the key locations that would be affected by traffic traveling to/from Makaiwa Hills Project.

Trip Generation

The numbers of vehicle trips generated by the new development within the City of Kapolei-Ko Olina area were based on standard trip rates compiled by the Institute of Transportation Engineers (ITE).[5] The vehicle trip generation rates and estimated vehicle trips for the various areas and types of developments are presented in Appendix B.

[5] *Trip Generation, Seventh Edition*, Institute of Transportation Engineers, 2003.

The numbers of vehicle trips entering or exiting a commercial development include both new vehicle trips and additional stops by vehicles that would be traveling through the area whether or not the Project is developed. These additional stops by traffic passing the site to use the retail and services uses are referred to as "pass-by trips," which do not represent additional trips on the adjacent roadway, but do result in additional turns into and out of the development driveways by vehicles that would be passing by that site. The ITE *Trip Generation Handbook*[6] provides a methodology and pass-by rates for estimating the proportion of the Project vehicle trip ends that are pass-by trips. Pass-by trip factors are usually applied only to the afternoon peak hour since many retail and service businesses are not open or have low rates of trip generation during the morning peak hour. For the commercial uses, Appendix A lists the total number of vehicles entering and exiting the land use and also lists the number of "new" vehicle trips on the area roadways generated by the land use in the afternoon peak hour, excluding the pass-by trips.

The anticipated growth within the City of Kapolei-Kapolei West area by 2015 would increase the morning peak hour trips by about 9,500 trips, and the afternoon peak hour by about 12,000 new trips on area roadways.

The development of the previously zoned 69-acre area within Makaiwa Hills is estimated to generate about 90 and 110 new vehicle trips in the morning and afternoon peak hours, respectively. These vehicle trips are included in the Without Project traffic forecasts.

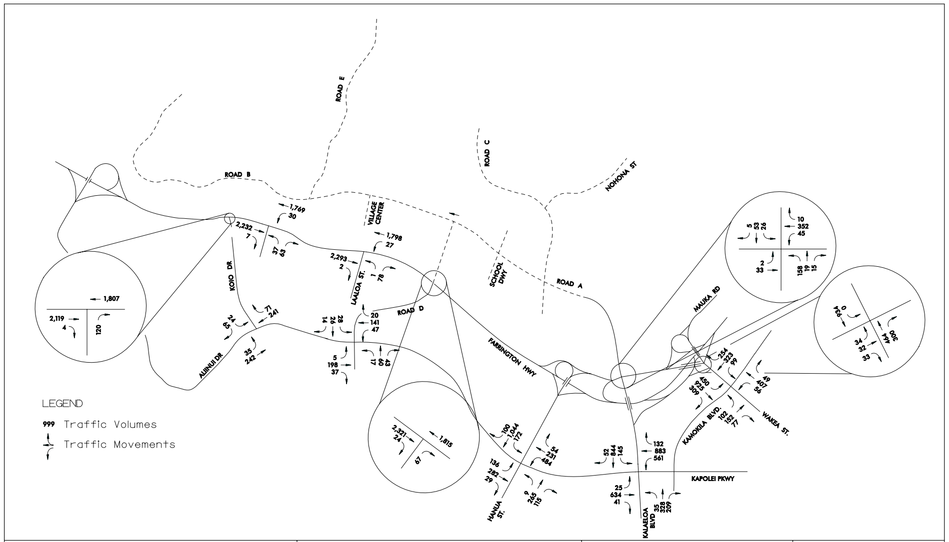
2015 Peak Hour Traffic Volumes

The origins and destinations of the additional vehicle trips were based on OMPO forecast data with the trips assigned to the roadway system to reflect the planned roadway connections. The forecast 2015 weekday traffic volumes without the Makaiwa Hills Project are depicted in Figures 3-3 and 3-4 for the morning and afternoon peak traffic hours, respectively.

At the Road D connection to Farrington Highway, the volume of traffic assigned to the right-turn out has been limited to a level that would not warrant improvement actions at the Road D connection, with any additional vehicles routed to Farrington Highway/H-1 Freeway via the Palailai Interchange.

The traffic volumes along the section of Farrington Highway between the Palailai Interchange and Honokai Hale are forecast to increase by about 40% over 2005 volumes in each peak hour, for an average increase of about 3.4% per year without the Makaiwa Hills Project.

[6] *Trip Generation Handbook, An ITE Proposed Recommended Practice*, Institute of Transportation Engineers, October 1998.



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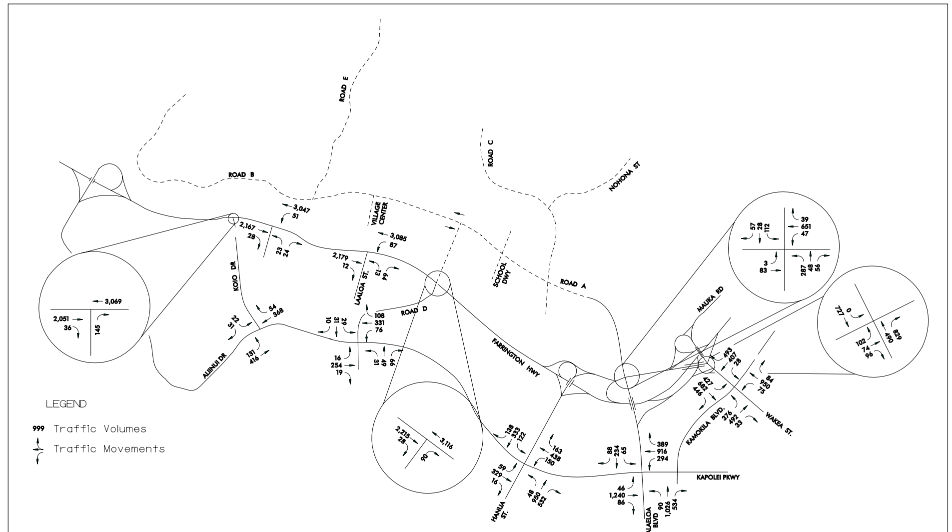
MAKAIWA HILLS
TRAFFIC IMPACT ASSESSMENT REPORT
HONOLULU, HI

2015 TRAFFIC WITHOUT PROJECT
MORNING PEAK HOUR

FIGURE 3-3



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MAKAIWA HILLS
TRAFFIC IMPACT ASSESSMENT REPORT
HONOLULU, HI

2015 TRAFFIC WITHOUT PROJECT
AFTERNOON PEAK HOUR

FIGURE 3-4

The parallel section of the Kapolei Parkway through the Kapolei West development is estimated to accommodate two-way traffic volumes of about 500 to 800 vehicles during the morning peak hour and about 800 to 1,100 vehicles during the afternoon peak hour. Most of these vehicles would be local trips to/from the Kapolei West development area. The Road D connection to Farrington Highway is assumed to allow only right-turns, therefore much of the Kapolei West traffic would use the new Hanua Street connection to the Palailai Interchange to access Farrington Highway/H-1 Freeway.

The traffic volumes along Kalaeloa Boulevard would be similar to the 2006 traffic volumes since the addition of the Hanua Street Extension paralleling Kalaeloa Boulevard would attract much of the additional traffic to/from the employment areas makai of the OR&L track line.

2015 Peak Hour Intersection Conditions

Traffic conditions for the year 2015 weekday traffic peak hours without the Makaiwa Hills Project traffic are summarized for the key intersections in Table 3-1. Traffic conditions are given only for those key intersections that would be most directly affected by the Makaiwa Hills development traffic.

Farrington Highway-Koio Drive – The Koio Drive connection to Farrington Highway is assumed to be open to traffic use by 2015 with access restricted to right turns in/out of Koio Drive to eastbound Farrington Highway. Traffic turning right from Koio Drive is expected to experience long delays (LOS F) while waiting for gaps in the high volume of Farrington Highway through traffic to turn out of Koio Drive.

Farrington Highway Intersections with Waiomea and Laaloa Streets – The overall intersection traffic would operate at acceptable levels of capacity (80%) and average delay (LOS A or B) in the morning peak hour at both intersections. However, the projected afternoon peak hour traffic would approximate the capacity of both intersections, with overall average delay at LOS D.

Farrington Highway-Road D – Road D would be initially connected to the makai side of Farrington Highway to serve the Kapolei West development with the connection allowing only right turns in and right turns out of Road D. This right-turn-in/right-turn-out connection is expected to be in place in 2015 without the Makaiwa Hills Project. The vehicles turning right onto eastbound Farrington Highway would experience average delay per vehicle at LOS E in both the morning and afternoon peak hours. However, the low volume of turning vehicles and the estimated delays would not merit improvement action.

Koio Drive-Aliinui Drive – The Koio Drive approach to Aliinui Drive is assumed to be open to traffic with STOP control for the Koio Drive. The forecast traffic on Koio Drive reflects the connection of the Ko Olina Kai development to Koio Drive and the opening of the intersection with Farrington Highway to right-turns in/out. The traffic turning left from makai-bound Koio Drive is projected to operate with acceptable LOS C delays or better in both peak hours.

Table 3-1
2015 TRAFFIC CONDITIONS AT KEY INTERSECTIONS
WITHOUT MAKAIWA HILLS

Intersection	Scenario	Morning Peak Hour			Afternoon Peak Hour		
		V/C	ADPV	LOS	V/C	ADPV	LOS
Farrington Hwy.- Koio Dr. NB Right Turn	Existing (Not Open) No Project RIRO	 0.68	NA 56.7	 F	 0.78	NA 66.3	 F
Farrington Hwy.- Waiomea St.	Existing No Project	0.58 0.80	14.1 14.6	B B	0.74 1.01	6.3 41.3	A D
Farrington Hwy.- Laaloa St.	Existing No Project	0.58 0.80	9.1 6.0	A A	0.75 1.01	12.6 38.8	B D
Farrington Hwy.- Road D	No Project RIRO	0.45	44.5	E	0.55	48.3	E
Aliinui Dr.- Koio Dr.	Existing (Not open) No Project STOP	 0.05	NA 13.0	 B	 0.10	NA 22.6	 C
Kapolei Pkwy.- Road D	No Project	0.20	30.8	C	0.20	30.0	C
Hanua St.- Kapolei Pkwy.	No Project	0.60	29.9	C	0.65	27.5	C
Kalaeloa Blvd.- Farrington Hwy. NB Left Turn	Existing STOP No Project (Signal)	0.44 0.33	6.5 21.7	A C	1.29 0.50	71.1 26.2	F C
Kalaeloa Blvd.- Kapolei Pkwy.	Existing No Project	0.64 0.65	20.8 28.1	C C	0.93 0.74	42.2 31.1	D C
Wakea St.- Farrington Hwy.	No Project	0.37	4.9	A	0.46	11.3	B
Wakea St.- Kamokila Blvd. NB Left Turn	Existing STOP No Project (Signal)	0.32 0.63	42.8 30.3	E C	0.70 0.92	49.1 40.6	E D

V/C = Ratio of the traffic volume to the theoretical capacity of the intersection.
ADPV = Average delay per vehicle, in seconds.
LOS = Level of service.
NA = Not Analyzed

Wilbur Smith Associates; February 7, 2007.

Road D-Kapolei Parkway – The right-turn in/out limitation of access to Farrington Highway would limit the traffic use of Road D in 2015 and constrain the volume of traffic turning into/out of Road D from the Kapolei Parkway. The forecast peak hour volumes would amount to about 20% of the intersection capacity with delays at LOS C.

Hanua Street-Kapolei Parkway – The peak hour traffic would approximate 60% to 65% of intersection capacity in 2015 with average delays at LOS C.

Kalaeloa Boulevard-Farrington Highway – The development of the previously-zoned parcel within Makaiwa Hills would be accessed by an extension of Kalaeloa Boulevard mauka from the Farrington Highway intersection. With this extension, the existing exit from the main visitor parking lot for the Hawaii Water Adventures Park would likely be closed and a relocated exit provided to the mauka extension of Kalaeloa Boulevard. With the planned lanes and addition of signal control, combined with the shift of the Water Park exiting visitor traffic to the Kalaeloa Boulevard extension, the 2015 peak hour traffic volumes would amount to 50% or less of the intersection capacity with average delays at LOS C.

Kalaeloa Boulevard-Kapolei Parkway – The morning peak hour traffic would amount to 65% of capacity of this intersection with the planned reconstruction with three through lanes and a right-turn lane on each approach, plus the addition of double left-turn lanes on three of the approaches. In the afternoon peak hour, the forecast traffic would approximate 74% of capacity, with overall intersection delays at LOS C.

Wakea Street-Farrington Highway – This future intersection, which provides access to the Eastbound On-ramp to the H-1 Freeway, is projected to operate at very acceptable levels with the planned lanes and traffic signal control.

Wakea Street-Kamokila Boulevard – This intersection would be used by some of the Makaiwa Hills traffic to access the City of Kapolei commercial core area. The intersection is projected to operate at very acceptable levels in the morning peak hour. In the afternoon peak hour, the forecast traffic would approximate 92% of the intersection capacity with the planned lanes. Long delays would be expected for the left-turn movements with overall average delay at LOS D.

2015 Freeway Ramp Conditions

The 2015 peak hour traffic conditions were assessed for the weaving section of the eastbound H-1 Freeway ramps on the east side of the Palailai Interchange as well as freeway merge/diverge sections for those Palailai and Kapolei Interchange ramps that would be used by the Project traffic. The analysis was made using the HCM procedures (Appendix A) and HCS software.

Westbound Makakilo-Wakea Weaving Section – This future weaving section would be constructed between the planned new Westbound On-ramp from Makakilo Drive and the planned new Westbound Off-ramp that would be initially constructed to access Farrington

Highway at the east end of the Hawaiian Waters Adventure Park during the Phase 1 construction for the Kapolei Interchange. This off-ramp would also provide access to the City of Kapolei via a loop ramp once the Wakea Street overpass is constructed across the freeway.

The 1,400-foot long weaving section would have a single-lane entry from Makakilo Drive at the east end with this single-lane continuing through the weaving section to exit via a single lane onto the Farrington Highway-Wakea Street ramp at the east end.

The 2015 freeway and ramp traffic volumes in the vicinity of this weaving section are estimated to operate at LOS C during the morning peak hour (Table 3-2). The estimated traffic speeds would average about 33 mph in the weaving lane and about 53 mph in the freeway through lanes. The afternoon peak hour volumes are estimated at LOS B with the average speeds in the weaving lanes of about 45 mph.

Palailai Interchange Ramps – The estimated peak hour traffic conditions in the freeway lanes near the merge or diverge points for each of the planned future Palailai Interchange ramps are summarized in Table 3-3. Each of the four ramps would be either a new ramp or a relocated ramp constructed as part of the Palailai Interchange project.

The new off-ramp from the eastbound freeway to Hanua Street is estimated to result in LOS C conditions in both peak hours for the freeway through lanes near the ramp merge point. The new on-ramp from Hanua Street to the eastbound freeway is estimated to result in LOS B conditions in the morning peak hour and LOS CD in the afternoon peak hour.

The traffic conditions in the westbound lanes approaching the new loop off-ramp to Hanua Street would result in average densities reflecting LOS C conditions in both the morning and afternoon peak hours.

The relocated on-ramp for westbound Hanua Street and Kalaeloa Boulevard traffic entering the H-1 Freeway is estimated to operate at LOS B in the morning peak hour. However, the conditions in the ramp and adjacent freeway lanes are expected to operate at LOS C in the afternoon peak hour by 2015.

2020 TRAFFIC CONDITIONS

The weekday peak hour traffic volumes were forecast for 2020 without the Makaiwa Hills Project based on the new developments and roadways described in the preceding sections. The peak hour traffic conditions were analyzed for the key locations that would be affected by traffic traveling to/from the Makaiwa Hills Project, which is planned for full development by 2020.

Table 3-2
2015 WEAVING SECTION TRAFFIC CONDITIONS WITHOUT PROJECT

Peak Hour	Average Speed (mph)			Density	Level of
	All Traffic	Non-Weave	Weaving	(vplph)	Service
Westbound Weaving Section Makakilo Dr.-Wakea St.					
Morning	46.40	53.31	33.40	22.05	C
Afternoon	49.76	51.51	44.80	17.29	B

vplph = vehicles per lane per hour

Wilbur Smith Associates; November 30, 2006

Table 3-3
2015 TRAFFIC CONDITIONS ALONG FREEWAY AT RAMP MERGE AND DIVERGE AREAS WITHOUT PROJECT

Ramp Junction	Peak Hour	Average Speed (mph)		Traffic Density (vplph)	Level of Service
		Near Ramp	Other Lanes		
Eastbound Freeway					
Off-ramp PH to Hanua St.	AM	50.3	NA	19.1	C
	PM	50.7	NA	20.2	C
On-ramp PI From	AM	51.2	NA	18.6	B
Hanua St.	PM	50.8	NA	23.3	C
Westbound Freeway					
Loop Off-ramp PE to	AM	49.9	NA	19.8	B
Hanua St.	PM	50.7	NA	21.3	B
On-ramp PA from	AM	51.4	NA	15.7	B
Kalaeloa Blvd./Hanua St.	PM	50.1	NA	26.9	C

Near Ramp is the 1,500-foot section of the 2 lanes closest to ramp.
Other lanes are lanes closest to median if 3 or more lanes on freeway.
Vplph = vehicles per lane per hour for 2 lanes near ramp.
Level of Service is for 2 lanes near ramp.
NA = Not Applicable

Wilbur Smith Associates; November 30, 2006

Trip Generation

As described for 2015, the numbers of vehicle trips generated by the new development within and near the City of Kapolei were based on standard trip rates compiled by the Institute of Transportation Engineers (ITE).[7] The vehicle trip generation rates and estimated vehicle trips for the various areas and types of developments are presented for 2020 in Appendix D.

Most of the City of Kapolei is expected to be developed by 2015 as are much of the lands in the Kalaeloa Boulevard corridor and within Ko Olina. The additional development within the Kalaeloa Boulevard-Ko Olina area during 2016-2020 is estimated to generate a total of approximately 2,500 and 2,700 vehicle trips in the weekday morning and afternoon peak hours, respectively.

2020 Peak Hour Traffic Volumes

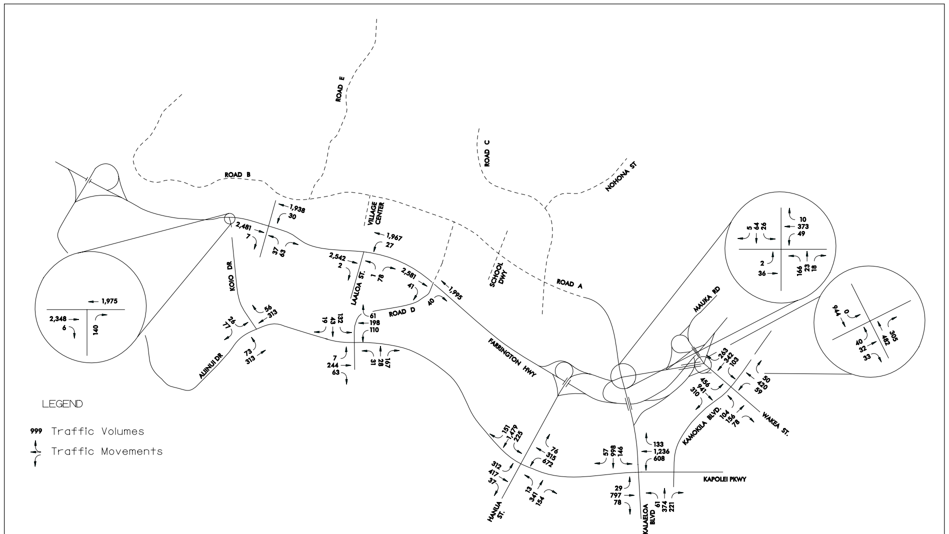
The forecast 2020 weekday traffic volumes without the Makaiwa Hills Project are depicted in Figures 3-5 and 3-6 for the morning and afternoon peak traffic hours, respectively. The projected traffic volumes reflect the makai-side Road D connection with Farrington Highway as limited to eastbound right-in and right-out turns to/from Road D. The volume of traffic assigned to the right-turn onto Farrington Highway has been limited to a level that would not warrant improvement actions at the Road D connection, with any additional vehicles routed to Farrington Highway/H-1 Freeway via the Palailai Interchange to test the capacity of other intersections to accommodate the additional traffic.

The traffic volumes along the section of Farrington Highway between the Palailai Interchange and Honokai Hale are forecast to increase by about 12% over 2015 volumes in each peak hour, for an average increase of about 2.3% per year.

Traffic volumes at the Road D connection to Farrington Highway is estimated at approximately 80 and 130 vehicles in the 2020 morning and afternoon peak hours, respectively. An additional 170 and 130 vehicles were routed to the Palailai Interchange would otherwise have used the right-turn out of Road D onto Farrington Highway in the morning and afternoon peak hours, respectively.

The section of the Kapolei Parkway through the Kapolei West development is estimated to accommodate volumes ranging between 370 and 960 vehicles in each direction during the peak hours. Most of these vehicles would be local trips to/from the Kapolei West development area.

[7] *Trip Generation, Sixth Edition*, Institute of Transportation Engineers, 1997.



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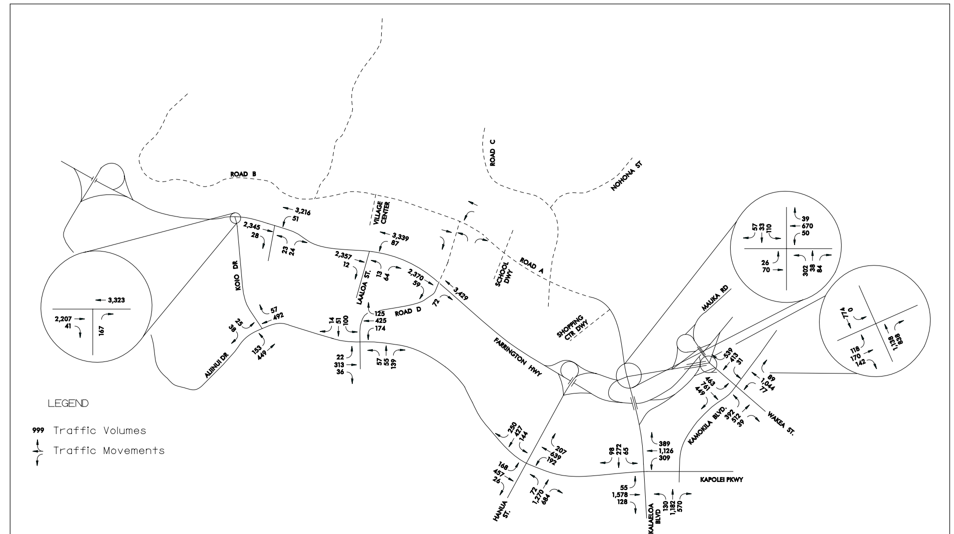
2020 TRAFFIC WITHOUT PROJECT
MORNING PEAK HOUR

FIGURE 3-5



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2020 TRAFFIC WITHOUT PROJECT
AFTERNOON PEAK HOUR

FIGURE 3-6

2020 Intersection Traffic Conditions

Traffic conditions for the year 2020 weekday morning and afternoon peak hours without the traffic generated by the Makaiwa Hills Project are summarized for the key intersections in Table 3-4. Traffic conditions are presented for those key intersections that would be most directly affected by the Makaiwa Hills Project.

Farrington Highway-Koio Drive – The Koio Drive connection to Farrington Highway is assumed to continue with only right turns in/out allowed to eastbound Farrington Highway. Traffic turning right from Koio Drive onto Farrington Highway is expected to experience very long delays (LOS F) during both peak hours while waiting for gaps in the high volume of Farrington Highway through traffic with Farrington Highway remaining a four-lane roadway. If Farrington Highway is widened by 2020, the Koio Drive average delay would be improved to LOS D conditions in both peak hours.

Farrington Highway Intersections with Waiomea and Laaloa Streets – With Farrington Highway as a four-lane roadway, the forecast 2020 morning peak hour traffic would be at acceptable levels of intersection capacity (88%) and average delay (LOS A or B) at both intersections. However, the projected high volumes of through traffic in the afternoon peak hour traffic would exceed the capacity of both intersections by about 10%, with overall average delay at LOS E. Very long waits would be expected for vehicles turning into or out of both cross streets.

If Farrington Highway has been widened to a six-lane roadway by 2020, both the forecast morning and afternoon peak hour traffic would operate at very acceptable conditions at both intersections.

Farrington Highway-Road D – Without the Makaiwa Hills Project, the Road D-Farrington Highway junction is expected to continue with only a right-in/right-out connection to serve the Kapolei West development. During the traffic forecasts, the volume of traffic using the right-turn out onto Farrington Highway was constrained to a level that would not merit improvements to this connection, with the other traffic assigned to use the Hanua Street connection to the H-1 Freeway, thus providing a test of the Hanua Street capacity to accommodate the 2020 traffic volumes.

With this diversion, the traffic volumes making the right-turn are indicated as having delays at LOS E in both peak hours. Traffic conditions for the Hanua Street intersection with the Kapolei Parkway and the ramp connections t the Palailai Interchange reflect the peak hour traffic diverted from the Road D right turn (170 vehicles in morning peak hour and 130 in afternoon peak hour).

Koio Drive-Aliinui Drive – Although the left turns from Koio Drive are forecast to encounter longer delays (LOS D) in the afternoon peak hour, the estimated average delay would be at acceptable levels.

Table 3-4
2020 TRAFFIC CONDITIONS AT KEY INTERSECTIONS WITHOUT MAKAIWA HILLS

Intersection	Scenario	Morning Peak Hour			Afternoon Peak Hour		
		V/C	ADPV	LOS	V/C	ADPV	LOS
Farrington Hwy.-	Existing (Not Open)		NA			NA	
Koio Dr.	No Project 4 Lanes	0.97	120.0	F	1.02	127.1	F
NB Right Turn	No Project 6 Lanes	0.50	28.2	D	0.55	28.7	D
Farrington Hwy.-	Existing	0.58	14.1	B	0.74	6.3	A
Waiomea St.	No Project 4 Lanes	0.88	22.7	B	1.10	71.2	E
	No Project 6 Lanes	0.65	14.9	B	0.77	12.4	B
Farrington Hwy.-	Existing	0.58	9.1	A	0.75	12.6	B
Laaloa St.	No Project 4 Lanes	0.88	9.6	A	1.10	67.0	E
	No Project 6 Lanes	0.63	5.2	A	0.77	11.1	B
Farrington Hwy.-	No Project 4 Lanes	0.34	46.3	E	0.51	50.0	E
Road D	No Project 6 Lanes	0.16	21.1	C	0.26	21.2	C
NB Right Turn	(With STOP Control)						
Aliinui Dr.-	Existing (Not Open)		NA			NA	
Koio Dr.	No Project STOP	0.08	16.3	C	0.18	33.2	D
Kapolei Pkwy.- Road D	No Project	0.36	30.5	C	0.39	29.9	C
Hanua St.- Kapolei Pkwy.	No Project	0.91	44.6	D	0.80	44.1	D
Kalaeloa Blvd.-	Existing STOP	0.44	6.5	A	1.29	71.1	F
Farrington Hwy.	No Project Signal	0.35	22.0	C	0.53	27.9	C
NB Left Turn							
Kalaeloa Blvd.-	Existing	0.64	20.8	C	0.93	42.2	D
Kapolei Pkwy.	No Project	0.75	30.8	C	0.91	40.1	D
Wakea St.- Farrington Hwy.	No Project	0.37	5.0	A	0.52	9.8	A
Wakea St.-	Existing STOP	0.32	42.8	E	0.70	49.1	E
Kamokila Blvd.	No Project Signal	0.65	30.4	C	0.99	43.3	D
NB Left Turn							

V/C = Ratio of the traffic volume to the theoretical capacity of the intersection.
ADPV = Average delay per vehicle, in seconds.
LOS = Level of service.
NA = Not Analyzed

Wilbur Smith Associates; February 8, 2007.

Road D-Kapolei Parkway –This intersection is forecast to accommodate the increased traffic volumes at very acceptable conditions in 2020 with the full-access interchange at the Road D connection to Farrington Highway.

Hanua Street-Kapolei Parkway – Most of the lands in the Kalaeloa Boulevard/Hanua Street corridor are assumed to be developed by 2020. With this level of development and the planned roadway lanes, the estimated traffic volumes would approximate 91% of intersection capacity in the morning peak hour and 80% of capacity in afternoon peak hour with average delays at LOS D. These conditions reflect the diversion of traffic from the Road D right-turn onto Farrington Highway.

Kalaeloa Boulevard-Farrington Highway – The development of the previously-zoned parcel within Makaiwa Hills would be accessed by an extension of Kalaeloa Boulevard mauka from the Farrington Highway intersection. The Hawaiian Waters Adventure Park visitor exit driveway is expected to be relocated from the Farrington Highway to the Kalaeloa Boulevard extension. The planned lanes and traffic signal control at the intersection are projected to accommodate the increased peak hour traffic volumes at 53% or less of the intersection capacity with average delays at LOS C.

Kalaeloa Boulevard-Kapolei Parkway – The morning peak hour traffic would amount to 75% of capacity of this intersection with the planned lanes with average delay at LOS C. In the afternoon peak hour, the forecast traffic would approximate 91% of capacity, with overall intersection delays at LOS D.

Wakea Street-Farrington Highway – This future intersection, which provides access to the Eastbound On-ramp to the H-1 Freeway, is projected to operate at very acceptable levels with the planned lanes and traffic signal control.

Wakea Street-Kamokila Boulevard – The intersection is projected to operate at very acceptable levels in the morning peak hour. In the afternoon peak hour, the forecast traffic would approximate 99% of capacity. Overall average delay is estimated at LOS D with long delays for the left-turn movements. The projected level of capacity use in the afternoon is at an unacceptable level and would merit actions to improve the intersection without the Makaiwa Hills Project.

2020 Freeway Ramp Conditions

The 2020 peak hour traffic conditions were assessed for the weaving sections along the westbound H-1 Freeway between the Makakilo Interchange on-ramp and Kapolei Interchange off-ramp. Also analyzed were the freeway sections affected by the merge/diverge traffic movements at those Palailai and Kapolei Interchange ramps that would be affected by the Project traffic. The analysis was made using the HCM procedures (Appendix A) and HCS McTrans software.

Westbound Weaving Section between Makakilo and Kapolei Interchanges – This weaving section would be used by Makaiwa Hills traffic exiting the H-1 Freeway onto Farrington Highway to use the mauka extension of Kalaeloa Boulevard (as Project Road A) to enter Makaiwa Hills. The 1,400-foot long weaving section is planned to have a single-lane on-ramp from Makakilo Drive and a single-lane off-ramp at the Kapolei Interchange. This weaving section is located along the six-lane section of the H-1 Freeway before the existing lanes add/drop at the Palailai Interchange.

The high density of traffic in the westbound through lanes and exiting the off-ramp in the 2020 morning peak hour is estimated to result in LOS D conditions in the freeway through lanes paralleling the weaving section. The afternoon peak our conditions are estimated at LOS C, as summarized in Table 3-5.

Palailai Interchange Ramp Junctions – The planned Eastbound Off-ramp, Eastbound On-ramp, Westbound Off-ramp, and Westbound On-ramp connections from the Hanua Street extension to the H-1 Freeway would be the closest independently operating ramps to the Makaiwa Hills Project, Although very little Project traffic would normally use these ramps, these ramp junctions are analyzed because each of the ramp junctions would be affected by the addition of the Project traffic in the through lanes, and both ramp junctions are located within the existing four-lane section of the H-1 Freeway beyond the lane drops at the existing Palailai Interchange ramps.

The estimated peak hour traffic conditions in the freeway lanes near the merge or diverge points for both the Eastbound On-ramp and Westbound Off-ramp at the Hanua Street connections would be at LOS B or C, as summarized in Table 3-6. This analysis is based on no widening of the freeway through this area.

The freeway section near the Hanua Street Off-ramp from the Eastbound H-1 Freeway is forecast to operate at LOS B in the morning peak hour and LOS C in the afternoon peak hour with the existing four-lane freeway. If this section is widened by 2020, the traffic in the ramp diverge area would operate at LOS B in both peak hours.

Table 3-5
2020 WEAVING SECTION TRAFFIC CONDITIONS
WITHOUT PROJECT

Peak Hour	Average Speed (mph)			Density (vplph)	Level of Service
	All Traffic	Non-Weave	Weaving		
Westbound Weaving Section Makakilo Dr.-Wakea St.					
Morning	46.94	48.63	41.78	25.37	C
Afternoon	49.00	50.72	43.89	19.57	B

vplph = vehicles per lane per hour

Wilbur Smith Associates; November 30, 2006

The freeway section near the Hanua Street On-ramp merge area with the Westbound H-1 Freeway is forecast to operate at LOS B in the morning peak hour with the existing four-lane freeway. However, traffic conditions are forecast as LOS D in the afternoon peak hour when there would be higher traffic use of both the westbound freeway lanes and the on-ramp. If this section is widened by 2020, the traffic in the ramp diverge area would operate at LOS C in the afternoon peak hour.

Table 3-6
2020 TRAFFIC CONDITIONS ALONG FREEWAY
AT RAMP MERGE AND DIVERGE AREAS WITHOUT PROJECT

Ramp Junction	Peak Hour	Average Speed (mph) Near Ramp	Average Speed (mph) Other Lanes	Traffic Density (vplph)	Level of Service
Eastbound Freeway					
On-ramp PI from Hanua St.	AM PM	50.1 50.6	NA NA	20.6 21.8	C C
Off-ramp to Hanua St. with Four-Lane Farrington Hwy.	AM PM	50.1 50.6	NA NA	19.0 21.0	B C
Off-ramp to Hanua St. with Six-Lane Farrington Hwy.	AM PM	50.1 50.6	60.3 60.3	15.6 16.0	B B
Westbound Freeway					
Loop Off-ramp PE to Hanua St.	AM PM	49.8 50.6	NA NA	13.9 20.3	B C
On-ramp from Hanua St. with Four-Lane Farrington Hwy.	AM PM	51.3 49.6	NA NA	17.2 29.0	B D
On-ramp from Hanua St. with Six-Lane Farrington Hwy.	AM PM	51.5 50.9	52.3 51.5	12.8 22.2	B C

Near Ramp is the 1,500-foot section of the 2 lanes closest to ramp.
Other lanes are lanes closest to median if 3 or more lanes on freeway.
Vplph = vehicles per lane per hour for 2 lanes near ramp.
Level of Service is for 2 lanes near ramp.
4 Lanes/6 Lanes = Conditions with existing 4-lane Farrington Highway and with planned 6-lane widening
NA = Not Applicable

Wilbur Smith Associates; December 11, 2006

Chapter 4
2020 WITH PROJECT BUILDOUT

The development of the Makaiwa Hills Project area is expected to extend through 2020, based on the beginning of development in 2009, for a development period of 12 years. The planned development has been segmented into nine development areas. This chapter assesses the traffic generation, traffic impacts, and mitigative actions for the full buildout of the Project.

DESCRIPTION OF THE PROJECT

The Project development would encompass most of the vacant lands located mauka of Farrington Highway between Kalaeloa Boulevard and the Waimanalo Gulch Landfill. Not included as part of the 'Project" is the 69-acre parcel in the southeast section of the Makaiwa Hills area that has previously received zoning approval for R-5 residential development. This previously zoned area is discussed in Chapter 3 and the traffic to/from the parcel is included within the "Without Project" forecasts and analyses for 2020 as well as the 2015 interim analysis year.

Land Uses

Most of the Project area is expected to be developed with residential uses that range from large single-family lots to townhouses to mid-rise (three to four floors) condominiums. The development in the mauka areas would primarily be single-family units with the higher-density residential uses located near Farrington Highway (Figure 1-1). The highest residential development densities would be located in a "Village Center" located approximately midway between the Palailai and Ko Olina Interchanges. The Project areas would include a total of about 4,100 residential units, not including the 131 units planned within the previously zoned area.

The Project would also include commercial, recreational, and public uses with most of these focused on serving the Makaiwa Hills community. These are planned to include:

- A Community Commercial Center with about 150,000 square feet of building floor area located in the southeast corner near the Palailai Interchange
- An elementary school located west of the Village Center
- A community center located near the Village Center with meeting and recreational uses
- Commercial uses (65,000 square feet of building floor area) located within the Village Center
- A commercial area with about 50,000 square feet of small retail, restaurant, and services businesses in the southwest area of the Project.

Project Roadways

For year 2020, regional access to the Project is expected to be provided at two locations:

1. The extension of Kalaeloa Boulevard mauka from its intersection with Farrington Highway. This extension is referred to herein as Road A and is planned as a four-lane roadway with median and left-turn lanes at major cross streets and driveways. The Road A route would provide Project access to the H-1 Freeway to/from Honolulu via the new Kapolei Interchange eastbound on-ramp and westbound off-ramp. Project traffic would be able to travel to/from the City of Kapolei via either the Farrington Highway/Wakea Street Extension connection to Kamokila Boulevard or via Kalaeloa Boulevard connection to the Kapolei Parkway.

2. The connection to the Road D junction with Farrington Highway, which would be constructed as a full-movement interchange by 2020. For initial traffic planning and analysis purposes, this access was considered as a partial cloverleaf interchange as described in the following section.

A network of major collector roadways would be constructed within the Project to link each development area to the regional access points as well as to provide access between the different Project areas. The major collectors would include the following roadways:

Road A – This four-lane roadway with median is planned to parallel Farrington Highway in the eastern portion of the Project and provide linkage to both the Kalaeloa Boulevard and Road D access connections. Road A would provide access to the community commercial center as well as provide access to the other major collector roadways within the Project.

Road B – This roadway would parallel Farrington Highway in the western portion of the Project site and connect to Road A and Road D. The section of Road B paralleling Farrington Highway would be constructed as a four-lane roadway with median and turn lanes at major cross streets and driveways. The western end of Road B that parallels the west property line is proposed as a two-lane roadway. Road B would provide access to the Village Center and western portions of the Project.

Road C – Road C would extend mauka from Road A paralleling the eastern boundary of the Project to provide access to the residential areas. The makai section of Road C is proposed as a four-lane roadway with median divider and separate left-turn lanes at cross streets and major driveways. Mauka of Road F, the roadway is proposed as a two-lane roadway.

Road D – The extension of Road D from Kapolei West across Farrington Highway into the Makaiwa Hills Project area is also referred to as Road D within the Project area. Road D is planned to extend mauka to connect to Road A and Road B. This short

extension between Farrington Highway and Road B would be constructed as a four-lane roadway with divider median and turn lanes.

Road E – Road E would extend mauka from Road B to provide access to the mauka residential areas in the western portion of the Project site. Road E is proposed as a four-lane roadway with median between Road B and Road F, and as two-lane roadway mauka of Road F.

Road F – This east-west roadway would link Road C and Road E to facilitate circulation within the Project area. Road F is proposed as a four-lane roadway with median.

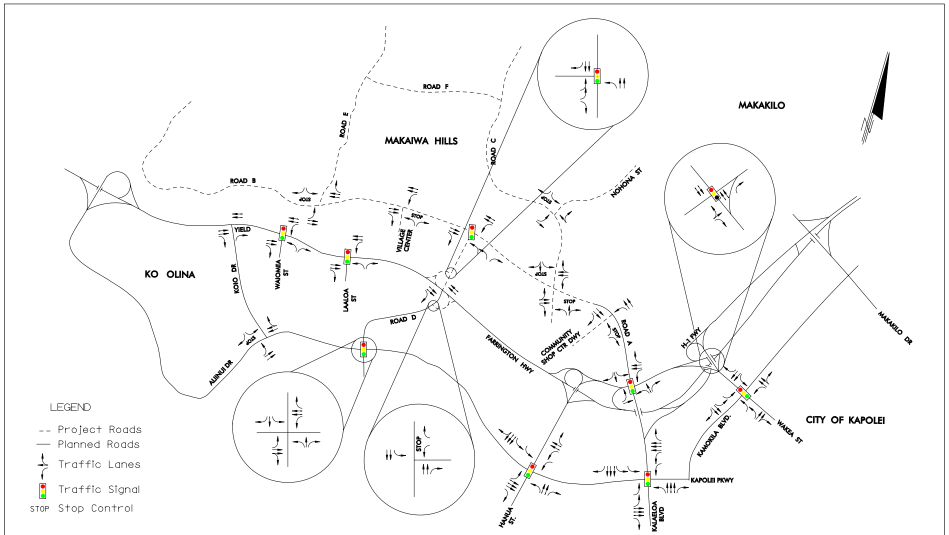
Nohona Street Connector – Nohona Street within the Makakilo community is proposed for extension into the Project to connect to Road C. This would allow circulation between the two communities and improve overall connectivity of the area roadways. This connection would allow circulation between the two communities without the using the H-1 Freeway or passing through the City of Kapolei business area, and would provide an additional network connection for use in potential emergencies. This connection would be constructed as a two-lane collector street.

Traffic signal controls are proposed at the intersections of Road D with Road A/Road B and with the Farrington Highway Westbound Ramps. All other intersections of Project collector roadways are assumed to be controlled by STOP signs on the minor street approaches for analysis purposes, although roundabouts could be constructed at several of these junctions. The planned numbers of travel lanes and lanes at key intersections are depicted in Figure 4-1.

Road D Interchange Configuration

A diamond-type interchange was initially considered at the Road D junction with Farrington Highway. However the diamond-type interchange would potentially adversely affect the planned Kapolei West residential uses in the southwest quadrant and the planned elementary school within the Project area in the northeast quadrant. To minimize such potential impacts, a partial-cloverleaf interchange has been proposed for the junction with the ramps located in the northwest and southeast quadrants to reduce impacts on the sensitive areas. The proposed interchange configuration would provide for all potential traffic movements.

The conceptual layout of a partial cloverleaf-type interchange at the planned Road D connection to Farrington Highway is depicted in Figure 4-2. The proposed location of the connection was based on the general area topography and the relationship to the planned land uses in the vicinity of the Road D junction with Farrington Highway, as well as the spacing to the adjacent Palailai Interchange ramps and to the Laaloa Street intersection.



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2020 PLANNED ROADWAY LANES AND CONTROLS WITH PROJECT

FIGURE 4-1

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PROPOSED ROAD D
PARTIAL CLOVERLEAF INTERCHANGE

FIGURE 4-2

The Road D crossing of Farrington Highway would be located approximately 2,000 feet east of the Laaloa Street intersection and about 4,600 feet west of the Kalaeloa Boulevard overpass. This location reflects a trade-off in optimizing the spacing of the interchange from the traffic-signal-controlled intersection of Farrington Highway at Laaloa Street, and from the future off-ramp and on-ramps for the planned Hanua Street connection to the H-1 Freeway as part of the Palailai Interchange.

- Very high volumes of traffic are expected to enter the westbound freeway lanes from the Palailai Interchange and exit onto the Road D interchange. The level of these volumes would merit the provision of an auxiliary lane (weaving section) that extends from the Palailai On-Ramp to the Road D Off-ramp. It is desirable to provide a minimum spacing of about 2,000 feet between the Road D Interchange ramp and the relocated westbound on-ramp of the Palailai Interchange, which will be reconstructed further west to accommodate the future Hanua Street connection. The 2,000-foot spacing would allow somewhat independent operation of the on-ramp and off-ramp maneuvers and minimize the potential for weaving problems along westbound Farrington Highway between the two interchanges. Once this spacing has been set, it would be extremely high cost to modify the weaving configuration and therefore the greater importance has been given to providing this spacing for the weaving section between the ramps.

- With this location, the entry point (start of the acceleration lane) for the westbound on-ramp from Road D would connect to Farrington Highway approximately 1,000 feet upstream from the Laaloa Street signal-controlled intersection. With an acceleration lane of about 600 feet for the on-ramp to a point where the auxiliary lane narrows to 6 feet, the transition taper would extend an additional 300 feet to end about 100 feet east of the Laaloa Street intersection. When the Laaloa Street signal changes to red for the Farrington Highway approach, the stopped queue of westbound through traffic may extend back into the transition area and acceleration lane to block traffic from entering from the westbound on-ramp during the red signal indication along Farrington Highway, particularly in the afternoon commute peak hour. When the through traffic on westbound Farrington begins to move with the change to a green signal indication, any stopped on-ramp traffic may not be able to merge into the through lane until the through lane queue dissipates.

The Road D Westbound On-ramp is expected to be used by relatively low volumes of traffic. However, if the potential operational issues regarding the spacing from the Laaloa Street signal become problematic in the future, the westbound traffic operations could be improved by one of the several potential modifications:

1. **Remove Signal Control of Westbound Farrington Highway at Laaloa Street** – This approach would reconstruct the median opening at Laaloa Street to permit left turns into Laaloa Street from westbound Farrington Highway, but prohibit the left turn out of Laaloa Street onto westbound Farrington Highway. This would allow the westbound through traffic to have continuous flow through the intersection and avoid potential queue of the Road D on-ramp. Vehicles exiting from Honokai Hale would have to use the

Waiomea Street signal-controlled intersection to turn left onto Farrington Highway. This approach would remove the signal-protected pedestrian crossing of Farrington Highway at this intersection.

2. **Remove Laaloa Street Signal** – This approach would remove the traffic signal and close the median opening to limit Laaloa Street to right turns into and out of the community. This would provide a normal condition for the westbound on-ramp traffic to accelerate and merge into the through lanes. A street linkage could be provided from the makai end of Laaloa Street to the Kapolei West collector road and hence to Road D to allow Laaloa Street traffic to access the Road D interchange or Kapolei Parkway/Aliinui Drive. Most of the exiting Honokai Hale traffic seeking to travel towards Waianae would likely use the Waiomea Street signalized connection to Farrington Highway. This approach would remove the signal-protected pedestrian crossing of Farrington Highway at this intersection.

3. **Extend the Westbound Acceleration Lane Through Laaloa Street Intersection** – This approach would continue the Road D acceleration lane through signal-controlled intersection for a minimum of 500 feet plus taper. This would allow the vehicles entering from the Westbound On-ramp to queue in the acceleration lane and merge into the through lane after passing through the Laaloa Street signal if necessary.

Option 3 is the approach used for the purpose of this traffic impact analysis since the Laaloa Street intersection with Farrington Highway is assumed to remain unchanged from the exiting signal operation and allows this study to assess the future conditions with a full-movement intersection. However, Option 1 represents the most desirable approach from a traffic-engineering perspective to address the spacing problem with the Laaloa Street intersection since it would avoid operational and safety concerns of the merge maneuver near a signal-controlled intersection while having minimal effects on access to the Honokai Hale community.

The partial cloverleaf configuration for the Road D interchange is used for the year 2020 analyses with the Makaiwa Hills Project, as depicted in Figure 4-2.

General Phasing of Project Development

The Project is divided into a number of smaller areas reflecting the drainage channels and the planned network of roadways, with these identified as areas 1 through 9. The order of the area numbers also reflects a potential sequence of development. In general, the sequence infers that development would start in the southeast portion of the site and progress westward and mauka through the site. These small areas have been grouped into several traffic analysis zones (TAZ) for the purposes of the traffic study, with these analysis zones identified as follows:

Area 1	Further split into Areas 1A and 1B, the southeast area includes about 884 residential units, the community commercial center, and the elementary school. Area is split between TAZ 80, 81, and 85.

Area 2	Further split into Areas 2A and 2B, this area includes the Village Center and the two residential areas mauka of the Village Center, with a total of about 1,532 residential units and 65,000 square feet of commercial building floor space. TAZ 86 includes areas makai of Road B and TAZ 68 areas mauka of Road B.
Area 3	Further split into Areas 3A and 3B, the southeast area includes about 903 residential units and a small commercial area as TAZ 82.
Area 4 and Area 8	Identified as TAZ 79, these two areas include the mauka areas that would be accessed from Road C along the eastern Project boundary. A total of about 370 residential units are included in TAZ 79.
Areas 5, 6, 7, and 9	Identified as TAZ 87, these four areas include the mauka section that would be accessed from Road E. A total of about 542 residential units are included in this TAZ.

With the development of several other new shopping centers and "big box" retail uses in the Kapolei area, it is expected that the development of the Makaiwa Hills commercial center, located within the Project Area 1, would likely not be developed until later in the overall development when a larger residential community has been developed to support the commercial uses. The community commercial center may be developed about the same time as Area 4 or Area 5.

Area 1, less the community commercial center, would be constructed with access provided by the Road A connection to the Kalaeloa Boulevard-Farrington Highway intersection.

The Road D connection would be developed after the start of the Area 2 development, with the initial Road D connection proposed as an at-grade intersection with Farrington Highway. The Areas 1 and 2 development (less the community commercial center) approximates the traffic level that could be accommodated by the combination of the initial access to Kalaeloa Boulevard-Farrington Highway intersection plus the addition of the Project access to the at-grade Road D intersection with Farrington Highway. This increment of development is analyzed in Chapter 5, "2015 Conditions With Project".

The Road D connection to Farrington Highway is proposed for upgrading to a full grade-separated interchange at the beginning of the Area 3 development, which is anticipated to start about 2015-2016.

Resident and Non-Resident Units

Given the Project location and vistas from the hillside areas, much of the development may appeal to persons who may acquire units for future retirement homes or for seasonal use. These units, referred to herein as "non-resident units," may be occupied only part-time or may be rented for short-term use through much of the year. Preliminary marketing assessments have indicated that the mauka areas and western areas closer to the Ko Olina area may attract non-resident use. This traffic study is based on the following levels of non-resident use for the Project areas:

Area 3	60% of all housing units occupied by non-residents
Area 2B	40% of single-family units occupied by non-residents
Areas 4 through 9	20% of all housing units occupied by non-residents

Based on these percentages, the marketing assessment indicates that about 755 residential units, or 18% of the total Project housing units, would be occupied by non-residents (or vacant) at any given time, with 82% of the Project units occupied by local full-time residents.

PROJECT TRIP GENERATION

The numbers of vehicle trips generated by the Project were based on standard trip rates compiled by the Institute of Transportation Engineers (ITE).[1] The trip rates for shopping centers (ITE Land Use Category #820) were used for commercial areas in Areas 1, 2, and 3. ITE trip rates for single-family homes (#210), condominium/townhouse (#230), low-rise (1-2 floors) condominium (#231), and high-rise (3 or more floors) condominium (#232) were used for the residential units in the various areas of the Project. The ITE trip rate for recreational homes (#260) was used for the "non-resident units" within the Project, with these trip rates reflecting higher unit vacancy levels and the lower trip-making during commute peak hours that typically occur with these types of units.

The numbers of vehicle trips entering or exiting a commercial development include both new vehicle trips and additional stops by vehicles that would be traveling through the area whether or not the Project is developed. These additional stops by traffic passing the site to use the retail and services uses are referred to as "pass-by trips," which do not represent additional trips on the adjacent roadway, but do result in additional turns into and out of the development driveways by vehicles that would be passing by that site. The ITE *Trip Generation Handbook*[2] provides a methodology and pass-by rates for estimating the proportion of the Project vehicle trip ends that

[1] *Trip Generation, Seventh Edition*, Institute of Transportation Engineers, 2003.
[2] *Trip Generation Handbook, An ITE Proposed Recommended Practice*, Institute of Transportation Engineers, October 1998.

are pass-by trips. Pass-by trip factors are usually applied to the weekday afternoon and weekend peak hours. For the commercial uses, Appendix Table D-6 lists the total number of vehicles entering and exiting the land use and also lists the number of "new" vehicle trips on the area roadways generated by the land use in the afternoon peak hour, excluding the pass-by trips.

Trip generation methodology also allows vehicle trip rates to be reduced for mixed-use developments where the integrated location of residential, retail, and office uses would encourage some trips to be made by walking between the uses instead of by driving between the two land uses, referred to as "internal capture" trips. Internal capture was estimated for the mixed residential, retail, and office uses planned for the Village Center area, with about 38 of the 538 afternoon peak hour vehicle trips (7.1%) to be converted from vehicle to pedestrian trips.

Full development of the Project is estimated to generate a total of 2,560 and 3,554 vehicle trips to or from the site in the weekday morning and afternoon peak hours, respectively, as outlined in Table 4-1. The Project would generate an estimated 37,900 vehicle trips to or from the various land uses (including pass-by trips) on a typical weekday. With the exclusion of pass-by trips, 3,180 vehicle trips would be added to the area roadways traveling to, from, or between the Project land uses.

PEAK HOUR TRAFFIC VOLUMES

The vehicle trips to/from the Makaiwa Hills Project were distributed to surrounding areas based on the percentages presented in Appendix C. The resultant forecast of weekday peak hour traffic volumes on the area roadways are depicted in Figure 4-3 and 4-4 for the year 2020 morning and afternoon peak hours, respectively.

Traffic volumes along Road A mauka of Farrington Highway are estimated at 600 vehicles in the morning peak hour and 1,020 vehicles in the afternoon peak hour. This section of roadway would be primarily used by Project trips to/from the City of Kapolei and by travel from the southeast portion of the Project to/from the Honolulu via the Kapolei Interchange ramps.

The majority of the Project trips are estimated to use the Road D Interchange for travel to areas outside of Makaiwa Hills. An estimated 1,090 and 1,130 vehicles are projected to use the Road D on- and off-ramps in the morning and afternoon peak hours, respectively. An additional 610 vehicles in the morning peak hour and 830 vehicles in the afternoon peak hour are estimated to use Road D and the Kapolei Parkway to travel to/from areas outside the Project.

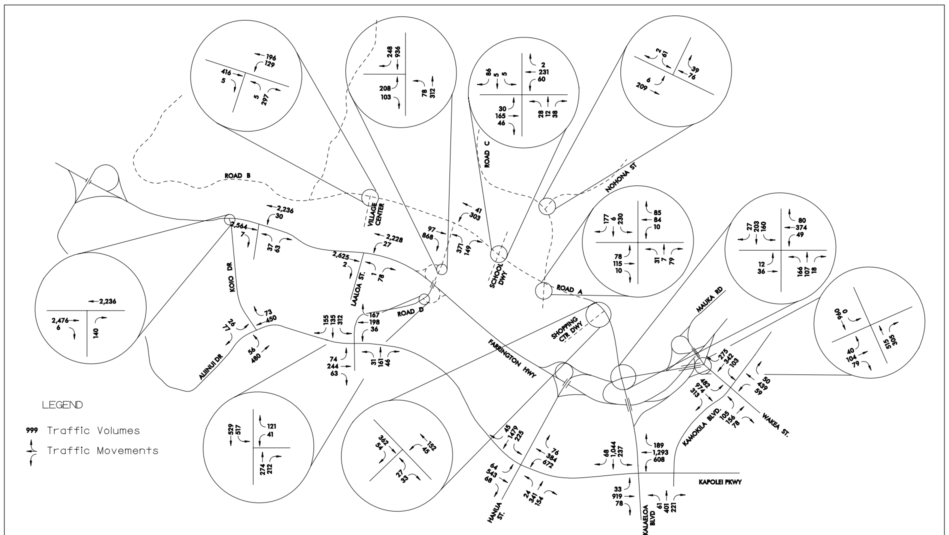
The highest traffic volumes within the Project site are forecast along the section of Road D between the Farrington Highway interchange and Road A. This roadway section would be used by about 1,690 and 1,950 vehicles in the morning and afternoon peak hours, respectively. The traffic volumes along the section of Road B just west of the Road D/Road A intersection are forecast at about 1,380 and 1,800 vehicles in the morning and afternoon peak hours, respectively.

Table 4-1
VEHICLE TRIP GENERATION
2020 WITH PROJECT BUILD-OUT

Area	Land Use	Morning Peak Hour			Afternoon Peak Hour		
		Total	Enter	Exit	Total	Enter	Exit
Area 1 Southeast	386 SF	290	74	216	390	251	139
	327 TH/Condo	144	23	121	177	118	59
	40 MF	27	7	20	33	19	14
	Elem. School	276	162	114	67	38	29
	Shop. Ctr.	155	95	60	563	270	293
	Subtotals	892	361	531	1,230	696	534
Area 2 Central Makai	507 SF	363	92	271	473	291	183
	30 Non-Resident	5	3	2	8	3	5
	923 MF 3-6 Floors	314	65	249	332	212	120
	72 MF TH/Condo	32	5	27	39	26	13
	Village Retail	41	25	16	132	65	67
	Village Office	39	34	5	32	3	29
	Subtotals	794	224	570	1,016	600	417
Area 3 Southwest	361 MF Resident	159	25	134	195	130	65
	542 MF Non-Resident	87	54	33	141	60	81
	Commercial	52	32	20	188	90	98
	Subtotals	298	111	187	524	280	244
Areas 4-9 Mauka	730 SF Resident	548	138	410	737	474	263
	182 Non-Resident	29	18	10	47	20	27
	Subtotals	577	156	420	784	494	290
TOTALS	New + Pass-bys	**2,560**	**852**	**1,708**	**3,554**	**2,070**	**1,485**
	New Trips Only	**2,560**	**852**	**1,708**	**3,180**	**1,890**	**1,290**

SF = Single Family Housing Units (Resident Occupied)
MF = Multi-Family Housing Units (Resident Occupied)
Non-Resident DU = Housing units occupied by persons not year-round residents
Pass-by Trips = Vehicles passing by commercial site that make extra stop, not new trip.

Wilbur Smith Associates; November 29, 2006



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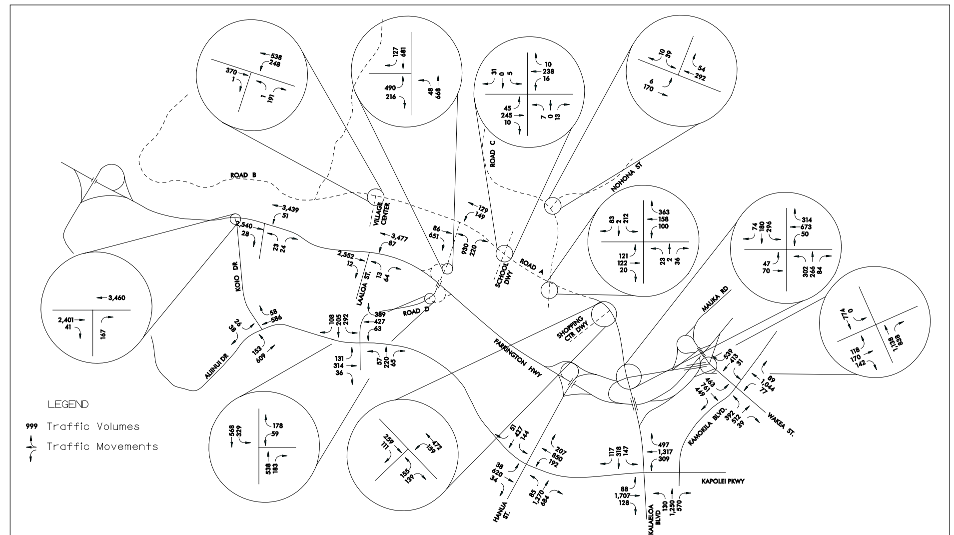
MAKAIWA HILLS
TRAFFIC IMPACT ASSESSMENT REPORT
HONOLULU, HI

2020 TRAFFIC WITH PROJECT
MORNING PEAK HOUR

FIGURE 4-3



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MAKAIWA HILLS
TRAFFIC IMPACT ASSESSMENT REPORT
HONOLULU, HI

2020 TRAFFIC WITH PROJECT
AFTERNOON PEAK HOUR

FIGURE 4-4

Traffic use of the Nohona Street connection between Makaiwa Hills and Makakilo is estimated at about 100 vehicles in each peak hour. These forecast vehicle trips primarily reflect Makakilo residents traveling to the Makaiwa Hills to work or shop, plus a small number of trips to/from the Kalaeloa Boulevard corridor. Traffic using this connection could be increased if the schools in each community attract trips from the other community, or if the connection is used by a higher volume of trips traveling from Makakilo to the Kalaeloa Boulevard corridor or to Ko Olina.

The Project is forecast to add about 820 vehicles, for an increase of about 12%, to the H-1 Freeway traffic through the City of Kapolei during the morning peak hour. In the afternoon peak hour, the Project would increase H-1 Freeway traffic by about 1,050 vehicles or 13% more than the projected 2020 volumes without the Project.

PEAK HOUR TRAFFIC CONDITIONS

Traffic conditions were analyzed for the 2020 weekday morning and afternoon peak one-hour traffic volumes with Project build-out. The analyses were made for the key intersection near the Project site, and for the key H-1 Freeway ramps at the Palailai Interchange. The methodology and criteria used in analyzing the traffic conditions at the intersection and on the freeway are described in Appendix A.

Key Intersection Conditions

Traffic conditions for the key intersections near the Project site, with the completion of the Project development, are summarized for the 2020 weekday morning and afternoon commute peak hours in Table 4-2. For comparison, year 2020 conditions without the Project are also presented in Table 4-2.

The OMPO Regional Transportation Plan includes the widening of Farrington Highway to six lanes from the Palailai Interchange westward during the 2016-2030 period. Since it is not known whether this widening may be completed by yearend 2020, the intersection conditions for the Koio Drive, Waiomea Street, and Laaloa Street intersections have been analyzed both with Farrington Highway as a four-lane and a six-lane roadway.

Farrington Highway-Koio Drive – With Farrington Highway as a four-lane roadway, the very long delays for the traffic turning right out of Koio Drive would worsen as a result of the increase in Project traffic from the Waianae Coast-Ko Olina area with delays at LOS F both without and with the Project.. The Project would add an estimated 20 to 50 seconds per vehicle to the estimated delays of 75 to 150 seconds without the Project.

With the planned widening of Farrington Highway to a six-lane roadway, the through traffic would be spread over three eastbound lanes, with the lower number of vehicles per lane providing an increased number of gaps for traffic to enter onto the roadway. The traffic turning

right from Koio Drive onto Farrington Highway is projected to experience average delays at LOS D in both peak hours with the Project. This would compare to LOS C and LOS D in the morning and afternoon peak hours, respectively, without the Project.

No mitigation is proposed since traffic could alternatively use the Road D Interchange to access Farrington Highway to avoid the delay until the planned widening of Farrington Highway results in much shorter delays.

Farrington Highway Intersections with Waiomea and Laaloa Streets – With Farrington Highway as a four-lane roadway, the traffic at both intersections would approximate a marginally acceptable 94% capacity in the morning peak hour with overall intersection average delays at an acceptable LOS B or C. In the afternoon peak hour, the increased volume of through traffic along Farrington Highway would worsen the conditions with traffic exceeding the capacity of both intersections by about 12% with the Project, versus 10% without the Project. The overall average delay is estimated at LOS E both without and with the Project.

With Farrington Highway as a six-lane roadway, the forecast traffic volumes at each intersection with the Project would amount to 78% of capacity versus 77% without the Project, with average overall intersection delays at LOS A or B.

No mitigation is proposed since the Project would increase the capacity use only by about 2% in the problem afternoon period; and the planned widening of Farrington Highway would result in acceptable conditions.

Between the time that the Road D full-access connection to Farrington Highway is provided and the widening of Farrington Highway, access conditions could be improved for the Honokai Hale community by the extension of Laaloa Street to connect to the Kapolei West roadway makai of the community. This Laaloa Street extension would permit Honokai Hale residents access to the Road D junction with Farrington Highway as well as to the Kapolei Parkway.

Road D-Farrington Highway Eastbound and Westbound Ramps – The proposed grade-separated interchange would have two at-grade intersections along Road D, one on the makai side of Farrington Highway to access the off- and on-ramps for the eastbound travel direction of Farrington Highway, and the second on the mauka side to access the on- and off-ramps for the westbound travel direction.

The at-grade intersection on the mauka side of Farrington Highway, which provides access for the off- and on-ramps for the westbound travel direction of Farrington Highway, is expected to be controlled by a traffic signal in 2020 due to the high volumes of traffic turning left from the Off-ramp approach onto mauka-bound Road D, which would merit the provision of dual left-turn lanes and signal control. The dual left turn lanes would be provided both for intersection capacity purposes and to shorten the distance the traffic queue extends on the Off-ramp. With signal control, the Westbound Ramp intersection with Road D would operate at acceptable conditions in both peak hours with traffic at 48% or less of capacity and average overall delays at LOS B.

Table 4-2
2020 TRAFFIC CONDITIONS AT KEY INTERSECTIONS WITH MAKAIWA HILLS BUILDOUT

Intersection	Scenario	Morning Peak Hour			Afternoon Peak Hour		
		V/C	ADPV	LOS	V/C	ADPV	LOS
Farrington Hwy.-	No Project/4 Lanes	0.97	120.0	F	1.02	127.1	F
Koio Dr.	With Project/4 Lanes	1.08	159.9	F	1.20	197.7	F
NB Right Turn	No Project/6 Lanes	0.50	28.2	D	0.55	28.7	D
with YIELD	With Project/6 Lanes	0.54	31.6	D	0.62	35.0	D
Farrington Hwy.-	No Project/4 Lanes	0.88	22.7	B	1.10	71.2	E
Waiomea St.	With Project/4 Lanes	0.93	31.5	C	1.14	88.2	F
	No Project/6 Lanes	0.65	14.9	B	0.77	12.4	B
	With Project/6 Lanes	0.68	14.8	B	0.80	13.4	B
Farrington Hwy.-	No Project/4 Lanes	0.88	9.6	A	1.10	67.0	E
Laaloa St.	With Project/4 Lanes	0.93	17.9	B	1.15	83.8	F
	No Project/6 Lanes	0.63	5.2	A	0.77	11.1	B
	With Project/6 Lanes	0.66	5.0	A	0.80	9.3	A
Road D - EB	No Project		NA			NA	
Farrington Ramp	With Project (STOP)	1.19	375.7	F	1.18	303.4	F
Road D - WB	No Project		NA			NA	
Farrington Ramp	With Project (Signal)	0.48	14.0	B	0.45	17.2	B
Koio Dr.-	No Project (STOP)	0.08	16.3	C	0.18	33.2	D
Aliinui Dr.	With Project (STOP)	0.10	19.4	C	0.24	44.7	E
Road D-	No Project	0.36	30.5	C	0.39	29.9	C
Kapolei Pkwy	With Project	0.50	32.0	C	0.71	33.9	C
Hanua St.-	No Project	0.91	44.6	D	0.80	44.1	D
Kapolei Pkwy.	With Project	0.92	40.5	D	0.92	41.5	D
Kalaeloa Blvd.-	No Project	0.35	22.0	C	0.53	27.9	C
Farrington Hwy.	With Project	0.46	28.9	C	0.69	37.5	D
Kalaeloa Blvd.-	No Project	0.75	30.8	C	0.90	40.1	D
Kapolei Pkwy.	With Project	0.87	33.4	C	0.97	50.8	D
Wakea St.-	No Project	0.37	5.0	A	0.52	9.8	A
Farrington Hwy.	With Project	0.43	8.3	A	0.59	13.2	B
Wakea St.-	No Project	0.65	30.4	C	0.99	43.3	D
Kamokila Blvd.	With Project	0.66	30.5	C	1.07	50.6	D

V/C = Ratio of the traffic volume to the theoretical capacity of the intersection.
ADPV = Average delay per vehicle, in seconds.
LOS = Level of service.
NA = Not Analyzed

Wilbur Smith Associates; February 8, 2007.

The Eastbound Ramp intersection with Road D was initially analyzed with STOP sign control. The analysis indicates that the traffic turning left from the off-ramp onto makai-bound Road D would operate with extremely long delays (LOS F) during both peak hours. The extremely long delays with the Makaiwa Hills traffic would merit mitigative actions at this intersection.

Koio Drive-Aliinui Drive – The left turn from Koio Drive onto Aliinui Drive would operate at acceptable levels of delay in both peak hours without or with the Project. In the afternoon peak hour, the Project would increase the average delay for the vehicles turning left by about 11 seconds, with the average delay estimated at LOS E versus LOS D without the Project. No mitigative actions should be needed at this intersection as the estimated average delay and number of vehicles turning left from Koio Drive would be substantially below levels needed to satisfy MUTCD Warrant 3 criteria to allow consideration of a traffic signal.

Road D-Kapolei Parkway –This intersection is forecast to operate at very acceptable conditions in 2020 with the full-access interchange at the Road D connection to Farrington Highway and the planned roadway lanes and signal control.

Hanua Street-Kapolei Parkway – Without the Makaiwa Hills Project traffic, the planned development of the lands in the Kalaeloa Boulevard/Hanua Street corridor by 2020 would result in morning peak hour traffic volumes that would approximate 91% of capacity with the planned lanes at this intersection. The Project would increase through traffic along the Kapolei Parkway at this intersection as well as the turning movements to/from the makai leg of Hanua Street. However, the construction of the Makaiwa Hills Interchange would divert some traffic that would otherwise use Hanua Street to access the H-1 Freeway. The net effect of the Project is estimated to result in morning peak hour traffic volumes that approximate 92% of intersection capacity with average delay at LOS D. A decrease in average delay is estimated due to the increase in through traffic which has lower delay per vehicle and the decrease (diversion) of much of the left-turn traffic, which has longer delays than the intersection average.

The forecast afternoon peak hour volumes would amount to about 92% of intersection capacity with the Project as compared to 80% without the Project. Due to decreased left turns and increased through traffic, the estimated average delay per vehicle is slightly less than without the Project, with both at LOS D.

With the addition of Project traffic, the projected 2020 peak hour traffic conditions at this intersection would be at minimally acceptable levels.

Kalaeloa Boulevard-Farrington Highway – The development of the previously-zoned parcel within Makaiwa Hills would be accessed by an extension of Kalaeloa Boulevard mauka from the Farrington Highway intersection. The planned intersection is projected to operate at acceptable conditions with the addition the full build-out of the Makaiwa Hills Project. With the planned lanes and addition of signal control, the 2020 peak hour traffic volumes would amount to 70% or less of the intersection capacity with average delays at LOS C.

Kalaeloa Boulevard-Kapolei Parkway – The Project would add traffic to all four approaches at this intersection, particularly to the eastbound and westbound through traffic movements and the right-turn from westbound Kapolei Parkway. The Project traffic would increase the morning peak hour traffic to 87% of capacity of this intersection with the planned lanes, with average delay at LOS C. In the afternoon peak hour, the forecast traffic with the Project would approximate 97% of the estimated intersection capacity versus traffic at 90% of capacity without the Project. The overall intersection delay is estimated at LOS D with or without the Project.

Improvement actions would be needed to better accommodate the projected 2020 traffic volumes in the afternoon peak hour.

Wakea Street-Farrington Highway – This future intersection, which provides access to the Eastbound On-ramp to the H-1 Freeway, is projected to operate at very acceptable levels with the addition of Project traffic.

Wakea Street-Kamokila Boulevard – The intersection is projected to operate at very acceptable levels in the morning peak hour. In the afternoon peak hour, the traffic volumes with the Project would exceed intersection capacity by 1%, versus traffic at 99% of capacity without the Project. Overall average delay is estimated at LOS D in the afternoon peak hour with long delays for the left-turn movements.

Project Access Road Intersection Conditions

Traffic conditions were analyzed for the planned key intersections within the Project area with the Project build-out traffic. The conditions are summarized for the 2020 weekday morning and afternoon commute peak hours in Table 4-3.

Road D-Road A-Road C – This intersection would provide the primary entry to the Makaiwa Hills development. The T-intersection of these four-lane divided roadways is analyzed with traffic signal controls due to the very high volume of turning vehicles which would merit dual left-turn lanes. The intersection would operate at very acceptable conditions with the proposed lanes and signal control.

The Project concept plan depicts this intersection with a roundabout. However, the four-lane roadways and high-volume of turning traffic would likely require a two circulating lanes for the roundabout. Most drivers in Honolulu would not have encountered a two-lane roundabout, so the provision of such a facility would require driver education as to the proper usage for it to be effectively utilized. The potential of a roundabout could be further assessed as the Project progresses to more detailed planning and analysis.

Road A-Elementary School Driveway – The main Elementary School exit driveway was analyzed as a four-leg intersection with the mauka leg as an access roadway to the residential area across from the school site. The intersection was analyzed with STOP sign control on the School Driveway approach. With the proposed lanes, the traffic turning left from the school driveway is projected with average delay at LOS B in both peak hours.

Road A-Road C – Road C is expected to have a four-leg intersection with Road A, with Road C as the mauka leg and the makai leg as an access to the residential area on the makai side of Road A. This intersection is forecast with a high volume of vehicles turning between the mauka and east legs. The analysis based on STOP sign control of the makai-bound (Road C) and mauka-bound approaches indicates the forecast volumes can be accommodated at acceptable conditions in the morning peak hour with the makai-bound left-turn estimated to experience average delay at LOS D. However, the left-turn from the makai-bound approach is projected with extremely long average delay of 241 seconds (LOS F) in the afternoon peak hour.

The extremely long delays forecast with STOP sign control could potentially merit the installation of traffic signal controls. Federal and state highway officials have established a series of warrants for consideration of traffic signal control at an intersection, which are set forth in the MUTCD.[3] If conditions for an intersection do not satisfy one of the warrants, a signal is not appropriate for the location. If the conditions do satisfy one or more warrants, then a signal may be appropriate and could be considered based on further engineering studies.

Table 4-3
2020 TRAFFIC CONDITIONS AT PROJECT ROADWAY INTERSECTIONS

Intersections	Weekday Morning Peak Hour			Weekday Afternoon Peak Hour		
	V/C	ADPV	LOS	V/C	ADPV	LOS
Road D-Road A-Road B	0.83	23.0	C	0.67	29.8	C
Road A-Elem. School Dwy. Mauka-bound Left Turn	0.16	20.0	C	0.02	14.8	B
Road A-Road C Makai-bound Left Turn	0.63	27.9	D	1.35	241.3	F
Road A- Shopping Center Dwy. Mauka-bound Left Turn	0.07	14.4	B	0.76	59.4	F
Road B-Village Center Road Mauka-bound Right Turn	0.42	12.9	B	0.26	33.1	D

V/C = Ratio of the traffic volume to the theoretical capacity of the intersection.
ADPV = Average delay per vehicle, in seconds.
LOS = Level of service.
Except for Road D-Road A-Road B, all are based on STOP sign control of access road.

Wilbur Smith Associates; December 4, 2006.

[3] *Manual on Uniform Traffic Control Devices for Streets and Highways, 2003 Edition*, Federal Highway Administration, 2003.

Warrant #3, Peak Hour, is the primary criteria when considering whether a traffic signal is merited to address forecast future traffic conditions at an intersection. The afternoon peak hour traffic conditions for the makai-bound approach of Road C to Road A were compared to the MUTCD Warrant #3 criteria. If the conditions do not satisfy the warrant, a traffic signal is not appropriate to address the long delays; if the conditions satisfy the warrant, a traffic signal may be considered for the intersection.

- **Warrant 3 Category A**
  All three conditions of these criteria must be satisfied by the same one-hour period: With the four-leg intersection and the Road C "minor street" approach striped to provide a separate left-turn lane and a shared through/right-turn lane, the requirements and forecast values for the afternoon peak hour period are as follows:

Peak Hour Criteria	Minimum Requirement	Forecast Amount	Satisfy Requirement
Minor Street Delay	5 hours	14.4 hours	Yes
Minor Street Volume	150 vehicles	297 vehicles	Yes
Total Intersection Volume	800 vehicles	1,237 vehicles	Yes

  The forecast intersection conditions in 2020 would satisfy the Warrant #3A criteria to permit consideration of a traffic signal at this location.

- **Warrant 3 Category B**
  For the number of lanes at this intersection and the afternoon peak hour volumes along Road A, this warrant would require a minimum of 150 vehicles exiting the makai-bound Road C approach in the peak hour.

  The makai-bound Road C approach to Road A, with a forecast 297 vehicles in the afternoon peak hour, has more than the minimum volume requirement and satisfies this part of the warrant.

Based on the forecast volumes and conditions in the afternoon peak hour, a traffic signal may be appropriate at this intersection by 2020. With the installation of a traffic signal and the planned lanes, the traffic conditions with the forecast 2020 traffic would be as follows:.

Peak Hour	Volume-to-Capacity Ratio	Ave. Delay Per Vehicle (sec.)	Level of Service
Morning	0.34	24.6	C
Afternoon	0.40	23.4	C

Road A-Shopping Center Main Driveway – The community shopping center was analyzed as having left-turns from only one exit driveway to provide a conservative assessment ("worst case") of the access conditions. The Shopping Center driveway was analyzed at a T-intersection with STOP sign control for the driveway approach. The use of STOP sign control on the Shopping Center Main Driveway approach to Road A would result in long delays (LOS F) for traffic turning left from this approach in the afternoon peak hour. However, the estimated delays with the T-type intersection depicted in the Project concept plan (estimated at a cumulative 2.96 hours in the afternoon peak hour) would not be long enough to satisfy the MUTCD Warrant #3 criteria for consideration of a traffic signal at this location.

Actual delays could potentially be increased by several factors that may be revised as the Project plans evolve or by changed conditions after development of the commercial center. The delays could potentially be increased to levels warranting a signal if one or more of the following occur:

- A greater proportion of the vehicles exiting the site turn left from the Main Driveway.
- The through traffic volumes along Road A are higher than those forecast with Project build-out.
- An access roadway to the residential area mauka of Road A is constructed and aligned opposite the commercial center Main Driveway, which would increase the number of conflicting movements at the intersection and increase the delays for traffic exiting from the shopping center.

The conditions at the intersection should be reassessed if the size or composition (big box retailers versus shopping center) of the commercial center changes, or if circulation plans are revised to create a four-leg intersection. Conditions should be monitored after construction to determine whether a signal is warranted by actual future traffic conditions.

Road B-Village Center Main Access Road – The preliminary concept plan for Makaiwa Hills indicates this as a T-intersection. STOP sign control was assumed for the Village Center Main Access Road approach to Road B. With the estimated volume of through traffic along Road B, the traffic turning left- and right from the Village Center Main Access Road should experience only short delays (LOS B) in the morning peak hour, with long delays anticipated in the afternoon peak hour (LOS D). However, neither the estimated delay nor the estimated volume of traffic would satisfy Warrant #3 for consideration of a traffic signal.

Freeway Ramp Conditions

The 2020 peak hour traffic conditions were assessed for the weaving sections between the Road D and Palailai Interchanges as well as the westbound weaving lane between the H-1 Freeway ramps between the Makakilo and Kapolei Interchanges. Also analyzed were the freeway merge/diverge sections for the Palailai Interchange ramps that would be located within the four-lane section of Farrington Highway closest to Project and should be most affected by the Project traffic. The analysis was made using the HCM procedures (Appendix A) and HCS McTrans software.

Weaving Sections between Road D and Palailai Interchanges –These two weaving sections would be created with the construction of the Road D Interchange. The weaving section in each direction would be about 2,000 feet in length between the on-ramp entry point and off-ramp exit point. A single-lane entry and exit ramp was assumed at each end of the weaving sections. However, the high volume of traffic estimated using the Westbound On-ramp (1,500 vehicles) in the afternoon peak hour would merit a two-lane ramp entry to the freeway.

With Farrington Highway remaining a four-lane highway in 2020, the traffic using the westbound weaving section is projected to result in LOS D conditions in the morning peak hour. This would compare to LOS C conditions at the Hanua Street On-ramp merge area without the Project. In the afternoon peak hour, the t traffic conditions along the westbound weaving section are estimated at LOS F with the existing two westbound through lanes, which would likely reduce the average speed along this freeway section by about 5 mph from conditions without the Project.

The planned Farrington Highway widening project would provide an additional through lane in each direction through this section. With the additional through lane, the conditions in the westbound weaving section would improve to LOS C and LOS D in the morning and afternoon peak hours, respectively.

The morning traffic conditions in the eastbound weaving section would operate at very good LOS B conditions both with Farrington Highway remaining a four-lane roadway and widened to six lanes in 2020. In the afternoon peak hour, conditions along the eastbound weaving section are estimated at LOS C with the existing two westbound through lanes, LOS B with the addition of a third through lane.

Westbound Weaving Section between Makakilo and Kapolei Interchanges – This weaving section would be used by Makaiwa Hills traffic exiting the H-1 Freeway onto Farrington Highway to use the mauka extension of Kalaeloa Boulevard (as Project Road A) to enter Makaiwa Hills. The 1,400-foot long weaving section is planned to have a single-lane on-ramp from Makakilo Drive and a single-lane off-ramp at the Kapolei Interchange.

The Project is estimated to have minimal effect on the westbound traffic conditions along this weaving section of the freeway in the morning peak hour, with an estimated 0.8 mph reduction in average freeway speeds. In the afternoon peak hour, the Project traffic is estimated to reduce average speeds along this section by about 1.75 mph. The afternoon conditions are estimated at LOS C with the Project versus LOS B without the Project traffic, as summarized in Table 4-4.

Palailai Interchange Ramp Junctions – The planned Eastbound On-ramp from the Hanua Street extension to the H-1 Freeway and the planned Westbound Off-ramp to Hanua Street would be the closest independently operating ramps to the Makaiwa Hills Project, although Project traffic would not normally use either of these ramps. These two ramp junctions are

analyzed because each of the ramp junctions would be affected by the addition of the Project traffic in the through lanes, and both ramp junctions are located within the existing four-lane section of the H-1 Freeway beyond the lane drops at the existing Palailai Interchange ramps.

The addition of Project traffic in the eastbound freeway through lanes passing the entry of the Hanua Street Eastbound On-ramp would result in a speed reduction of about 1.0 mph in the morning peak hour and minimal change in the afternoon peak hour, as summarized in Table 4-5. The traffic conditions in the freeway lanes near the merge point are estimated at LOS C in both peak hours both without and with the addition of the Project traffic.

The westbound freeway lanes near the future Off-ramp to Hanua Street are estimated to operate at LOS B in the morning peak hour with or without the Project. In the afternoon peak hour, conditions are estimated at LOS C both with and without the Project as summarized in Table 4-5. The Project is not projected to significantly affect speeds in either peak hour.

Table 4-4
2020 TRAFFIC CONDITIONS AT
FREEWAY RAMP WEAVING SECTIONS

Year and Development Scenarios	Morning Peak Hour				Afternoon Peak Hour			
	Density	Weave Speed	Thru Speed	LOS	Density	Weave Speed	Thru Speed	LOS
Westbound Weaving from Makakilo On-ramp to Wakea Off-ramp (Kapolei Interchange)								
No Project 6 Lns	25.37	41.78	48.63	C	19.57	43.89	50.72	B
With Project 6 Lns	27.34	41.03	47.78	C	24.04	42.15	48.98	C
Westbound Weaving from Hanua Street (Palailai) On-ramp to Road D Off-ramp								
With Project 4 Lns	18.92	35.39	53.17	B	44.82	27.80	44.73	F
With Project 6 Lns	13.34	38.52	55.07	B	30.82	30.50	48.25	D
Eastbound Weaving from Road D On-ramp to Hanua Street (Palailai) Off-ramp								
With Project 4 Lns	30.15	32.6	50.44	D	21.04	45.87	50.82	C
With Project 6 Lns	21.05	35.66	52.95	C	15.65	39.89	55.88	B

Density = Passenger car equivalents per mile per lane in analyses section.
Weave Speed = Average speed in miles per hour of weaving traffic through analysis section.
Thru Speed = Average speed in miles per hour of non-weaving traffic through analysis section.
LOS = Level of service in weaving area.

Wilbur Smith Associates; November 30, 2006.

Table 4-5
2020 FREEWAY TRAFFIC CONDITIONS AT KEY RAMP MERGE/DIVERGE SECTIONS

Freeway Section at Ramp	Scenario	Morning Peak Hour			Afternoon Peak Hour		
		Density	Speed	LOS	Density	Speed	LOS
Eastbound Freeway							
At On-Ramp from Hanua St.	No Project	20.6	50.1	C	21.8	50.6	C
	With Project	25.0	50.1	C	24.9	50.6	C
Westbound Freeway							
At Loop Off-Ramp to Hanua St.	No Project	13.9	49.8	B	20.3	50.6	C
	With Project	16.3	49.8	B	25.7	50.6	C

Density = Passenger car equivalents per mile per lane in analyses section.
Speed = Average speed in miles per hour through weaving area.
LOS = Level of service in weaving area.

Wilbur Smith Associates; November 30, 2006

PUBLIC TRANSIT AND BICYCLE TRAVEL

The concept plan for the Makaiwa Hills development provides a generally continuous network of major collector roadways for circulation within the community and access to the various development parcels. The street network would provide a framework for bus routes and bicycle travel although the increasing elevation mauka through the Project site and the resultant relatively steep grades along the mauka-makai roadways would affect both bus and bicycle travel on these roadways.

The City and County of Honolulu is planning to construct a public transit guideway that could extend from the central Honolulu area as far west as Kapolei West development area. The presence of a guideway transit station and park-and-ride facility near the Kapolei Parkway-Hanua Street intersection would likely increase public transit usage by Makaiwa Hills residents and workers, which could result in lower vehicle trip generation, particularly for trips via the H-1 Freeway to the central Honolulu area.

The concept plan includes a bicycle path paralleling Farrington Highway to encourage use of bicycles for transportation purposes as well as for recreation. The bicycle path would begin within the commercial area at the west end of the Project area and extend eastward as a separate facility to the Village Center. Bicycle lanes would be provided through the Village Center and

the separate bicycle path would resume east of the Village Center to extend to Road D/Road A where it ends in the preliminary concept plan. This planned facility would provide access to the elementary school.

Sidewalks would be provided along the major collector roadways and local streets in conformance with City and County of Honolulu guidelines and standards.

The following proposed actions could encourage use of these travel modes for travel within the Project.

Public Transit

- The Project Team should meet with City DTS and TheBus staffs in early stages of Project design to identify potential routes for TheBus within the Makaiwa Hills area so that the community layout and design can facilitate access to public transit.
- The Project Team should coordinate the potential location of bus stops with the City DTS and TheBus staffs.
- The community design should provide direct pedestrian linkages between each residential area and the likely bus stop location(s) serving that area to allow convenient access and encourage bus use.
- Bus shelters should be provided at the potential high-use stop locations, such as those serving the commercial areas, the school, and the community center.

Bicycles

- The makai bicycle path should be continued east of Road D to provide access at least as far east as the Makaiwa Hills community shopping center. The crossing could be provided at the signal-protected Road D-Road B intersection.
- Bicycle lanes should be provided along Road D between Makaiwa Hills and the Kapolei Parkway to provide a regional linkage. Road D between Farrington Highway and Road A within the Project should be constructed with bicycle lanes to allow this linkage.
- The collector streets within the Project site should be planned to accommodate bicycle use, and should provide a network of continuous street connections between most neighborhoods to allow use for bicycle travel by those who prefer not to travel along the major streets.

POTENTIAL MITIGATIVE ACTIONS

Potential mitigative actions were considered for those locations that may be substantially affected by the Makaiwa Hills Project traffic.

Potential Mitigative Actions

The following paragraphs identify potential roadway improvements and other actions to mitigate the impacts at those locations substantially affected by the projected Makaiwa Hills traffic in 2020.

Road D-Farrington Highway Eastbound Ramps – The proposed at-grade intersection would result in extremely long delays for vehicles exiting from the Eastbound Off-ramp with STOP sign control, with the long delays potentially meriting the installation of traffic signal controls. Federal and state highway officials have established a series of warrants for consideration of traffic signal control at an intersection, which are set forth in the MUTCD.[4] If conditions for an intersection do not satisfy one of the warrants, a signal is not appropriate for the location. If the conditions do satisfy one or more warrants, then a signal may be appropriate and could be considered based on further engineering studies.

Warrant #3, Peak Hour, is the primary criteria when considering whether a traffic signal is merited to address forecast future traffic conditions at an intersection. The morning peak hour traffic conditions for the two-lane approach of the Eastbound Off-ramp to Road D were compared to the MUTCD Warrant #3 criteria. If the conditions do not satisfy the warrant, a traffic signal is not appropriate to address the long delays; if the conditions satisfy the warrant, a traffic signal may be considered for the intersection.

- **Warrant 3 Category A**
  All three conditions of these criteria must be satisfied by the same one-hour period: With the T-type intersection and the Eastbound Off-ramp "side-street" approach striped to provide separate left-turn and right-turn lanes, the requirements and forecast values for the afternoon peak hour period are as follows:

Peak Hour Criteria	Minimum Requirement	Forecast Amount	Satisfy Requirement
Minor Street Delay	5 hours	5.6 hours	Yes
Minor Street Volume	150 vehicles	237 vehicles	Yes
Total Intersection Volume	650 vehicles	1,850 vehicles	Yes

[4] *Manual on Uniform Traffic Control Devices for Streets and Highways, 2003 Edition*, Federal Highway Administration, 2003.

The forecast intersection conditions in 2020 would satisfy the Warrant #3A criteria to permit consideration of a traffic signal at this location.

- **Warrant 3 Category B**
  For the number of lanes at this intersection and the afternoon peak hour volumes along Road D, this warrant would require a minimum of 150 vehicles exiting the Off-ramp approach in the peak hour.

  The Eastbound Off-ramp approach to Road D, with a forecast 237 vehicles in the afternoon peak hour, has more than the minimum volume requirement and satisfies this part of the warrant.

Based on the forecast volumes and conditions in the morning peak hour, a traffic signal may be appropriate at this intersection by 2020. With the installation of a traffic signal and the planned lanes, the traffic conditions with the forecast 2020 traffic would be as follows:.

Peak Hour	Volume-to-Capacity Ratio	Ave. Delay Per Vehicle (sec.)	Level of Service
Morning	0.51	20.4	C
Afternoon	0.48	18.8	B

Since the projected volumes and delays satisfy the signal warrant, the actual intersection conditions should be monitored and a traffic signal installed if and when appropriate.

Separate right- and left-turn lanes should be provided on the Off-ramp approach. This would allow vehicles to turn right without being delayed by vehicles waiting to turn left.

Kalaeloa Boulevard-Kapolei Parkway – The Project would add traffic to all four approaches of the intersection in the problem afternoon peak hour, particularly to the eastbound and westbound approaches of the Kapolei Parkway, with traffic amounting to 97% of capacity. It would be desirable to provide additional capacity to lower this level of capacity utilization. However, the planned intersection includes three through lanes, dual left-turn lanes and separate right-turn lanes on most of the approaches, thus already incorporating most reasonable and effective lane additions.

The City DTS is using very long signal cycle lengths at other intersections in the Kapolei area to maximize traffic throughput. Cycle lengths of 180 seconds and longer are currently used at intersections along Fort Barrette Road. With a cycle length of 180 seconds, double the 90-second cycle used in the base analysis, the afternoon peak hour traffic would approximate 87% of capacity with average delay at LOS D (53.5 seconds).

The Kalaeloa Redevelopment Plan proposes the extension of Saratoga Road to provide a major roadway connection to Lauwiliwili Street in the Kapolei Business Park. This would provide a second connection, in addition to the Malakole Street connection included in this analysis that would divert some additional traffic away from the Kapolei Parkway-Kalaeloa Boulevard intersection. This second connection would likely divert sufficient traffic from the Kapolei Parkway-Kalaeloa Boulevard intersection to avoid the addition of the mauka-bound dual right-turn lanes. If the Saratoga Road connection is made to Lauwiliwili Street, this would eliminate the need for the dual left-turn lanes.

Longer cycle lengths, such as 180 seconds, should be used at this intersection in the commute peak periods and conditions monitored at this intersection. If necessary, intersection capacity could be improved by the provision of dual right-turn lanes on either the westbound or mauka-bound approaches.

Wakea Street-Kamokila Boulevard – The Project would primarily add traffic to the Wakea Street approaches of the intersection in the problem afternoon peak hour. Several potential options were analyzed to offset the Project impacts on the intersection conditions in 2015:

1. Re-stripe and sign the outside westbound through lane to change to a shared through/right-turn lane. This would allow right-turns to be made from two lanes to the westbound approach of Kamokila Boulevard onto the Wakea Street connection to the freeway eastbound on-ramp and to Farrington Highway.

2. Add a separate right-turn lane to the Wakea Street mauka-bound approach.

As summarized in the following table, Option 2, with both the re-striped shared westbound through/right-turn lane and the additional mauka-bound right-turn lane, would be needed to fully offset the Project impacts at the intersection. The separate right-turn lane on mauka-bound Wakea Street would improve conditions but not fully offset the Project impacts. Option 2 would improve capacity use to 97% in the afternoon peak hour, versus 99% without the Project and would also reduce the average delay to levels close to those for the Without Project condition (44.2 seconds per vehicle with mitigation versus 43.3 seconds without the Project).

MITIGATION OPTIONS
WAKEA STREET-KAMOKILA BOULEVARD

Options	Weekday Morning Peak Hour			Weekday Afternoon Peak Hour		
	V/C	ADPV	LOS	V/C	ADPV	LOS
1 – Re-stripe WB Through Lane as Shared Through/Right-turn Lane	0.67	30.5	C	1.00	50.6	D
2 – Option 1 + Add Separate Right-turn Lane to Mauka-bound Approach	0.67	30.2	C	0.97	44.2	D

V/C = Ratio of the traffic volume to the theoretical capacity of the intersection.
ADPV = Average delay per vehicle, in seconds.
LOS = Level of service.
Wilbur Smith Associates; November 27, 2006.

PROPOSED MITIGATIVE ACTIONS

The following actions are proposed to accommodate future transportation needs in the Makaiwa Hills Project study area.

Proposed Actions to Mitigate Project Impacts

The following listing identifies transportation improvements to mitigate the impacts at those locations substantially affected by the projected Makaiwa Hills traffic at buildout in 2020.

Road D Junction with Farrington Highway
- Construct initially as at-grade intersection and upgrade to full interchange in incremental phases
- With the interim at-grade intersection, construct the planned ramps to accommodate the left turns via “jug-handle maneuvers, with no left-turns permitted at the at-grade crossing of Road D with Farrington Highway
- With the interim at-grade intersection, construct a short section of three traffic lanes in each direction on Road D to increase capacity through the intersection, with these added lanes serving as left-turn lanes onto the jug-handle on-ramps
- With the interim at-grade intersection, construct a short section of a westbound auxiliary lane along Farrington Highway to increase capacity through the intersection

Farrington Highway/H-1 Freeway
- When the Road D junction is upgraded to an interchange, construct an auxiliary lane in both travel directions to provide weaving sections between the Palailai and Road D Interchange ramps

Road D-Eastbound Farrington Highway Ramps
- Monitor and install traffic signal when warranted by traffic conditions
- Provide separate left- and right-turn lanes to minimize delays
- Provide sufficient median width to allow the provision of dual left-turn lanes from makai-bound Road D onto the On-ramp if needed for future conditions.

Road D- Westbound Farrington Highway Ramps
- Install traffic signal

- Provide double left-turn lanes on the Off-ramp approach

Road D-Road A-Road B

- Install traffic signal
- Provide double left-turn lanes on Road D approach

Kalaeloa Boulevard-Kapolei Parkway

- Provide long signal cycle length, similar to those currently used along Fort Barrette Road, to increase green time and reduce lost time during the peak traffic periods.

Wakea Street-Kamokila Boulevard

- Provide separate right-turn lane on mauka-bound Kamokila Boulevard
- Re-stripe existing outside through lane on westbound Kamokila Boulevard to provide a shared right-turn/through lane, which would allow right turns to be made from two lanes onto mauka-bound Wakea Street.

Proposed Actions By Others

The following roadways and/or modifications would be needed to provide access at Project build-out and are planned as actions by others without the development of the Makaiwa Hills Project:

- Construct the Kapolei Interchange complex
- Construct the section of Road D between the Kapolei Parkway and Farrington Highway
- Construct the Kapolei Parkway
- Widen Kalaeloa Boulevard to six lanes at the Kapolei Parkway intersection
- Construct the Hanua Street extension and new ramps at Palailai Interchange.

Chapter 5
2015 WITH PARTIAL PROJECT

The Makaiwa Hills Project traffic impacts were analyzed for year 2015 to test whether this intermediate level of development could be accommodated by the combination of the initial access to Kalaeloa Boulevard-Farrington Highway intersection plus the addition of the Project access to an at-grade Road D intersection with Farrington Highway. Earlier traffic analyses on preliminary land use concepts had indicated that the 2015 level of development likely approximates the traffic volumes along Farrington Highway that could be accommodated with an at-grade intersection with Road D. Therefore the 2015 traffic analyses were made to indicate the traffic impacts for a "midway" level of development as well as to test the adequacy of an initial at-grade intersection at the junction of Road D with Farrington Highway.

The initial development of the Makaiwa Hills Project area is expected in the southeast area near the Kalaeloa Boulevard access and extend westward through the makai lower elevation areas of the site. By 2015, the eastern and central lower-elevation sections are expected to be nearing full development with the exception of the community commercial center located near the Palailai Interchange. With the planned development of several other new shopping centers and "big box" retail uses in the Kapolei area over the next several years, it is expected that the development of the Makaiwa Hills commercial center would likely occur later in the overall development when a large residential community has been developed to support the commercial uses.

DESCRIPTION OF THE PROJECT IN 2015

In 2015, the Makaiwa Hills development is expected to encompass most of Area 1 and Area 2, with the exception of the community shopping center parcel. The Project development in 2015 is expected to extend from the eastern boundary westward to the area opposite the Honokai Hale community, and from Farrington Highway to about midway to the mauka boundary.

Land Uses

About one-half of the Project area is expected to be developed by 2015. Included within the 2015 development would be the following land uses:

- Approximately 2,285 residential units would be developed ranging from single-family homes to high-rise condominiums. Within Areas 1 and 2 areas, about 30 of the residential units (2%) are expected to be occupied by persons not year-around residents.
- The residential development would include the Village Center higher-density residential uses (3 to 6-level buildings).

- An elementary school would be located east of Road D.

- Ground floor commercial uses would be located within the Village Center, with an estimated 65,000 square feet of building floor area occupied by specialty retail and office uses to service the residential uses.

Project Roadways

Project access would include both the initial Kalaeloa Boulevard connection and the planned access at the Road D junction with Farrington Highway, which would be added at the initial stages of the Area 2 development.

The initial Project connection to the Road D-Farrington Highway junction is proposed to expand the makai-side right-turn in/out connection that is planned for the early phases of the Kapolei West development (Without Makaiwa Hills Project scenario) to a full-movement at-grade intersection. The intersection would be signal-controlled with double left-turn lanes and right-turn lanes proposed for the higher-volume turning movements to increase capacity and to allow maximum allocation of signal green time to the through traffic movement along Farrington Highway.

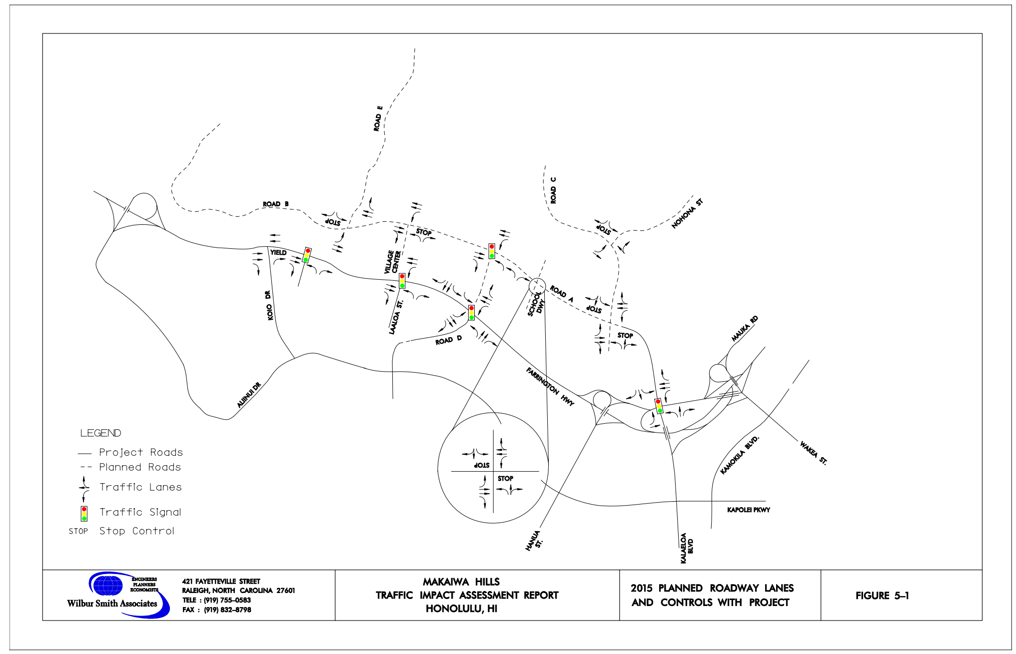
All of Road A as well as the sections of Road B, Road C, and Road E within Areas 1 and 2 are planned as four-lane roadways with landscaped median and left-turn lanes at cross streets and major driveways.

Traffic signal controls are assumed to be installed at the Road D intersection with Road A/Road B. All other intersections of Project roadways are assumed to be controlled by STOP signs on the minor street approaches. The planned numbers of travel lanes at key intersections within the Project and along the adjacent section of Farrington Highway are depicted in Figure 5-1.

PROJECT TRIP GENERATION

The numbers of vehicle trips generated by the Project were based on standard trip rates compiled by the Institute of Transportation Engineers (ITE).[1] The trip rates for shopping centers (ITE Land Use Category #820) and general offices (#710) were used for commercial uses in Area 2. ITE trip rates for single-family homes (#210), condominium/townhouse (#230), low-rise condominium (#231), high-rise (3 to 6 floors) condominium (#232), and recreational homes (#260) were used for the residential units in the various areas of the Project. The trip rates used for each use and the estimated trips are presented in Appendix Table B-6.

[1] *Trip Generation, Seventh Edition*, Institute of Transportation Engineers, 2003.



The numbers of vehicle trips entering or exiting a commercial development include both new vehicle trips and additional stops by vehicles that would be traveling through the area whether or not the Project is developed. These additional stops by traffic passing the site to use the retail and services uses are referred to as "pass-by trips," which do not represent additional trips on the adjacent roadway, but do result in additional turns into and out of the development driveways by vehicles that would be passing by that site. The ITE *Trip Generation Handbook*[2] provides a methodology and pass-by rates for estimating the proportion of the Project vehicle trip ends that are pass-by trips. Pass-by trip factors are usually applied to the weekday afternoon and weekend peak hours. For the commercial uses, Appendix Table B-6 lists the total number of vehicles entering and exiting the land use and also lists the number of "new" vehicle trips on the area roadways generated by the land use in the afternoon peak hour, excluding the pass-by trips.

The Project Areas 1 and 2, less the community shopping center, are estimated to generate a total of 1,444 and 1,662 vehicle trips to or from the land uses within the Project in the weekday morning and afternoon peak hours, respectively, as outlined in Table 5-1. In the afternoon peak hour, the Project would generate trips to 1,589 new vehicle trips on area roadways without pass-bys. The 2015 vehicle trip amount to 56.4% of the total Project trips for the morning peak hour and 50.0% of the afternoon peak hour trips. The Project in 2015 would generate an estimated 17,600 vehicle trips to or from the various land uses (including pass-by trips) on a typical weekday.

PEAK HOUR TRAFFIC VOLUMES

The vehicle trips to/from the Makaiwa Hills Project were distributed to surrounding areas based on the percentages presented in Appendix C. The resultant forecast of weekday peak hour traffic volumes on the area roadways are depicted in Figure 5-2 and 5-3 for the year 2015 morning and afternoon peak hours, respectively.

Traffic volumes along Road A mauka of Farrington Highway are estimated at 440 vehicles in the morning peak hour and 570 vehicles in the afternoon peak hour. This section of roadway would be primarily used by Project trips to/from the City of Kapolei and by travel from the southeast portion of the Project to/from the Honolulu direction via the Kapolei Interchange ramps.

A slightly higher number of the Project trips are estimated to use the Road D connection to Farrington Highway, as compared to the Kalaeloa Boulevard connection, for travel to areas outside of Makaiwa Hills. An estimated 960 and 950 vehicles are projected to use the section of Road D mauka of Farrington Highway in the morning and afternoon peak hours, respectively. About 40% to 50% of these vehicles would be traveling on Farrington Highway/H-1 Freeway to/from areas east of the Project, about 20% would be accessing Farrington Highway west of Road D, and the remainder would be using Road D to travel to/from the Kapolei Parkway.

[2] *Trip Generation Handbook, An ITE Proposed Recommended Practice*, Institute of Transportation Engineers, October 1998.

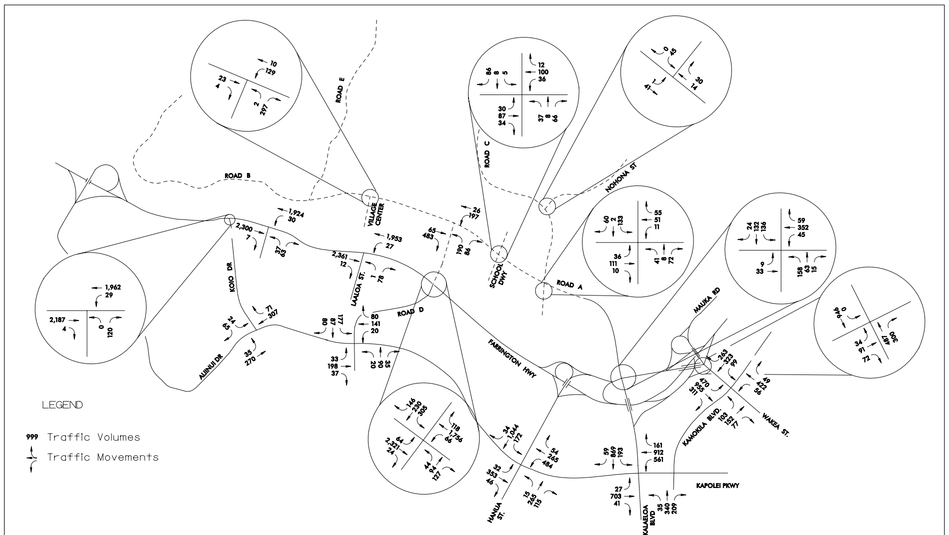
Table 5-1
VEHICLE TRIP GENERATION
2015 WITH PARTIAL PROJECT

Area	Land Use	Morning Peak Hour			Afternoon Peak Hour		
		Total	**Enter**	**Exit**	**Total**	**Enter**	**Exit**
Area 1 Southeast	386 SF Houses	290	74	216	390	251	139
	327 TH/Condo Units	144	23	121	177	118	59
	40 MF Units	27	7	20	33	19	14
	Elem. School	189	111	78	46	26	20
	Shop. Ctr.	0	0	0	0	0	0
	Subtotals	650	215	435	646	414	232
Area 2 Central Makai	507 SF	363	92	271	473	291	183
	30 Non-Resident Units	5	3	2	8	3	5
	923 MF 3-6 Floors	314	65	249	332	212	120
	72 TH/Condo Units	32	5	27	39	26	13
	Village Retail	41	25	16	132	65	67
	Village Office	39	34	5	32	3	29
	Subtotals	794	224	570	1,016	600	417
TOTALS	New Trips + Pass-bys	**1,444**	**439**	**1,005**	**1,662**	**1,014**	**648**
	New Trips Only	**1,444**	**439**	**1,005**	**1,589**	**978**	**611**

SF = Single Family Housing Units (Resident Occupied)
MF = Multi-Family Housing Units (Resident Occupied)
Non-Resident DU = Housing units occupied by persons not year-round residents
Pass-by Trips = Vehicles passing by commercial site that make extra stop, not new trip.

Wilbur Smith Associates; November 29, 2006

Traffic use of the Nohona Street connection between Makaiwa Hills and Makakilo is estimated at about 60 to 80 vehicles in each peak hour. These forecast vehicle trips primarily reflect Makakilo residents traveling to the Makaiwa Hills to work or shop, plus a small number of Makakilo trips to/from the Kalaeloa Boulevard corridor. Traffic using this connection could be increased if the schools in each community attract trips from the other community, or if the connection is used by a higher volume of trips traveling from Makakilo to the Kalaeloa Boulevard corridor or to Ko Olina.



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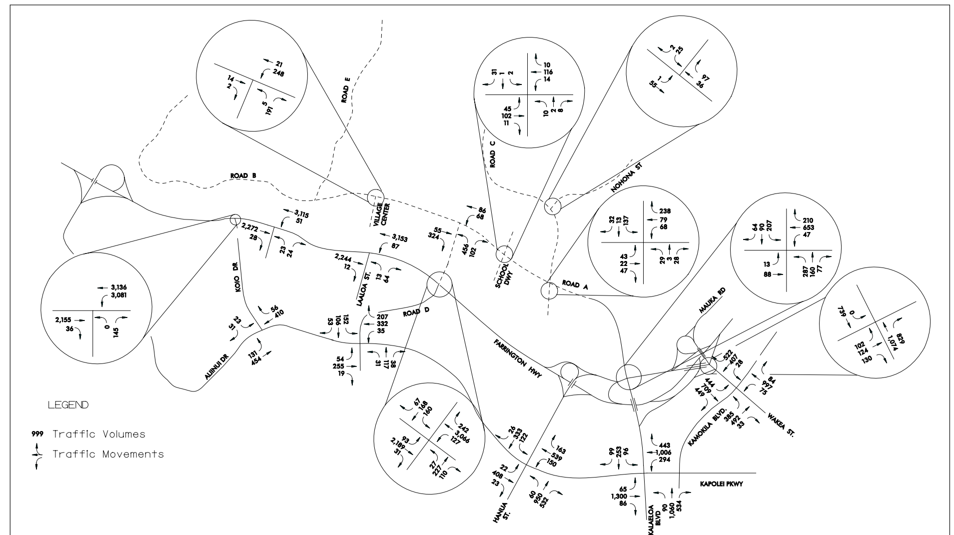
MAKAIWA HILLS
TRAFFIC IMPACT ASSESSMENT REPORT
HONOLULU, HI

2015 TRAFFIC WITH PROJECT
MORNING PEAK HOUR

FIGURE 5–2



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MAKAIWA HILLS
TRAFFIC IMPACT ASSESSMENT REPORT
HONOLULU, HI

2015 TRAFFIC WITH PROJECT
AFTERNOON PEAK HOUR

FIGURE 5–3

The Project is forecast to add about 500 vehicles, for an increase of about 8.7%, to the H-1 Freeway traffic through the City of Kapolei during the morning peak hour. In the afternoon peak hour, the Project would increase H-1 Freeway traffic by about 540 vehicles or 7.6% more than the projected 2015 volumes without the Project.

PEAK HOUR TRAFFIC CONDITIONS

Traffic conditions were analyzed for the 2015 weekday morning and afternoon peak one-hour traffic volumes with Project build-out. The analyses were made for the key intersections near the Project site, and for the key H-1 Freeway/Farrington Highway ramps affected by Project traffic. The methodology and criteria used in analyzing the traffic conditions at the intersection and on the freeway are described in Appendix A.

Key Off-Site Intersection Conditions

Traffic conditions for the key intersections near the Project site, with the completion of the Project development, are summarized for the 2015 weekday morning and afternoon commute peak hours in Table 5-2. For comparison, year 2015 conditions without the Project are presented in the table. The Farrington Highway intersections were analyzed only with a four-lane roadway since the regional transportation plan indicates the widening to a six-lane highway is planned for the 2016-2030 period.

Farrington Highway-Koio Drive – The increase in Project traffic would worsen the long delays for the traffic turning right out of Koio Drive onto eastbound Farrington Highway. The average delays are estimated to increase by about 8 seconds and 17 seconds in the morning and afternoon peak hours, respectively. Delays would be at LOS F in the commute peak hours both without and with the Project.

Farrington Highway is planned for widening to six lanes after 2015. No mitigation is proposed since the Koio Drive traffic could alternatively use the Road D to access Farrington Highway to avoid the delay until the planned widening of Farrington Highway.

Farrington Highway Intersections with Waiomea and Laaloa Streets – With the addition of the Project traffic the overall traffic at each intersection would amount to an acceptable 82% of capacity in the morning peak hour with average delay at both intersections an acceptable LOS B. In the afternoon peak hour, the increased Project traffic would worsen the conditions with traffic exceeding the capacity of both intersections by about 4% with the Project, versus traffic volumes 1% above capacity without the Project. The overall average delay is estimated at acceptable LOS D or better both without and with the Project.

Table 5-2
2015 TRAFFIC CONDITIONS AT KEY INTERSECTIONS
MAKAIWA HILLS AREAS 1 AND 2

Intersection	Scenario	Morning Peak Hour			Afternoon Peak Hour		
		V/C	ADPV	LOS	V/C	ADPV	LOS
Farrington Hwy.-Koio Dr. NB Right Turn	No Project With Project	0.68 0.72	56.7 64.4	F F	0.78 0.85	66.3 83.2	F F
Farrington Hwy.-Waiomea St.	No Project With Project	0.80 0.82	14.6 15.1	B B	1.01 1.04	41.3 47.9	D D
Farrington Hwy.-Laaloa St.	No Project With Project	0.80 0.82	6.0 13.4	A B	1.01 1.04	38.8 49.1	D D
Farrington Hwy.-Road D	No Project (RIRO) With Project (Signal)	0.45 0.93	44.5 58.3	E E	0.55 1.30	48.3 125.9	E F
Koio Dr.-Aliinui Dr.	No Project (STOP) With Project (STOP)	0.05 0.06	13.0 14.1	B B	0.10 0.17	22.6 27.1	C D
Road D-Kapolei Pkwy.	No Project With Project	0.20 0.30	30.8 30.4	C C	0.20 0.38	30.0 31.1	C C
Hanua St.-Kapolei Pkwy.	No Project With Project	0.60 0.64	29.9 28.9	C C	0.65 0.62	27.5 27.6	C C
Kalaeloa Blvd.-Farrington Hwy.	No Project With Project	0.33 0.36	21.7 26.8	C C	0.50 0.56	26.2 29.0	C C
Kalaeloa Blvd.-Kapolei Pkwy.	No Project With Project	0.65 0.73	28.1 29.1	C C	0.74 0.76	31.1 32.6	C C
Wakea St.-Farrington Hwy.	No Project With Project	0.37 0.41	4.9 10.3	A B	0.46 0.52	11.3 15.8	B B
Wakea St.-Kamokila Blvd.	No Project With Project	0.63 0.64	30.3 30.1	C C	0.92 1.02	40.6 44.6	D D
Road D-Road A	With Project	0.45	27.4	C	0.37	29.9	C
Road A-School Dwy.	With Project (STOP)	0.09	13.7	B	0.02	11.7	B
Road A-Road C	With Project (STOP)	0.27	14.3	B	0.36	18.8	C
Road B-Village Center Main Rd.	With Project (STOP)	0.53	19.8	C	0.19	9.2	A

V/C = Ratio of the traffic volume to the theoretical capacity of the intersection.
ADPV = Average delay per vehicle, in seconds.
LOS = Level of service.
NA = Not Analyzed

Wilbur Smith Associates; February 7, 2007.

No modifications are proposed at these two intersections since the afternoon traffic problem conditions are forecast without or with the Project, the Project would increase the capacity use by 3%, and the planned future widening of Farrington Highway would result in acceptable conditions.

Access conditions could be improved for the Honokai Hale community by the extension of Laaloa Street to connect to the Kapolei West roadway makai of the community. This Laaloa Street extension would permit Honokai Hale access to the Road D junction with Farrington Highway as well as to the Kapolei Parkway. This connection could offset some of the increased delay that is forecast for vehicles exiting from Laaloa and Waiomea Streets.

Road D-Farrington Highway – The forecast 2015 traffic volumes would approximate 93% of the capacity of the proposed at-grade, full-movement intersection in the morning peak hour and exceed capacity by 30% in the afternoon peak hour. Average delays would be at undesirable LOS E or LOS F in the both peak hours. Improvement actions would be needed at this intersection to address these conditions.

Koio Drive-Aliinui Drive – The vehicles turning left from Koio Drive are forecast to experience acceptable levels of delay without or with the Project, with the Project traffic increasing delays in the afternoon peak hour to LOS D as compared to LOS C without the Project.

Road D-Kapolei Parkway –This intersection is forecast to operate at very acceptable conditions in 2015 after the full access connection has been provided at the Road D junction with Farrington Highway.

Hanua Street-Kapolei Parkway – Traffic conditions are forecast to remain at very acceptable levels with the Project. The Project is estimated to slightly reduce the average traffic delay at this intersection in the morning peak hour as a result of the diversion of some traffic from this intersection to the Road D full-movement connection to Farrington Highway with the Project. In the afternoon peak hour, the Project would result in a small decrease in capacity use due to the diversion of some traffic to the Road D full-movement intersection.

Kalaeloa Boulevard-Farrington Highway – The Makaiwa Hills Project would increase the capacity usage of this intersection by about 3% to 6% in peak hours and the delay by about 3 to 5 seconds per vehicle. The average delays would be at LOS C with the Project.

Kalaeloa Boulevard-Kapolei Parkway – The Project would increase morning peak hour traffic to 73% of capacity of this intersection, versus 65% of capacity without the Project. In the afternoon peak hour, the forecast traffic would amount to 74%% of capacity. Average delay is forecast at LOS C for both peak hours with or without the Project. No actions are proposed to mitigate this impact.

Wakea Street-Farrington Highway – This future intersection is projected to operate at very acceptable levels with the addition of Project traffic.

Wakea Street-Kamokila Boulevard – The intersection is projected to operate at very acceptable levels in the morning peak hour. In the afternoon peak hour, the forecast traffic would exceed capacity by 2% with the Project trips, versus traffic at 92% of capacity without the Project. The overall average delay is estimated at LOS D with or without the Project with the Project estimated to add about 4 seconds to the afternoon average delay per vehicle.

The projected conditions in the afternoon peak hour would merit actions to mitigate the anticipated Project impacts at this intersection.

Key On-Site Intersection Conditions

Traffic conditions for the key intersections within the Project site were analyzed for the 2015 weekday morning and afternoon commute peak hours. The intersection conditions are summarized in Table 5-2.

Road D-Road A-Road B – This intersection would accommodate a high volume of turns between the makai leg or Road D and the Road B leg. Double left-turn lanes have been proposed to accommodate these turning volumes from the Road D leg. The double left-turn lanes would require traffic signal control. With the proposed lanes and signal control, the intersection should operate at acceptable conditions in both peak hours.

Road A-School Driveway – This intersection was analyzed based on the alignment of the School Driveway with a collector road serving the residential area mauka of Road A, which would provide a “worse case” assessment of whether any modifications such as signal control may be necessary at the intersection. The analysis indicates that the forecast traffic turning left-from the School Driveway, with STOP sign control, would result in only short delays (LOS B) with the mauka leg and the anticipated 2015 levels of development.

Road A-Road C – Road C, the mauka leg of this intersection, would be a collector roadway providing access to the residential areas along the eastern boundary of the Project, while the makai leg would be a local street providing access to the residential subdivision between Road A and the freeway. The high volume of vehicles turning left from makai-bound Road C would operate at acceptable levels with the proposed lanes and STOP sign controls on the mauka and makai approaches.

Road B-Village Center Main Road – Road B would be a collector roadway providing access from Road D to the residential and commercial areas in the central and western portions of the Project. STOP sign control is proposed for the Village Center Main Road approach to Road B. The forecast 2015 traffic volumes would operate at very acceptable conditions with the planned lanes and STOP control.

Freeway Ramp Conditions

The 2015 peak hour traffic conditions were assessed for the weaving section of the westbound H-1 Freeway between the Makakilo and Kapolei Interchanges as well as the freeway merge/diverge sections for those ramps that would be most directly affected by the Project traffic. The analysis was made using the HCM procedures (Appendix A) and HCS software.

Westbound Weaving Section between Makakilo and Kapolei Interchanges – This weaving section would be used by Makaiwa Hills traffic exiting the H-1 Freeway onto Farrington Highway to use the mauka extension of Kalaeloa Boulevard (as Project Road A) to enter Makaiwa Hills.

The Project is estimated to have minimal effect on the westbound traffic conditions along this weaving section of the freeway in the morning peak hour, with the additional Project traffic reducing average freeway speeds by an estimated 0.5 mph. Through traffic conditions are estimated at LOS C both without and with the Project. In the afternoon peak hour, although analysis indicates the Project traffic is estimated to increase average speeds along this section in the through lanes, the combined average speed of weaving and non-weaving (through) traffic would be reduced by about 1.75 mph due to the large decrease in speed of the weaving vehicles. Afternoon peak hour conditions estimated at LOS C with the Project, versus LOS B without the Project, as summarized in Table 5-3.

Palailai Interchange Ramp Junctions – The planned new or relocated ramps to/from the Hanua Street extension to the H-1 Freeway would be the closest independently operating ramps to the Makaiwa Hills Project, although very few Project vehicles would be expected to use these ramps. These ramp junctions are analyzed because each of the ramp junctions would be affected by the addition of the Project traffic in the through lanes, and the ramp junctions are located along the four-lane section of the H-1 Freeway.

The addition of Project traffic in the eastbound freeway through lanes passing the exit of the Eastbound Off-ramp to Hanua Street should have little effect on conditions at this off-ramp, with the HCS analysis indicating no change in speed with the increased through traffic, as summarized in Table 5-4. The morning traffic conditions in the freeway lanes near the merge point are estimated at LOS C with the addition of the Project traffic, versus LOS B without the Project. The service level is determined from the average density rather than the speed estimates; therefore the LOS is indicated as worsening even though there is no estimated speed reduction at this ramp in the morning peak hour.

At the entry of the Hanua Street Eastbound On-ramp to the freeway, the increased traffic density in the freeway lanes with the Project is estimated to slightly decrease travel speeds, by 0.2 mph, in each peak hour.

Table 5-3
2015 TRAFFIC CONDITIONS AT
FREEWAY RAMP WEAVING SECTIONS

Year and Development Scenarios	Morning Peak Hour				Afternoon Peak Hour			
	Density	Weave Speed	Thru Speed	LOS	Density	Weave Speed	Thru Speed	LOS
Westbound Weaving from Makakilo On-ramp to Kapolei Off-ramp								
No Project 6 Lns	22.05	33.40	53.31	C	17.29	44.80	51.51	B
With Project 6 Lns	23.31	32.80	52.82	C	20.26	34.15	53.81	C

Density = Passenger car equivalents per mile per lane in analyses section.
Weave Speed = Average speed in miles per hour of weaving traffic through analysis section.
Thru Speed = Average speed in miles per hour of non-weaving traffic through analysis section.
LOS = Level of service in weaving area.

Wilbur Smith Associates; November 30, 2006.

Table 5-4
2015 FREEWAY TRAFFIC CONDITIONS AT
KEY RAMP MERGE/DIVERGE SECTIONS

Freeway Section at Ramp	Scenario	Morning Peak Hour			Afternoon Peak Hour		
		Density	Speed	LOS	Density	Speed	LOS
Eastbound Freeway							
At Off-Ramp to Hanua St.	No Project	19.1	50.3	B	20.2	50.7	C
	With Project	22.0	50.3	C	21.7	50.7	C
At On-Ramp from Hanua St.	No Project	18.6	51.2	B	23.3	50.8	C
	With Project	21.1	51.0	C	24.8	50.6	C
Westbound Freeway							
At Loop Off-Ramp to Hanua St.	No Project	19.8	49.9	B	21.3	50.7	C
	With Project	20.9	49.9	C	23.5	50.7	C
At On-Ramp from Hanua St.	No Project	15.7	51.4	B	26.9	50.1	C
	With Project	17.0	51.3	B	29.8	49.4	D

Density = Passenger car equivalents per mile per lane in analyses section.
Speed = Average speed in miles per hour through weaving area.
LOS = Level of service in weaving area.

Wilbur Smith Associates; November 30, 2006

The westbound freeway speeds near the future Off-ramp to Hanua Street are estimated to be little changed in either peak hour with the Project. The addition of a mauka-bound left-turn movement with the full access intersection at the Road D junction with Farrington Highway is expected to divert some of the non-Project traffic that otherwise would have to use this ramp to access the westbound freeway to Waianae. The reduction in the non-Project ramp traffic would largely offset the effect of the increased traffic density in the freeway through lanes. The level of service results from the estimated traffic density in the merge area, with the increased density with the Project (20.9 versus 19.8 vehicles per mile per lane) indicating LOS C versus LOS B without the Project.

The increased Project traffic past the entry point for the Westbound On-ramp from Hanua Street/Kalaeloa Boulevard is projected to have little effect on morning peak hour conditions. This ramp is used by much higher volumes in the afternoon peak hour. During the afternoon peak hour, the increased Project traffic is estimated to reduce freeway speed by about 0.7 mph below the average speed without the Project, with LOS D conditions projected with the Project versus LOS C without the Project.

POTENTIAL MITIGATIVE ACTIONS

The following paragraphs identify potential roadway improvements and other actions to mitigate the impacts at those locations substantially affected by the projected Makaiwa Hills traffic in 2015.

Road D–Farrington Highway

The forecast 2015 traffic would approximate the at-grade intersection capacity in the morning peak hour and exceed capacity by 30% during the afternoon peak hour. The junction would eventually be reconstructed as a grade-separated interchange and Farrington Highway is planned for widening to a six-lane roadway during the 2016-2030 period. Several alternative at-grade intersection configurations were assessed that would comprise an early partial implementation of these planned future modifications, but with the junction remaining an at-grade intersection (no overpass bridge structure).

Option 1 Construct Planned Ramps to Provide Jug-Handle Left Turns – In this option, several of the planned future ramp connections would be constructed by 2015 to provide "jug-handle" connections to accommodate the left-turn movements. All left turns would be restricted at the Road D-Farrington Highway intersection to avoid the provision of separate turn phases and green/yellow-time for the left-turn movements at the Road D-Farrington Highway intersection. The left turns would be accommodated via these jug-handle connections that would be constructed for the graded-separated interchange, but with Road D continuing to cross Farrington Highway at-grade. The proposed partial-cloverleaf interchange ramps would be constructed to accommodate each of the left turn movements:

- Westbound Loop Off-ramp would be constructed to connect to the Road D-Road B intersection. This ramp would accommodate the left turns from westbound Farrington Highway onto makai-bound Road D.
- Westbound On-ramp would be constructed to accommodate the left turns from mauka-bound Road D onto westbound Farrington Highway. Makai-bound vehicles on Road D that would otherwise turn right onto Farrington Highway could also use this on-ramp.
- Eastbound Loop Off-ramp would be constructed to accommodate the left turns from eastbound Farrington Highway to mauka-bound Road D.
- Eastbound On-ramp would be constructed to accommodate the left turns from makai-bound Road D onto eastbound Farrington Highway. Mauka-bound vehicles that would otherwise turn right from Road D could also use this on-ramp.

The Road D-Farrington Highway intersection was analyzed with Farrington Highway having two through lanes and a right-turn lane on each approach. Road D was analyzed with three through lanes in each direction with one lane becoming the left-turn lane onto the "jug-handle" on-ramps after crossing Farrington Highway. A simple two-phase operation would be used for the traffic signal control.

As summarized in Table 5-5, this scenario would improve intersection conditions, but the forecast 2015 traffic would exceed the capacity by 8% in the afternoon peak hour.

Table 5-5
ROAD D-FARRINGTON HIGHWAY INTERSECTION
2015 TRAFFIC CONDITIONS WITH MITIGATION OPTIONS

Option	Scenario	Morning Peak Hour			Afternoon Peak Hour		
		V/C	ADPV	LOS	V/C	ADPV	LOS
1	Construct planned ramps to provide jug handle left turns	0.82	24.7	C	1.08	79.4	E
2	Add third westbound through lane at intersection	0.94	57.5	D	0.99	45.5	D
3	Add third eastbound and westbound through lanes at intersection	0.74	35.3	D	0.93	35.7	D
4	Add third westbound plus provide jug handle left turns	0.82	23.0	C	0.79	19.4	B

V/C = Ratio of the traffic volume to the theoretical capacity of the intersection.
ADPV = Average delay per vehicle, in seconds.
LOS = Level of service.

Wilbur Smith Associates; February 6, 2007.

Option 2 Add Third Westbound Through Lane – The westbound through traffic is the critical volume affecting the afternoon traffic conditions. The westbound approach of Farrington Highway could be widened to provide a third through lane from 300 feet east of the intersection and continuing through the intersection for a distance of about 1,000 feet to allow the traffic to merge back into the two existing westbound lanes. This option would add a short section of the third westbound through lane that is planned for Farrington Highway in the regional transportation plan for the 2016-2030 period. Dual left-turn lanes and separate right-turn lanes would be provided at the intersection to accommodate all movements at the intersection.

With the Option 2 additional westbound lane, the afternoon peak hour traffic would approximate the intersection capacity with average delay at LOS D. The three westbound through lanes would result in the eastbound through traffic and westbound left-turn becoming the critical conflicting traffic movements at the intersection during the afternoon peak hour.

Morning peak hour traffic would amount to 94% of capacity with delay at LOS E.

Option 3 Add Third Eastbound and Westbound Lanes Through Intersection – This option would add a short sections of both the third westbound and eastbound through lanes that are planned for Farrington Highway in the regional transportation plan for the 2016-2030 period. The third eastbound lane would begin about 300 feet west of the intersection and extending through the intersection for about 1,000 feet. Dual left-turn lanes and separate right-turn lanes would be provided at the intersection to accommodate all movements at the intersection.

As summarized in Table 5-5, Option 3 would result in very acceptable conditions in the morning peak hour. Traffic volumes in the afternoon peak hour would approximate 93% of capacity with average delay at LOS D.

Option 4 Jug-Handle Left Turns Plus Third Westbound Lane – This option would combine the addition of a short section of the third westbound through traffic (Option 2) with the jug handle left turns of Option 1.

With this option, the traffic would approximate 79% of the intersection capacity in the afternoon peak hour, based on use of the standard default lane utilization factors for the three westbound lanes. However, the short auxiliary lane through the intersection would not likely attract the level of use typical of a continuous lane. The auxiliary lane would need to attract use by about 20% of the westbound through traffic to accommodate the total 2015 afternoon peak hour traffic flow at acceptable conditions.

Summary of Options – Option 4 should provide the most cost-effective approach to accommodating the anticipated traffic through at least 2015 with the at-grade intersection at Road D. This Option could potentially provide adequate capacity to accommodate traffic at this intersection for one or more years beyond the forecast 2015 volume levels.

Option 3 would accommodate the forecast traffic volumes until 2015, but a grade-separated interchange or addition of the jug-handle ramps would be needed to serve further traffic growth.

Other Intersections

Wakea Street-Kamokila Boulevard – The Project would primarily add traffic to the makai-bound and mauka-bound approaches of Wakea Street with some traffic added to the turns from the mauka leg of Wakea Street onto Kamokila Boulevard. Several potential options were analyzed to offset the Project impacts on the intersection conditions in 2015:

1. Re-stripe and sign the outside westbound through lane to change to a shared through/right-turn lane. This would allow right-turns to be made from two lanes to the westbound approach of Kamokila Boulevard onto the Wakea Street connection to the freeway eastbound on-ramp and to Farrington Highway. Add a separate right-turn lane to the Wakea Street mauka-bound approach

2. Add a second (double) right-turn lane to the westbound approach of Kamokila Boulevard.

As summarized in the following table, Option 2, with the addition of the right-turn lane on mauka-bound Wakea Street, would provide the most effective approach to offset most of the Project impacts at the intersection. The separate right-turn lane on mauka-bound Wakea Street would improve conditions but not fully offset the Project impacts. The combination of the two modifications does not provide any benefit over that from Option 2.

MITIGATION OPTIONS
WAKEA STREET-KAMOKILA BOULEVARD

Options	Weekday Morning Peak Hour			Weekday Afternoon Peak Hour		
	V/C	ADPV	LOS	V/C	ADPV	LOS
1 – Re-stripe westbound approach to allow right-turns	0.65	30.1	C	0.99	46.4	D
2 – Add Separate Right-turn Lane to Mauka-bound Approach	0.64	29.9	C	0.94	40.2	D

V/C = Ratio of the traffic volume to the theoretical capacity of the intersection.
ADPV = Average delay per vehicle, in seconds.
LOS = Level of service.

Wilbur Smith Associates; December 14, 2006.

PROPOSED MITIGATIVE ACTIONS

The following actions are proposed to accommodate 2015 transportation needs in the Makaiwa Hills Project study area.

Proposed Actions to Mitigate Project Impacts

The following paragraphs identify transportation improvements to mitigate the impacts at those locations substantially affected by the projected Makaiwa Hills traffic with development of Project Areas 1 and 2 in 2015.

Road D- Farrington Highway
- Install traffic signal control at at-grade intersection
- Prohibit left turns at intersection
- Construct Eastbound On- and Off-ramps to accommodate left turns
- Construct Westbound On- and Off-ramp to accommodate left turns
- Widen short section (1,300 feet) of westbound Farrington Highway to provide three through lanes through the intersection

Road D-Westbound Farrington Highway Ramps
- Provide double left-turn lanes on Off-ramp approach to Road D
- Install traffic signal

Road D-Road A-Road B
- Install traffic signal
- Provide double left-turn lanes for Road D approach

Wakea Street-Kamokila Boulevard
- Add separate right-turn lane on mauka-bound Kamokila Boulevard

Proposed Actions By Others

The following roadways and/or modifications would be needed to provide access at Project build-out and are planned as actions by others without the development of the Makaiwa Hills Project:

- Construct the Kapolei Interchange complex

- Construct the section of Road D between the Kapolei Parkway and Farrington Highway

- Construct the Kapolei Parkway

- Widen Kalaeloa Boulevard to six lanes and add turn lanes at the Kapolei Parkway intersection

- Construct the Hanua Street extension and new ramps at Palailai Interchange.

APPENDICES

Appendix A
Methodology for Analyzing Traffic Conditions

The Transportation Research Board (TRB), a division of the National Science Foundation, has developed standardized methods for use in evaluating the effectiveness and quality of service for roadways and streets. Different methodologies are available for analyzing traffic signal-controlled intersections and other types of roadways.

The TRB evaluation methods use concepts referred to as volume-to-capacity ratio and level-of-service (LOS). The volume-to-capacity ratio (V/C) compares the existing or projected traffic volumes on a facility to the facility's theoretical capacity and, as such, indicates the relative adequacy of the facility to accommodate the traffic volumes. Capacity is estimated primarily from the facility's physical characteristics (e.g. number and widths of lanes), and to a lesser extent by the traffic characteristics (e.g. types of vehicles) and type of traffic controls. The level of service concept describes facility traffic conditions in terms of travel delays or travel speeds, with the service quality expressed on a letter basis from A to F, which signify excellent to unacceptable conditions, respectively.

Signal-Controlled Intersections--Traffic conditions at traffic signal-controlled intersections were evaluated using the Operations Analysis methodology described in the *2000 Highway Capacity Manual (HCM).*[1] The methodology calculates a ratio of actual or estimated peak hour traffic volumes to the theoretical capacity of the intersection. This volume-to-capacity ratio (V/C) reflects the physical characteristics of the intersection and the traffic characteristics, and is somewhat independent of the efficiency of the traffic signal phasing/timing. This ratio indicates the proportion of available capacity being used by traffic volumes and where there is unused capacity available for future traffic increases.

With the 2000 HCM method, the level-of-service is based on the average delay per vehicle for the various movements within the intersection as a result of the traffic signal control. This total delay is the difference between the travel time experienced with the traffic signal and the reference travel time that would result under ideal conditions, in the absence of the traffic control and geometric delay. This delay, referred to as control delay, includes initial deceleration delay, stop delay, queue move-up delay, and final acceleration delay. Average delay time and level-of-service is estimated for the entire intersection, for each roadway approach, and for each traffic movement or lane group. A description of the criteria associated with LOS A through LOS F is provided in Table A-1.

In the assessment of traffic signal-controlled intersections, it is usually most appropriate to relate the adequacy of the geometric design features (such as numbers and use of lanes, lane widths, etc.) to the V/C. Delay and LOS are most relevant to assessing modifications to the traffic signal controls, since these are most directly related to the signal design features, such as cycle length, number and arrangement of phases, and allocation of green time.

[1] *2000 Highway Capacity Manual,* Transportation Research Board, October 2000.

Table A-1
LEVEL OF SERVICE CRITERIA FOR INTERSECTIONS WITH TRAFFIC SIGNAL CONTROL

Level of Service	Average Control Delay (seconds per vehicle)
A	10 or Less
B	10.1 – 20.0
C	20.1 – 35.0
D	35.1 – 55.0
E	55.1 – 80.0
F	More than 80.0

Source: Highway Capacity Manual 2000, Transportation Research Board, Chapter 16, 2000.

Unsignalized Intersections—At intersections with STOP sign controls, the level of service was calculated using the 2000 HCM procedures for intersections with STOP or YIELD signs. In this methodology, the six levels of service, A through F, are used to describe traffic conditions for those movements that must yield to other movements:

- Left-turn out of the side street or driveway;
- Through movement from the side street,
- Right-turn out of the side street or driveway; and
- Left-turn into the side street.

Through vehicles on the major streets are not required to yield to other movements at two-way STOP controlled intersections.

The general indicator of intersection delay is determined by calculating the one-hour capacity for each key movement, based on the conflicting traffic volumes, and then comparing the number of vehicles making that maneuver to the calculated capacity. The unused or "reserve" capacity for the movement is then used to identify a delay time and a level-of-service for that movement. Unlike analysis at signalized intersections, an overall intersection level-of-service is not calculated, but a level-of-service is calculated for each lane group subject to the STOP or YIELD condition.

The level-of-service criteria for unsignalized intersections with STOP or YIELD controls are defined in Table A-2.

Table A-2
LEVEL OF SERVICE CRITERIA FOR UNSIGNALIZED INTERSECTIONS

Level of Service	Average Stopped Delay (seconds per vehicle)
A	10 or Less
B	10.1 – 15.0
C	15.1 – 25.0
D	25.0 – 35.0
E	35.1 – 50.0
F	More than 50.0

Source: Highway Capacity Manual 2000, Transportation Research Board, Chapter 17, 2000.

Freeway Sections – Speed and the freedom to maneuver are primary indicators of operating conditions on freeway sections. Both of these are related to the density of vehicles in the traffic stream, which the 2000 HCM uses to define conditions on freeway sections. Table A-3 presents the maximum vehicle density, minimum speed, and maximum volume-to-capacity ratio for Level of Service A through F for freeways designed for free flow speeds of 65 mph. The criteria for the 65 mph free flow speed are used in this study since this represents the posted speed limit, even though the design speed is likely higher. The maximum capacity is considered to be 2,400 vehicles per lane per hour under average conditions for six- and eight-lane freeways.

With these guidelines and assumptions, the H-1 Freeway is assumed to provide capacities of 2,350 vehicles per hour for normal use lanes.

Roadway or Freeway Ramp Weaving Sections – Weaving sections are formed where a merge area is followed by a diverge area with the two joined by an auxiliary lane with intense lane-change maneuvers taking place. The conditions within a weaving section is a factor of the length of the weaving section, the number of lanes, and the configuration of the entry leg, weaving section, and exit leg, as well as the volumes of the various traffic movements. The HCM 2000 relates the level of service to the vehicle density within the weaving section as presented in Table A-4.

Table A-3
LEVEL OF SERVICE CRITERIA FOR BASIC FREEWAY SEGMENTS

Level of Service	Maximum Density (PC/Mi/Ln)	Minimum Speed (mph)	Maximum Service Flow Rate (PC/Hr/Ln)	Maximum Volume/Capacity Ratio
A	11.0	65.0	710	0.30
B	18.0	65.0	1,170	0.50
C	26.0	64.6	1,680	0.71
D	35.0	59.7	2,090	0.89
E	45.0	52.2	2,350	1.00
F	*	*	*	*

Criteria based on free flow speed of 65 miles per hour (mph)
PC/Mi/Ln = Passenger cars per mile per lane
PC/Hr/Ln = Passenger cars per hour per lane
* = An unstable operation, demand exceeds capacity.

Source: Highway Capacity Manual 2000, Transportation Research Board, Chapter 23, 2000.

Table A-4
LEVEL OF SERVICE CRITERIA FOR WEAVING SEGMENTS

Level of Service	Density (pc/mi/ln)	
	Freeway Weaving Segment	Multilane and Collector-Distributor Segments
A	10 or less	12 or less
B	10-20	12-24
C	20-28	24-32
D	28-35	32-36
E	35-43	36-40
F	Over 43	Over 40

PC/Mi/Ln = Passenger cars per mile per lane

Source: Highway Capacity Manual 2000, Transportation Research Board, Chapter 24, 2000.

Ramp Merge and Diverge Areas – Traffic conditions in the freeway through lanes are affected by vehicles entering from or exiting onto ramps. The influence area of a ramp junction with the freeway generally encompasses the two freeway through lanes closest to the ramp with the influence area extending for a length of about 1,500 feet along the ramp entry/exit point and slightly upstream of the exit or downstream of the entry. The impact of the ramp junction on traffic flow is based on the traffic density within this influence area. Table A-5 lists the range of traffic densities associated with each level of service within the ramp merge or diverge influence area.

Table A-5
LEVEL OF SERVICE CRITERIA
FOR RAMP MERGE AND DIVERGE AREAS

Level of Service	Density (pc/mi/ln)
A	10 or Less
B	10-20
C	20-28
D	28-35
E	35 or More
F	Demand Exceeds Capacity

PC/Mi/Ln = Passenger cars per mile per lane

Source: Highway Capacity Manual 2000, Transportation Research Board, Chapter 25, 2000.

Appendix Table B-1

VEHICLE TRIP GENERATION FOR 2015
NON-PROJECT LAND USES WITHIN CITY OF KAPOLEI

					Trip Generation Rates							Vehicle Trips To/From Area							Trips Less Passbys			
				ITE	AM Peak Hour			PM Peak Hour				AM Peak Hour			PM Peak Hour				PM Peak Hour			
ZONE	Activity	Quantity	Units	Use	Total	In	Out	Total	In	Out	Daily	Total	In	Out	Total	In	Out	Daily	%	Total	In	Out
4	Kapowai Place	17	TSF	710	1.56	1.37	0.19	1.49	0.25	1.24		27	23	3	25	4	21	0	1	25	4	21
11	Advertiser Printing		Emp Trips		0.5	0.4	0.11	1	0.25	0.75		0	0	0	0	0	0	0	1	0	0	0
12	Kapolei Power Ctr Retail	130	TSF	820	1.03	0.63	0.4	3.75	1.8	1.95		134	82	52	488	234	254	0	0.62	302	145	157
	Ministorage	75	TSF	151	0.15	0.09	0.06	0.26	0.13	0.13		11	7	5	20	10	10	0	1	20	10	10
	FHB Office	7	TSF	710	1.56	1.37	0.19	1.49	0.25	1.24		11	10	1	10	2	9	0	1	10	2	9
15	Library																					
	Public Library		TSF	590	1	0.72	0.28	7.09	3.4	3.69		0	0	0	0	0	0	0	1	0	0	0
	Library Distribution	5	TSF	590	1	0.82	0.18	4.76	2.19	2.57		5	4	1	24	11	13	0	1	24	11	13
16	Civic Center	0	Emp	710	0.48	0.42	0.06	0.46	0.08	0.38		0	0	0	0	0	0	0	1	0	0	0
17	Ai / Chun Retail	25	TSF	814	0.71	0.43	0.28	2.59	1.11	1.48		18	11	7	65	28	37	0	0.35	23	10	13
18	Uluohia																					
	Retail	6	TSF	814	0.71	0.43	0.28	2.59	1.11	1.48		4	3	2	16	7	9	0	0.3	5	2	3
	Quality Resturant		TSF	831	0	0	0	7.49	5.02	2.47		0	0	0	0	0	0	0	0.56	0	0	0
	Lot 56 Restaurant	6	TSF	831	0	0	0	7.49	5.02	2.47		0	0	0	45	30	15	0	0.56	25	17	8
30	Kapolei Senior Village	187	Veh. Trips		0.42	0.24	0.18	1	0.51	0.49		79	45	34	187	95	92	0	1	187	95	92
38	Generic A5 Office	65	TSF	710	1.56	1.37	0.19	1.49	0.25	1.24		101	89	12	97	16	81	0	1	97	16	81
41	Kamaaha N2 Office	39	TSF	710	1.56	1.37	0.19	1.49	0.25	1.24		61	53	7	58	10	48	0	1	58	10	48
42	Kamaaha N3																					
	Office	39	TSF	710	1.56	1.37	0.19	1.49	0.25	1.24		61	53	7	58	10	48	0	1	58	10	48
	Private School	400	Students	521	0.92	0.55	0.37	0.2	0.08	0.12		368	220	148	80	32	48	0	1	80	32	48
43	YMCA	40	TSF	495	1.32	0.87	0.45	1.75	0.6	1.15		53	35	18	70	24	46	0	1	70	24	46
44	Block 58 Road E Office	40	TSF	710	1.56	1.37	0.19	1.49	0.25	1.24		62	55	8	60	10	50	0	1	60	10	50
45	Block 59 Road E Ofice	48	TSF	710	1.56	1.37	0.19	1.49	0.25	1.24		75	66	9	72	12	60	0	1	72	12	60
46	Pad A Bank Drive-thru	3	TSF	912	12.63	7.07	5.56	54.78	27.39	27.4		38	21	17	164	82	82		0.53	87	44	44
48	Kapolei Power Ctr West																					
	Home Depot		TSF	862	1.48	0.8	0.68	2.87	1.35	1.52		0	0	0	0	0	0	0	0.52	0	0	0
	Ace Hardware		TSF	816	1.08	0.5	0.58	4.42	2.12	2.3		0	0	0	0	0	0	0	0.35	0	0	0
	Retail	15	TSF	814	0.71	0.43	0.28	2.59	1.11	1.48		11	6	4	39	17	22	0	0.35	14	6	8
	Theme Steak House		TSF	831	0	0	0	7.49	5.02	2.47		0	0	0	0	0	0	0	0.56	0	0	0
69	Kapolei Mauka Residential																					
	Low Density	350	DU	231	0.67	0.17	0.5	0.62	0.42	0.2		235	60	175	217	147	70	0	1	217	147	70
	Total											1352	842	510	1793	780	1013	0		1433	606	827

5/2/2006

Appendix Table B-2

VEHICLE TRIP GENERATION FOR 2015
NON-PROJECT EAST AND SOUTH AREAS

					Trip Generation Rates							Vehicle Trips To/From Area							Trips Less Passbys			
				ITE	AM Peak Hour			PM Peak Hour				AM Peak Hour			PM Peak Hour				PM Peak Hour			
ZONE	Activity	Quantity	Units	Use	Total	In	Out	Total	In	Out	Daily	Total	In	Out	Total	In	Out	Daily	%	Total	In	Out
	Villages of Kapolei																					
23	Village Center																					
	Church	67	TSF	560	0.72	0.39	0.33	0.66	0.36	0.3		48	26	22	44	24	20	0	1	44	24	20
	Shopping Center	67	TSF	820	1.03	0.63	0.4	3.75	1.8	1.95		69	42	27	251	121	131	0	0.58	146	70	76
	Medium Density Apts	290	DU	230	0.44	0.07	0.37	0.54	0.36	0.18		128	20	107	157	104	52	0	1	157	104	52
27	Kapolei Village																					
	Single Family	314	DU	210	0.75	0.19	0.56	1.01	0.65	0.36		236	60	176	317	204	113	0	1	317	204	113
32	NW Commercial																					
	Shopping Center	199.5	TSF	820	1.03	0.63	0.4	3.75	1.8	1.95		205	126	80	748	359	389	0	0.68	509	244	265
	Medium Density Apts	200	DU	230	0.44	0.07	0.37	0.54	0.36	0.18		88	14	74	108	72	36	0	1	108	72	36
33	Kapolei Knolls																					
	Single Family	50	DU	210	0.75	0.19	0.56	1.01	0.65	0.36		38	10	28	51	33	18	0	1	51	33	18
	Total											**811**	**297**	**514**	**1676**	**917**	**759**	**0**		**1331**	**751**	**580**
	Kalaeloa Redevelopment Area																					
56	Central Saratoga Area																					
	Lt. Ind.	10	Acres	110	7.51	6.23	1.28	7.26	1.6	5.66		75	62	13	73	16	57	0	1	73	16	57
	Office	5	TSF	710	1.56	1.37	0.19	1.49	0.25	1.24		8	7	1	7	1	6	0	1	7	1	6
	Specialty Retail	10	TSF	814	0.71	0.43	0.28	2.59	1.11	1.48		7	4	3	26	11	15	0	0.3	8	3	4
	Mid Rise Apt.	200	DU	223	0.3	0.09	0.21	0.39	0.23	0.16		60	18	42	78	46	32	0	1	78	46	32
58	Regional Park	250	Acres	417	0.12	0.07	0.05	0.2	0.09	0.11		30	18	13	50	23	28	0	1	50	23	28
	Mid Rise Apt.	100	DU	223	0.3	0.09	0.21	0.39	0.23	0.16		30	9	21	39	23	16	0	1	39	23	16
57	Enterprise Voc Sch	25	Emp	540	2.85	2.28	0.57	3.12	1.78	1.34		71	57	14	78	45	34	0	1	78	45	34
84	NW Lt Ind																					
	Lt Ind	0	Acres	110	7.51	6.23	1.28	7.26	1.6	5.66		0	0	0	0	0	0	0	1	0	0	0
	Total											**281**	**175**	**106**	**351**	**164**	**187**	**0**		**333**	**157**	**176**
24	**Makakilo**																					
	Condominiums	329	DU	230	0.44	0.07	0.37	0.54	0.36	0.18		145	23	122	178	118	59	0	1	178	118	59
	Apartments	64	DU	220	0.51	0.1	0.41	0.62	0.4	0.22		33	6	26	40	26	14	0	1	40	26	14
	Single Family	746	DU	210	0.75	0.19	0.56	1.01	0.65	0.36		560	142	418	753	485	269	0	1	753	485	269
	Easter Seals Office	20	TSF	710	1.56	1.37	0.19	1.49	0.25	1.24		31	27	4	30	5	25	0	1	30	5	25
	Total											**788**	**199**	**570**	**1001**	**634**	**367**	**0**		**1001**	**634**	**367**
	Mehana at Kapolei (Schuler)																					
52	Mehana West																					
	Low Density	344	DU	231	0.67	0.17	0.5	0.83	0.47	0.36		230	58	172	286	162	124	0	1	286	162	124
	Medium Density	282	DU	230	0.44	0.07	0.37	0.54	0.36	0.18		124	20	104	152	102	51	0	1.00	152	102	51
	Neighborhood Commercial	10	TSF	820	1.03	0.63	0.4	3.75	1.8	1.95		7	4	3	26	11	15	0	0.30	8	3	4
	Apartments	30	DU	220	0.3	0.09	0.21	0.39	0.23	0.16		9	3	6	12	7	5	0	1	12	7	5
53	Mehana East																					
	Low Density	270	DU	231	0.67	0.17	0.5	0.83	0.47	0.36		181	46	135	224	127	97	0	1	224	127	97
	Medium Density	230	DU	230	0.44	0.07	0.37	0.54	0.36	0.18		101	16	85	124	83	41	0	1	124	83	41
54	Elementary School	650	Studei	520	0.29	0.17	0.12	0.07	0.04	0.03		189	111	78	46	26	20	0	1	46	26	20
	Total											**841**	**258**	**583.4**	**870**	**517**	**353**	**0**		**851.3**	**509**	**342**
	Grand Total											**2702**	**929**	**1773**	**3897**	**2232**	**1665**	**0**		**3516**	**2051**	**1464**

11/11/2006

Appendix Table B-3

VEHICLE TRIP GENERATION FOR 2015
OTHER AREAS WEST OF KAPOLEI

					Trip Generation Rates							Vehicle Trips To/From Area							Trips Less Passbys			
				ITE	AM Peak Hour			PM Peak Hour				AM Peak Hour			PM Peak Hour				PM Peak Hour			
ZONE	Activity	Quantity	Units	Use	Total	In	Out	Total	In	Out	Daily	Total	In	Out	Total	In	Out	Daily	%	Total	In	Out
	Kapolei Business Park																					
25	Ind. Park Phase 1	37	Acres	130	8.55	7.1	1.45	8.84	1.86	6.98	63.1	316	263	54	327	69	258	2335	1	327	69	258
91	Ind. Park Phase 2	46.4	Acres	130	8.55	7.1	1.45	8.84	1.86	6.98	63.1	397	329	67	410	86	324	2928	1	410	86	324
	Total											**713**	**592**	**121**	**737**	**155**	**582**	**5263 0**		**737**	**155**	**582**
	Barbers Pt. Harbor																					
28	Lt. Ind.	155	Veh Trips	110	1	0.81	0.19	0	0	0		155	126	29	0	0	0	0	1	0	0	0
		125	Veh Trips		0	0	0	1	0.32	0.68		0	0	0	125	40	85	0	1	125	40	85
	Kalaeloa I-2																					
92	I-2 Mauka	43	Acres	130	8.55	7.1	1.45	8.84	1.86	6.98	63.1	368	305	62	380	80	300	2714	1	380	80	300
70	I-2 Makai Studios	360	Employees		0.87	0.82	0.05	1.11	0.17	0.94		313	295	18	400	61	338	0	1.00	400	61	338
	I-2 Central	42	Acres	130	8.55	7.1	1.45	8.84	1.86	6.98	63.1	359	298	61	371	78	293	2651	1	371	78	293
	Total											**1040**	**899**	**141**	**1151**	**219**	**932**	**5364 0**		**1151**	**219**	**932**
	Harborside Center																					
88	Northeast 1,2,3	23.7	Acres	130	8.55	7.1	1.45	8.84	1.86	6.98	63.1	203	168	34	210	44	165	1496	1.00	210	44	165
88	Northwest 19	0	Acres	130	8.55	7.1	1.45	8.84	1.86	6.98	63.1	0	0	0	0	0	0	0	1.00	0	0	0
78	East Central 4,5	40.9	Acres	130	8.55	7.1	1.45	8.84	1.86	6.98	63.1	350	290	59	362	76	285	2581	1.00	362	76	285
78	West Central 17, 18	25	Acres	130	8.55	7.1	1.45	8.84	1.86	6.98	63.1	214	178	36	221	47	175	1578	1.00	221	47	175
89	Southwest 6, 7, 12-15	27.4	Acres	130	8.55	7.1	1.45	8.84	1.86	6.98	63.1	234	195	40	242	51	191	1729	1.00	242	51	191
89	West Central 16	8.1	Acres	130	8.55	7.1	1.45	8.84	1.86	6.98	63.1	69	58	12	72	15	57	511	1.00	72	15	57
90	Southeast 8, 9	0	Acres	130	8.55	7.1	1.45	8.84	1.86	6.98	63.1	0	0	0	0	0	0	0	1.00	0	0	0
	Total	125.1										1070	888	181	1106	233	873	7895 0		1106	233	873
83	**Maritime Ind**	10	Acres	120	1.98	1.64	0.34	2.16	0.48	1.68	6.75	20	16	3	22	5	17	68	1	22	5	17
93	Hawaii Raceway Ind Park	33	Acres	130	8.55	7.1	1.45	8.84	1.86	6.98	63.1	282	234	48	292	61	230	2083	1	292	61	230
	Total Kalaeloa Area											**3280**	**2755**	**524**	**3432**	**713**	**2719**	**20673 0**		**3432**	**713**	**2719**
	Ko Olina																					
61	Resort Beach Areas																					
	Hotel	690	Rooms	330	0.31	0.22	0.09	0.42	0.18	0.24		214	152	62	290	124	166	0	1	290	124	166
62	Olani St Hotel	300	Rooms	330	0.31	0.22	0.09	0.42	0.18	0.24		93	66	27	126	54	72	0	1	126	54	72
63	Coconut Plantation/Centex																					
	Single Family	60	DU	210	0.75	0.19	0.56	1.01	0.65	0.36		45	11	34	61	39	22	0	1	60.6	39	21.6
	Medium Density	390	DU	230	0.44	0.07	0.37	0.54	0.36	0.18		172	27	144	211	140	70	0	1	211	140	70.2
64	Medium Density	110	DU	230	0.44	0.07	0.37	0.54	0.36	0.18		48	8	41	59	40	20	0	1	59.4	39.6	19.8
65	Marina Area																					
	Marriott Timeshares	470	DU	330	0.31	0.22	0.09	0.42	0.18	0.24		146	103	42	197	85	113	0	1	197	85	113
	Aquarium	25	Veh Trips		1	0.87	0.13	0	0	0		25	22	3	0	0	0	0	1	0	0	0
		180	Veh Trips		0	0	0	1	0.44	0.56		0	0	0	180	79	101	0	1	180	79	101
67	Hillside Villas Low D	174	DU	231	0.67	0.17	0.5	0.62	0.42	0.2		117	30	87	108	73	35	0	1	108	73.1	34.8
	Total											**859**	**419**	**440**	**1232**	**634**	**598**	**0 0**		**1232**	**634**	**598**
	Grand Total											**4139**	**3174**	**965**	**4664**	**1347**	**3317**	**20673 0**		**4664**	**1347**	**3317**

7/6/2006

Appendix Table B-4

VEHICLE TRIP GENERATION FOR 2015
KAPOLEI CCOMMONS AND WEST KAPOLEI AREAS

					Trip Generation Rates							Vehicle Trips To/From Area							Trips Less Passbys			
				ITE	AM Peak Hour			PM Peak Hour				AM Peak Hour			PM Peak Hour				PM Peak Hour			
ZONE	Activity	Quantity	Units	Use	Total	In	Out	Total	In	Out	Daily	Total	In	Out	Total	In	Out	Daily	%	Total	In	Out
	Kapolei Commons																					
10	Kap Commons Zoned Area																					
	Shopping Center	207	TSF	820	1.03	0.63	0.4	3.6	1.72	1.88	42.9	213	130	83	745	356	389	8884	0.75	559	267	292
	Subtotal Zoned Land											213	130	83	745	356	389	8884		559	267	292
66	Kapolei Commons Unzoned																					
	Shopping Center	159.4	TSF	820	1.03	0.63	0.4	3.6	1.72	1.88	42.9	164	100	64	574	274	300	6841	0.75	430	206	225
	Discount Store	123.8	TSF	815	0.84	0.57	0.27	4.86	2.42	2.44	56	104	71	33	602	300	302	6935	0.75	451	225	227
	Office	50	TSF	710	1.56	1.37	0.19	1.11	0.17	0.94	11	78	69	10	56	9	47	551	1.00	56	9	47
	Theater	2000	Seats	445	0	0	0	0.08	0.03	0.05	1.76	0	0	0	160	60	100	3520	1.00	160	60	100
	Med Density Condos	300	DU	230	0.44	0.07	0.37	0.33	0.25	0.08	5.86	132	21	111	99	75	24	1758	1.00	99	75	24
	Subtotal Unzoned Land											478	260	218	1490	717	773	19605		1196	574	622
	Totals Kapolei Commons											**691**	**391**	**300**	**2235**	**1073**	**1162**	**28490**		**1755**	**841**	**914**
	Kapolei West																					
71	"L" Transit/Mixed Use																					
	Resident HiRise Condo	0	DU	232	0.34	0.06	0.28	0.23	0.15	0.08	4.18	0	0	0	0	0	0	0	1.00	0	0	0
	Non-Resident Homes	0	DU	260	0.16	0.1	0.06	0.26	0.11	0.15	3.16	0	0	0	0	0	0	0	1.00	0	0	0
	Office	0	TSF	710	1.56	1.37	0.19	1.37	0.19	1.18	11	0	0	0	0	0	0	0	1	0	0	0
	Retail	0	TSF	820	1.03	0.63	0.4	3.29	1.6	1.69	42.9	0	0	0	0	0	0	0	0.55	0	0	0
	Park-n-Ride	0	Stalls	90	0.75	0.6	0.15	0.62	0.14	0.48	4.5	0	0	0	0	0	0	0	1	0	0	0
72	"A" Residential																					
	Resident HiRise Condo	0	DU	232	0.34	0.06	0.28	0.38	0.24	0.14	4.18	0	0	0	0	0	0	0	1.00	0	0	0
	Non-Resident Condos	0	DU	260	0.16	0.1	0.06	0.26	0.11	0.15	3.16	0	0	0	0	0	0	0	1.00	0	0	0
73	"C" Residential																					
	Primary Resident SF Homes	0	DU	210	0.75	0.19	0.56	1.01	0.65	0.36	9.57	0	0	0	0	0	0	0	1.00	0	0	0
	Non-Resident Homes	0	DU	260	0.16	0.1	0.06	0.26	0.11	0.15	3.16	0	0	0	0	0	0	0	1.00	0	0	0
74	"B" Residential																					
	Primary Resident 2/4/6-plexes	77	DU	210	0.75	0.19	0.56	1.01	0.65	0.36	9.57	58	15	43	78	50	28	737	1.00	78	50	28
	Non-Resident Homes	180	DU	260	0.16	0.1	0.06	0.26	0.11	0.15	3.16	29	18	11	47	20	27	569	1.00	47	20	27
75	"E" Residential																					
	Primary Resident 2/4/6-plexes	38	DU	210	0.75	0.19	0.56	1.01	0.65	0.36	9.57	29	7	21	38	25	14	364	1.00	38	25	14
	Non-Resident Homes	89	DU	260	0.16	0.1	0.06	0.26	0.11	0.15	3.16	14	9	5	23	10	13	281	1.00	23	10	13
76	"D, I, J" Residential																					
	Resident LowRise Condo/TH	287	DU	231	0.67	0.17	0.5	0.78	0.45	0.33	8.85	192	49	144	224	129	95	2540	1.00	224	129	95
	Non-Resident Condos/TH	51	DU	260	0.16	0.1	0.06	0.26	0.11	0.15	3.16	8	5	3	13	6	8	161	1.00	13	6	8
77	" F, G, H" Residential																					
	Resident 3/4-Floor Condo/TH	186	DU	232	0.34	0.06	0.28	0.38	0.24	0.14	4.18	63	11	52	71	45	26	777	1.00	71	45	26
	Non-Resident Condos/TH	433	DU	260	0.16	0.1	0.06	0.26	0.11	0.15	3.16	69	43	26	113	48	65	1368	1.00	113	48	65
94	Middle School	600	Student	522	0.53	0.29	0.24	0.15	0.08	0.07	1.62	318	174	144	90	48	42	972	1.00	90	48	42
95	Golf Course	18	Holes	430	3.01	1.41	1.6	3.56	1.53	2.03	35.7	54	25	29	64	28	37	643	1.00	64	28	37
	Neighborhood Commercial	0	TSF	820	1.03	0.63	0.4	3.75	1.8	1.95	42.9	0	0	0	0	0	0	0	0.40	0	0	0
	Total											**834**	**356**	**478**	**761**	**407**	**354**	**8413**		**761**	**407**	**354**
	Grand Total											**1526**	**747**	**778**	**2996**	**1480**	**1516**	**36902**		**2516**	**1248**	**1268**

11/14/2006

Appendix Table B-5

VEHICLE TRIP GENERATION FOR 2015
KAPOLEI REZONING PARCELS 1, 2 & 3

ZONE	Activity	Quantity	Units	ITE Use	Trip Generation Rates: AM Peak Hour Total	In	Out	PM Peak Hour Total	In	Out	Daily	Vehicle Trips To/From Area: AM Peak Hour Total	In	Out	PM Peak Hour Total	In	Out	Daily	Trips Less Passbys: PM Peak Hour %	Total	In	Out
	Parcel 1																					
8	Civic Center																					
	Court Bldg	120	TSF		2.38	2.16	0.22	2.2	0.2	2	7.62	286	259	26	264	24	240	914	1	264	24	240
	Juvenile Detention Ctr	21	Trips		1	0.67	0.33	0.57	0.14	0.38		21	14	7	12	3	8	0	1	12	3	8
20	South Kalaeloa Costco	160	TSF	815	0.84	0.57	0.27	5.06	2.53	2.53		134	91	43	810	405	405	0	0.65	526	263	263
34	Generic Office	0	TSF	710	1.56	1.37	0.19	1.49	0.25	1.24		0	0	0	0	0	0	0	1	0	0	0
	Spec. Commercial	30	TSF	814	0.71	0.43	0.28	2.59	1.11	1.48		21	13	8	78	33	44	0	0.4	31	13	18
	Park-n-Ride	100	Stalls	90	0.75	0.6	0.15	0.62	0.14	0.48	4.5	75	60	15	62	14	48	450	1	62	14	48
35	Generic Office	30	TSF	710	1.56	1.37	0.19	1.49	0.25	1.24		47	41	6	45	8	37	0	1	45	8	37
36	Spec. Commercial	130	TSF	814	0.71	0.43	0.28	2.59	1.11	1.48		92	56	36	337	144	192	0	0.63	212	91	121
	Mid rise Apts	300	DU	223	0.3	0.09	0.21	0.39	0.23	0.16		90	27	63	117	69	48	0	1	117	69	48
37	Generic A4 Office	65	TSF	710	1.56	1.37	0.19	1.49	0.25	1.24		101	89	12	97	16	81	0	1	97	16	81
39	Generic A6 Office	65	TSF	710	1.56	1.37	0.19	1.49	0.25	1.24		101	89	12	97	16	81	0	1	97	16	81
40	Kamaaha N1 Office	39	TSF	710	1.56	1.37	0.19	1.49	0.25	1.24		61	53	7	58	10	48	0	1	58	10	48
49	Generic D3 Office	100	TSF	710	1.56	1.37	0.19	1.49	0.25	1.24		156	137	19	149	25	124	0	1	149	25	124
50	Generic B1 Retail	170	TSF	814	0.71	0.43	0.28	2.59	1.11	1.48		121	73	48	440	189	252	0	0.65	286	123	164
51	Generic B2 Retail	195	TSF	814	0.71	0.43	0.28	2.59	1.11	1.48		138	84	55	505	216	289	0	0.67	338	145	193
55	Generic B3 Retail	100	TSF	814	0.71	0.43	0.28	2.59	1.11	1.48		71	43	28	259	111	148	0	0.62	161	69	92
60	Generic D1 Office	250	TSF	710	1.56	1.37	0.19	1.49	0.25	1.24		390	343	48	373	63	310	0	1	373	63	310
	Total											**1906**	**1472**	**433.8**	**3701**	**1346**	**2355**	**1364**		**2828**	**951**	**1875**
	Parcel 2																					
21	North Kalaeloa Retail	120	TSF	820	1.03	0.63	0.4	3.75	1.8	1.95		124	76	48	450	216	234	0	0.62	279	134	145
	Total											**124**	**76**	**48**	**450**	**216**	**234**	**0**		**279**	**134**	**145**
	Parcel 3 Farrington																					
31	NE Discount Store	156	TSF	815	0.84	0.57	0.27	5.06	2.53	2.53		131	89	42	789	395	395	0	0.67	529	264	264
	Restaurant	6	TSF	931	0.81	0.66	0.15	7.49	5.02	2.47		5	4	1	45	30	15	0	0.67	30	20	10
	Shopping Ctr Retail	19	TSF	820	1.03	0.63	0.4	3.75	1.8	1.95		20	12	8	71	34	37	0	0.67	48	23	25
	Total											**155**	**105**	**51**	**906**	**459**	**447**			**607**	**308**	**299**
	Grand Total											**2185**	**1653**	**532.5**	**5057**	**2021**	**3035**	**1364**		**3713**	**1392**	**2320**

11/11/2006

Table B-6

VEHICLE TRIP GENERATION FOR 2015
MAKAIWA HILLS
With NonResident Homes

ZONE	Activity	Quantity	Units	ITE Use	Trip Generation Rates: AM Peak Hour Total	In	Out	PM Peak Hour Total	In	Out	Daily	Vehicle Trips To/From Area: AM Peak Hour Total	In	Out	PM Peak Hour Total	In	Out	Daily	Trips Less Passbys: PM Peak Hour %	Total	In	Out
68	**Makaiwa Central Res**																					
	Single Family	291	DU	210	0.75	0.19	0.56	1.01	0.65	0.36	9.57	218	55	163	294	189	105	2785	1	294	189	105
	Duplexes	216	DU	231	0.67	0.17	0.5	0.83	0.47	0.36	7.9	145	37	108	179	102	78	1706	1	179	102	78
	Non Resident Homes	30	DU	260	0.16	0.1	0.06	0.26	0.11	0.15	3.16	5	3	2	8	3	5	95	1	8	3	5
												368	**95**	**273**	**481**	**294**	**187**	**4586**		**481**	**294**	**187**
79	**Makaiwa E Mauka**																					
	Single Family	0	DU	210	0.75	0.19	0.56	1.01	0.65	0.36	9.57	0	0	0	0	0	0	0	1	0	0	0
	Low Density	0	DU	231	0.67	0.17	0.5	0.83	0.47	0.36	7.9	0	0	0	0	0	0	0	1	0	0	0
	Non Resident Homes	0	DU	260	0.16	0.1	0.06	0.26	0.11	0.15	3.16	0	0	0	0	0	0	0	1	0	0	0
	Total											**0**	**0**	**0**	**0**	**0**	**0**	**0**		**0**	**0**	**0**
80	**Makaiwa Commercial**																					
	Shopping Center	0	TSF	820	1.03	0.63	0.4	3.75	1.8	1.95	42.9	0	0	0	0	0	0	0	0.65	0	0	0
	Townhouse-Condo 6plex	327	DU	230	0.44	0.07	0.37	0.54	0.36	0.18	5.86	144	23	121	177	118	59	1916	1	177	118	59
	Elementary School	650	Student	520	0.29	0.17	0.12	0.07	0.04	0.03	1.29	189	111	78	46	26	20	839	1	46	26	20
	Total											**332**	**133**	**199**	**222**	**144**	**78**	**2755**		**222**	**144**	**78**
81	**Makaiwa SE Res**																					
	MF Duplex-Zoned	98	DU	231	0.67	0.17	0.5	0.83	0.47	0.36	7.9	66	17	49	81	46	35	774	1	81	46	35
	Single Family-Zoned	33	DU	210	0.75	0.19	0.56	1.01	0.65	0.36	9.57	25	6	18	33	21	12	316	1	33	21	12
	MF - 4plex	24	DU	231	0.67	0.17	0.5	0.83	0.47	0.36	7.9	16	4	12	20	11	9	190	1	20	11	9
	Single Family	162	DU	210	0.75	0.19	0.56	1.01	0.65	0.36	9.57	122	31	91	164	105	58	1550	1	164	105.3	58.3
	Total											**228**	**58**	**170**	**298**	**184**	**114**	**2830**		**298**	**184**	**114**
82	**Makaiwa SW Res**																					
	MF 2-3 Flrs	0	DU	230	0.44	0.07	0.37	0.54	0.36	0.18	5.86	0	0	0	0	0	0	0	1	0	0	0
	Non Resident Homes	0	DU	260	0.16	0.1	0.06	0.26	0.11	0.15	3.16	0	0	0	0	0	0	0	1	0	0	0
	Neighborhood Commercia	0	TSF	820	1.03	0.63	0.4	3.75	1.8	1.95	42.9	0	0	0	0	0	0	0	0.45	0	0	0
	Total											**0**	**0**	**0**	**0**	**0**	**0**	**0**		**0**	**0**	**0**
85	**Makaiwa E Midlevel Res**																					
	Single Family	224	DU	210	0.75	0.19	0.56	1.01	0.65	0.36	9.57	168	43	125	226	146	81	2144	1	226	145.6	80.6
	MF - Duplex	16	DU	231	0.67	0.17	0.5	0.83	0.47	0.36	7.9	11	3	8	13	8	6	126	1	13	8	6
	Total											**179**	**45**	**133**	**240**	**153**	**86**	**2270**		**240**	**153**	**86**
86	**Makaiwa Village Ctr**																					
	High Rise Condo	923	DU	232	0.34	0.07	0.27	0.36	0.23	0.13	4.18	314	65	249	332	212	120	3858	1	332	212	120
	MF 4-plex	72	DU	230	0.44	0.07	0.37	0.54	0.36	0.18	5.86	32	5	27	39	26	13	422	1	39	26	13
	Village Offices	25	TSF	710	1.56	1.37	0.19	1.29	0.13	1.16	11	39	34	5	32	3	29	275	1	32	3	29
	Village Commercial	40	TSF	820	1.03	0.63	0.4	3.29	1.62	1.67	42.9	41	25	16	132	65	67	1717	0.45	59	29	30
	Total											**426**	**129**	**297**	**535**	**306**	**229**	**6272**		**463**	**271**	**192**
87	**Makaiwa W Mauka**																					
	Single Family	0	DU	210	0.75	0.19	0.56	1.01	0.65	0.36	9.57	0	0	0	0	0	0	0	1	0	0	0
	Low Density	0	DU	231	0.67	0.17	0.5	0.83	0.47	0.36	7.9	0	0	0	0	0	0	0	1	0	0	0
	Non Resident Homes	0	DU	260	0.16	0.1	0.06	0.26	0.11	0.15	3.16	0	0	0	0	0	0	0	1	0	0	0
	Total											**0**	**0**	**0**	**0**	**0**	**0**	**0**		**0**	**0**	**0**
	Grand Total											**1533**	**461**	**1072**	**1776**	**1081**	**695**	**18713**		**1703**	**1046**	**658**

11/13/2006

Appendix Table C-1

DISTRIBUTION OF VEHICLE TRIPS
2015-2030

Subarea or Cordon Sta.	Gate	Commercial AM	Commercial PM	Residential East AM	Residential East PM	Residential West AM	Residential West PM	Recreation Uses Emp	Recreation Uses Guest	Industrial/Harbor AM	Industrial/Harbor PM	Resort AM	Resort PM
		Percent of Trips For Land Use Types to/from Subareas and Cordon Entry/Exit Stations											
H-1 Fwy West	1	4.0	5.0	4.0	2.5	14.0	9.0	11.0	8.0	8.0	6.0	10.0	12.0
H-1 Fwy East	2	28.0	26.0	44.0	41.0	40.0	36.0	28.0	79.0	26.0	22.0	30.0	28.0
Makakilo Dr	3	3.5	3.0	8.0	8.0	1.0	1.5	4.0	2.0	3.0	2.5	2.0	1.5
Farrington Hwy East	5	7.0	6.0	5.0	4.0	2.0	2.0	5.0	1.0	3.0	3.0	1.0	0.0
Kapolei Pkwy East	6	15.0	12.0	6.0	6.0	2.0	3.0	15.0	2.0	12.0	10.0	6.0	4.0
Kalaeloa Blvd South	7	6.0	8.0	5.0	7.0	8.0	9.0	6.0	0.0	16.0	20.0	3.0	5.0
Kapolei West	9	3.0	3.0	1.0	1.5	6.0	7.0	3.0	1.0	5.0	7.0	12.0	10.0
Villages of Kapolei	10	6.0	5.0	4.0	8.0	1.0	1.0	8.0	2.0	4.0	4.0	3.0	1.5
Kapolei Power Ctr Area	11	3.0	4.0	3.0	3.0	1.0	2.0	2.0	0.0	2.0	3.0	1.0	2.0
Kapolei Shop Ctr Area	12	3.0	4.0	3.0	3.0	1.0	1.0	2.0	0.0	2.0	2.0	1.0	1.0
Roosevelt East	14	4.0	2.0	0.0	0.0	0.0	1.0	4.0	0.0	4.0	3.0	1.0	0.0
Kalaeloa Redev.	15	2.5	2.0	2.0	2.0	1.0	0.5	2.0	0.0	2.0	2.0	2.0	1.0
Kapolei Office Core	16	10.0	14.0	12.0	10.0	7.0	10.0	5.0	0.0	8.0	10.0	5.0	6.0
Ko Olina	17	2.0	3.0	2.0	2.0	8.0	9.0	2.0	3.0	2.0	2.5	17.0	22.0
Makaiwa Hills	20	3.0	3.0	1.0	2.0	8.0	8.0	3.0	2.0	3.0	3.0	6.0	6.0
Totals		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

10/26/2005

Appendix Table D-1

VEHICLE TRIP GENERATION FOR 2020
NON-PROJECT LAND USES WITHIN CITY OF KAPOLEI

					Trip Generation Rates							Vehicle Trips To/From Area							Trips Less Passbys			
				ITE	AM Peak Hour			PM Peak Hour				AM Peak Hour			PM Peak Hour				PM Peak Hour			
ZONE	Activity	Quantity	Units	Use	Total	In	Out	Total	In	Out	Daily	Total	In	Out	Total	In	Out	Daily	%	Total	In	Out
4	Kapowai Place	17	TSF	710	1.56	1.37	0.19	1.49	0.25	1.24		27	23	3	25	4	21	0	1	25	4	21
10	Kalaeloa West Retail		TSF	820	1.03	0.63	0.4	3.75	1.8	1.95		0	0	0	0	0	0	0	0.65	0	0	0
11	Advertiser Printing		Emp Trips		0.5	0.4	0.11	1	0.25	0.75		0	0	0	0	0	0	0	1	0	0	0
12	Kapolei Power Ctr Retail	130	TSF	820	1.03	0.63	0.4	3.75	1.8	1.95		134	82	52	488	234	254	0	0.62	302	145	157
	Ministorage	75	TSF	151	0.15	0.09	0.06	0.26	0.13	0.13	2.5	11	7	5	20	10	10	188	1	20	10	10
	FHB Office	7	TSF	710	1.56	1.37	0.19	1.49	0.25	1.24		11	10	1	10	2	9	0	1			
15	Library																					
	Public Library		TSF	590	1	0.72	0.28	7.09	3.4	3.69		0	0	0	0	0	0	0	1	0	0	0
	Library Distribution	5	TSF	590	1	0.82	0.18	4.76	2.19	2.57		5	4	1	24	11	13	0	1	24	11	13
16	Civic Center	50	Emp	710	0.48	0.42	0.06	0.46	0.08	0.38		24	21	3	23	4	19	0	1	23	4	19
17	Ai / Chun Retail	25	TSF	814	0.71	0.43	0.28	2.59	1.11	1.48		18	11	7	65	28	37	0	0.35	23	10	13
18	Uluohia																					
	Retail	6	TSF	814	0.71	0.43	0.28	2.59	1.11	1.48		4	3	2	16	7	9	0	0.3	5	2	3
	Quality Resturant		TSF	931	0	0	0	7.49	5.02	2.47		0	0	0	0	0	0	0	0.56	0	0	0
	Lot 56 Restaurant	6	TSF	931	0	0	0	7.49	5.02	2.47		0	0	0	45	30	15	0	0.56	25	17	8
30	Sr Village Ph I/ Ph II	187	Veh. Trips		0.42	0.24	0.18	1	0.51	0.49		79	45	34	187	95	92	0	1	187	95	92
38	Generic A5 Office	65	TSF	710	1.56	1.37	0.19	1.49	0.25	1.24		101	89	12	97	16	81	0	1	97	16	81
41	Kamaaha N2 Office	39	TSF	710	1.56	1.37	0.19	1.49	0.25	1.24		61	53	7	58	10	48	0	1	58	10	48
42	Kamaaha N3																					
	Office	39	TSF	710	1.56	1.37	0.19	1.49	0.25	1.24		61	53	7	58	10	48	0	1	58	10	48
	Island Pacific Academy	400	Students	521	0.92	0.55	0.37	0.2	0.08	0.12		368	220	148	80	32	48	0	1	80	32	48
43	YMCA	40	TSF	495	1.32	0.87	0.45	1.75	0.6	1.15		53	35	18	70	24	46	0	0.9	63	22	41
44	Block 58 Road E Office	40	TSF	710	1.56	1.37	0.19	1.49	0.25	1.24		62	55	8	60	10	50	0	1	60	10	50
45	Block 59 Road E Ofice	48	TSF	710	1.56	1.37	0.19	1.49	0.25	1.24		75	66	9	72	12	60	0	1	72	12	60
46	Pad A Bank Drive-thru	3	TSF	912	12.63	7.07	5.56	54.78	27.39	27.4		38	21	17	164	82	82		0.53	87	44	44
48	Kapolei Power Ctr West																					
	Home Depot		TSF	862	1.48	0.8	0.68	2.87	1.35	1.52		0	0	0	0	0	0	0	0.52	0	0	0
	Ace Hardware		TSF	816	1.08	0.5	0.58	4.42	2.12	2.3		0	0	0	0	0	0	0	0.35	0	0	0
	Retail	15	TSF	814	0.71	0.43	0.28	2.59	1.11	1.48		11	6	4	39	17	22	0	0.35	14	6	8
	Theme Steak House		TSF	831	0	0	0	7.49	5.02	2.47		0	0	0	0	0	0	0	0.56	0	0	0
69	Kapolei Mauka Residential																					
	Low Density	350	DU	231	0.67	0.17	0.5	0.62	0.42	0.2		235	60	175	217	147	70	0	1	217	147	70
	Total											**1376**	**863**	**513**	**1816**	**784**	**1032**	**188**		**1438**	**606**	**833**

11/7/2006

Appendix Table D-2

VEHICLE TRIP GENERATION FOR 2020
NON-PROJECT EAST AND SOUTH AREAS

					Trip Generation Rates							Vehicle Trips To/From Area							Trips Less Passbys			
				ITE	AM Peak Hour			PM Peak Hour				AM Peak Hour			PM Peak Hour				PM Peak Hour			
ZONE	Activity	Quantity	Units	Use	Total	In	Out	Total	In	Out	Daily	Total	In	Out	Total	In	Out	Daily	%	Total	In	Out
	Villages of Kapolei																					
23	Village Center																					
	Church	67	TSF	560	0.72	0.39	0.33	0.66	0.36	0.3		48	26	22	44	24	20	0	1	44	24	20
	Shopping Center	67	TSF	820	1.03	0.63	0.4	3.75	1.8	1.95		69	42	27	251	121	131	0	0.58	146	70	76
	Medium Density Apts	290	DU	230	0.44	0.07	0.37	0.54	0.36	0.18		128	20	107	157	104	52	0	1	157	104	52
27	Kapolei Village																					
	Single Family	314	DU	210	0.75	0.19	0.56	1.01	0.65	0.36		236	60	176	317	204	113	0	1	317	204	113
32	NW Commercial																					
	Shopping Center	199.5	TSF	820	1.03	0.63	0.4	3.75	1.8	1.95		205	126	80	748	359	389	0	0.68	509	244	265
	Medium Density Apts	200	DU	230	0.44	0.07	0.37	0.54	0.36	0.18		88	14	74	108	72	36	0	1	108	72	36
33	Kapolei Knolls																					
	Single Family	50	DU	210	0.75	0.19	0.56	1.01	0.65	0.36		38	10	28	51	33	18	0	1	51	33	18
	Total											**811**	**297**	**514**	**1676**	**917**	**759**	**0**		**1331**	**751**	**580**
	Kalaeloa Redevelopment Area																					
56	Central Saratoga Area																					
	Lt. Ind.	10	Acres	110	7.51	6.23	1.28	7.26	1.6	5.66		75	62	13	73	16	57	0	1	73	16	57
	Office	10	TSF	710	1.56	1.37	0.19	1.49	0.25	1.24		16	14	2	15	3	12	0	1	15	3	12
	Specialty Retail	15	TSF	814	0.71	0.43	0.28	2.59	1.11	1.48		11	6	4	39	17	22	0	0.55	21	9	12
	Mid Rise Apt. -	400	DU	223	0.3	0.09	0.21	0.39	0.23	0.16		120	36	84	156	92	64	0	1	156	92	64
58	Regional Park	250	Acres	417	0.12	0.07	0.05	0.2	0.09	0.11		30	18	13	50	23	28	0	1	50	23	28
	Mid Rise Apt.	200	DU	223	0.3	0.09	0.21	0.39	0.23	0.16		60	18	42	78	46	32	0	1	78	46	32
57	Enterprise Voc Sch	25	Emp	540	2.85	2.28	0.57	3.12	1.78	1.34		71	57	14	78	45	34	0	1	78	45	34
84	NW Lt Ind																					
	Lt Ind	10	Acres	110	7.51	6.23	1.28	7.26	1.6	5.66		75	62	13	73	16	57	0	1	73	16	57
	Total											**458**	**273**	**184**	**561**	**256**	**305**	**0**		**543**	**249**	**295**
24	**Makakilo**																					
	Condominiums	329	DU	230	0.44	0.07	0.37	0.54	0.36	0.18		145	23	122	178	118	59	0	1	178	118	59
	Apartments	64	DU	220	0.51	0.1	0.41	0.62	0.4	0.22		33	6	26	40	26	14	0	1	40	26	14
	Single Family	746	DU	210	0.75	0.19	0.56	1.01	0.65	0.36		560	142	418	753	485	269	0	1	753	485	269
	Easter Seals Office	20	TSF	710	1.56	1.37	0.19	1.49	0.25	1.24		31	27	4	30	5	25	0	1	30	5	25
	Total											**768**	**199**	**570**	**1001**	**634**	**367**	**0**		**1001**	**634**	**367**
	Mehana at Kapolei (Schuler)																					
52	Mehana West																					
	Low Density	344	DU	231	0.67	0.17	0.5	0.83	0.47	0.36		230	58	172	286	162	124	0	1	286	162	124
	Medium Density	282	DU	230	0.44	0.07	0.37	0.54	0.36	0.18		124	20	104	152	102	51	0	1.00	152	102	51
	Neighborhood Commercial	10	TSF	814	0.71	0.43	0.28	2.59	1.11	1.48		7	4	3	26	11	15	0	0.30	8	3	4
	Apartments	30	DU	220	0.3	0.09	0.21	0.39	0.23	0.16		9	3	6	12	7	5	0	1	12	7	5
53	Mehana East																					
	Low Density	270	DU	231	0.67	0.17	0.5	0.83	0.47	0.36		181	46	135	224	127	97	0	1	224	127	97
	Medium Density	230	DU	230	0.44	0.07	0.37	0.54	0.36	0.18		101	16	85	124	83	41	0	1	124	83	41
54	Elementary School	650	Studer	520	0.29	0.17	0.12	0.07	0.04	0.03		189	111	78	46	26	20	0	1	46	26	20
	Total											**841**	**258**	**583.4**	**870**	**517**	**353**	**0**		**851.3**	**509**	**342**
	Grand Total											**2878**	**1027**	**1851**	**4107**	**2324**	**1783**	**0**		**3726**	**2143**	**1583**

4/24/2006

Appendix Table D-3

VEHICLE TRIP GENERATION FOR 2020
OTHER AREAS WEST OF KAPOLEI

				Trip Generation Rates								Vehicle Trips To/From Area							Trips Less Passbys			
				ITE	I Peak Hour			PM Peak Hour				AM Peak Hour			PM Peak Hour				PM Peak Hour			
ZONE	Activity	Quantity	Units	Use	Total	In	Out	Total	In	Out	Daily	Total	In	Out	Total	In	Out	Daily	%	Total	In	Out
	Kapolei Business Park																					
25	Ind. Park Phase 1	67	Acres	130	8.55	7.1	1.45	8.84	1.86	6.98	63.1	573	476	97	592	125	468	4228	1.00	592	125	468
91	Ind. Park Phase 2	46.4	Acres	130	8.55	7.1	1.45	8.84	1.86	6.98	63.1	397	329	67	410	86	324	2928	1.00	410	86	324
	Total											970	805	164	1002	211	792	7157 0		1002	211	792
	Barbers Pt. Harbor																					
28	Lt. Ind.	232	Veh Trips	110	1	0.81	0.19	0	0	0		232	188	44	0	0	0	0	1.00	0	0	0
		190	Veh Trips	110	0	0	0	1	0.32	0.68		0	0	0	190	61	129	0	1.00	190	61	129
	Kalaeloa Blvd West																					
92	Kalaeloa W Mauka I-2	43	Acres	130	8.55	7.1	1.45	8.84	1.86	6.98	63.1	368	305	62	380	80	300	2714	1.00	380	80	300
70	Studios	360	Employees		0.87	0.82	0.05	1.11	0.17	0.94		313	295	18	400	61	338	0	1.00	400	61	338
	Kalaeloa W Center I-2	42	Acres	130	8.55	7.1	1.45	8.84	1.86	6.98	63.1	359	298	61	371	78	293	2651	1.00	371	78	293
	Total											1040	899	141	1151	219	932	5364 0		1151	219	932
	Kalaeloa West Ind Area																					
88	Northeast 1,2,3	23.7	Acres	130	8.55	7.1	1.45	8.84	1.86	6.98	63.1	203	168	34	210	44	165	1496	1.00	210	44	165
88	Northwest 19	23.6	Acres	130	8.55	7.1	1.45	8.84	1.86	6.98	63.1	202	168	34	209	44	165	1489	1.00	209	44	165
78	East Central 4,5	40.9	Acres	130	8.55	7.1	1.45	8.84	1.86	6.98	63.1	350	290	59	362	76	285	2581	1.00	362	76	285
78	West Central 17, 18	54.9	Acres	130	8.55	7.1	1.45	8.84	1.86	6.98	63.1	469	390	80	485	102	383	3465	1.00	485	102	383
89	Southwest 6, 7, 12-15	79.3	Acres	130	8.55	7.1	1.45	8.84	1.86	6.98	63.1	678	563	115	701	147	554	5005	1.00	701	147	554
89	West Central 16	8.1	Acres	130	8.55	7.1	1.45	8.84	1.86	6.98	63.1	69	58	12	72	15	57	511	1.00	72	15	57
90	Southeast 8, 9	19.2	Acres	130	8.55	7.1	1.45	8.84	1.86	6.98	63.1	164	136	28	170	36	134	1212	1.00	170	36	134
	Total	249.7										2135	1773	362	2207	464	1743	15759 0	7	2207	464	1743
83	Maritime Ind	75	Acres	120	1.98	1.64	0.34	2.16	0.48	1.68	6.75	149	123	26	162	36	126	506	1.00	162	36	126
93	Hawaii Raceway Ind Park	66	Acres	130	8.55	7.1	1.45	8.84	1.86	6.98	63.1	564	469	96	583	123	461	4165	1.00	583	123	461
	Total Kalaeloa Area											**5089**	**4256**	**833**	**5296**	**1114**	**4182**	**32951 0**		**5296**	**1114**	**4182**
	Ko Olina																					
61	Resort Beach Areas																					
	Hotel	1290	Rooms	330	0.31	0.22	0.09	0.42	0.18	0.24		400	284	116	542	232	310	0	1.00	542	232	310
62	Olani St Hotel	300	Rooms	330	0.31	0.22	0.09	0.42	0.18	0.24		93	66	27	126	54	72	0	1.00	126	54	72
63	Coconut Plantation/Centex																					
	Single Family	60	DU	210	0.75	0.19	0.56	1.01	0.65	0.36		45	11	34	61	39	22	0	1.00	61	39	22
	Medium Density	390	DU	230	0.44	0.07	0.37	0.54	0.36	0.18		172	27	144	211	140	70	0	1.00	211	140	70
	Shopping Center	30	TSF	820	1.03	0.63	0.4	3.75	1.8	1.95	42.9	31	19	12	113	54	59	1288	0.35	39	19	20
64	Medium Density	300	DU	230	0.44	0.07	0.37	0.54	0.36	0.18		132	21	111	162	108	54	0	1.00	162	108	54
65	Marina Area																					
	Marriott Timeshares	650	DU	330	0.31	0.22	0.09	0.42	0.18	0.24		202	143	59	273	117	156	0	1.00	273	117	156
	Aquarium	25	Veh Trips		1	0.87	0.13	0	0	0		25	22	3	0	0	0	0	1.00	0	0	0
		180	Veh Trips		0	0	0	1	0.44	0.56		0	0	0	180	79	101	0	1.00	180	79	101
67	Hillside Villas Low D	174	DU	231	0.67	0.17	0.5	0.62	0.42	0.2		117	30	87	108	73	35	0	1.00	108	73	35
	Total											**1215**	**623**	**593**	**1774**	**897**	**878**	**1288 0**		**1701**	**862**	**839**
	Grand Total											**6305**	**4879**	**1426**	**7071**	**2011**	**5060**	**34239 0**		**6997**	**1976**	**5021**

11/7/2006

Appendix Table D-4

VEHICLE TRIP GENERATION FOR 2020
KAPOLEI CCOMMONS AND WEST KAPOLEI AREAS

					Trip Generation Rates							Vehicle Trips To/From Area							Trips Less Passbys			
				ITE	AM Peak Hour			PM Peak Hour				AM Peak Hour			PM Peak Hour				PM Peak Hour			
ZONE	Activity	Quantity	Units	Use	Total	In	Out	Total	In	Out	Daily	Total	In	Out	Total	In	Out	Daily	%	Total	In	Out
	Kapolei Commons																					
10	Kap Commons Zoned Area																					
	Shopping Center	207	TSF	820	1.03	0.63	0.4	3.6	1.72	1.88	42.9	213	130	83	745	356	389	8884	0.75	559	267	292
	Subtotal Zoned Land											213	130	83	745	356	389	8884		559	267	292
66	Kapolei Commons Unzoned																					
	Shopping Center	159.4	TSF	820	1.03	0.63	0.4	3.6	1.72	1.88	42.9	164	100	64	574	274	300	6841	0.75	430	206	225
	Discount Store	123.8	TSF	815	0.84	0.57	0.27	4.86	2.42	2.44	56	104	71	33	602	300	302	6935	0.75	451	225	227
	Office	50	TSF	710	1.56	1.37	0.19	1.11	0.17	0.94	11	78	69	10	56	9	47	551	1.00	56	9	47
	Theater	2000	Seats	445	0	0	0	0.08	0.03	0.05	1.76	0	0	0	160	60	100	3520	1.00	160	60	100
	Med Density Condos	300	DU	230	0.44	0.07	0.37	0.33	0.25	0.08	5.86	132	21	111	99	75	24	1758	1.00	99	75	24
	Subtotal Unzoned Land											478	260	218	1490	717	773	19605		1196	574	622
	Totals Kapolei Commons											**691**	**391**	**300**	**2235**	**1073**	**1162**	**28490**		**1755**	**841**	**914**
	Kapolei West																					
71	"L" Transit/Mixed Use																					
	Resident HiRise Condo	130	DU	232	0.34	0.06	0.28	0.23	0.15	0.08	4.18	44	8	36	30	20	10	543	1.00	30	20	10
	Non-Resident Homes	20	DU	260	0.16	0.1	0.06	0.26	0.11	0.15	3.16	3	2	1	5	2	3	63	1.00	5	2	3
	Office	50	TSF	710	1.56	1.37	0.19	1.37	0.19	1.18	11	78	69	10	69	10	59	550	1	69	10	59
	Retail	50	TSF	820	1.03	0.63	0.4	3.29	1.6	1.69	42.9	52	32	20	165	80	85	2146	0.55	90	44	46
	Park-n-Ride	150	Stalls	90	0.75	0.6	0.15	0.62	0.14	0.48	4.5	113	90	23	93	21	72	675	1	93	21	72
72	"A" Residential																					
	Resident HiRise Condo	360	DU	232	0.34	0.06	0.28	0.38	0.24	0.14	4.18	122	22	101	137	86	50	1505	1.00	137	86	50
	Non-Resident Condos	54	DU	260	0.16	0.1	0.06	0.26	0.11	0.15	3.16	9	5	3	14	6	8	171	1.00	14	6	8
73	"C" Residential																					
	Primary Resident SF Homes	96	DU	210	0.75	0.19	0.56	1.01	0.65	0.36	9.57	72	18	54	97	62	35	919	1.00	97	62	35
	Non-Resident Homes	118	DU	260	0.16	0.1	0.06	0.26	0.11	0.15	3.16	19	12	7	31	13	18	373	1.00	31	13	18
74	"B" Residential																					
	Primary Resident SF Homes	203	DU	210	0.75	0.19	0.56	1.01	0.65	0.36	9.57	152	39	114	205	132	73	1943	1.00	205	132	73
	Non-Resident Homes	87	DU	260	0.16	0.1	0.06	0.26	0.11	0.15	3.16	14	9	5	23	10	13	275	1.00	23	10	13
75	"E" Residential																					
	Primary Resident SF Homes	43	DU	210	0.75	0.19	0.56	1.01	0.65	0.36	9.57	32	8	24	43	28	15	412	1.00	43	28	15
	Non-Resident Homes	101	DU	260	0.16	0.1	0.06	0.26	0.11	0.15	3.16	16	10	6	26	11	15	319	1.00	26	11	15
76	"D, I, J" Residential																					
	Resident LowRise Condo/TH	398	DU	231	0.67	0.17	0.5	0.78	0.45	0.33	8.85	267	68	199	310	179	131	3522	1.00	310	179	131
	Non-Resident Condos/TH	70	DU	260	0.16	0.1	0.06	0.26	0.11	0.15	3.16	11	7	4	18	8	11	221	1.00	18	8	11
77	" F, G, H" Residential																					
	Resident LowRise Condo/TH	215	DU	231	0.67	0.17	0.5	0.78	0.45	0.33	8.85	144	37	108	168	97	71	1903	1.00	168	97	71
	Non-Resident Condos/TH	503	DU	260	0.16	0.1	0.06	0.26	0.11	0.15	3.16	80	50	30	131	55	75	1589	1.00	131	55	75
94	Middle School	600	Student	522	0.53	0.29	0.24	0.15	0.08	0.07	1.62	318	174	144	90	48	42	972	1.00	90	48	42
95	Golf Course	18	Holes	430	3.01	1.41	1.6	3.56	1.53	2.03	35.7	54	25	29	64	28	37	643	1.00	64	28	37
	Neighborhood Commercial	40	TSF	820	1.03	0.63	0.4	3.75	1.8	1.95	42.9	41	25	16	150	72	78	1717	0.50	75	36	39
	Total											**1642**	**708**	**933**	**1868**	**967**	**901**	**20461**		**1719**	**895**	**824**
	Grand Total											**2333**	**1099**	**1234**	**4103**	**2040**	**2063**	**48950**		**3474**	**1736**	**1738**

2/5/2007

Appendix Table D-5

VEHICLE TRIP GENERATION FOR 2020
KAPOLEI REZONING PARCELS 1, 2 & 3

					Trip Generation Rates							Vehicle Trips To/From Area							Trips Less Passbys			
				ITE	AM Peak Hour			PM Peak Hour				AM Peak Hour			PM Peak Hour				PM Peak Hour			
ZONE	Activity	Quantity	Units	Use	Total	In	Out	Total	In	Out	Daily	Total	In	Out	Total	In	Out	Daily	%	Total	In	Out
	Parcel 1																					
8	Civic Center																					
	Court Bldg	120	TSF		2.38	2.16	0.22	2.2	0.2	2	7.62	286	259	26	264	24	240	914	1	264	24	240
	Juvenile Detention Ctr	21	Trips		1	0.67	0.33	0.57	0.14	0.38		21	14	7	12	3	8	0	1	12	3	8
20	South Kalaeloa Costco	160	TSF	815	0.84	0.57	0.27	5.06	2.53	2.53		134	91	43	810	405	405	0	0.65	526	263	263
34	Generic A1 Office	45	TSF	710	1.56	1.37	0.19	1.49	0.25	1.24		70	62	9	67	11	56	0	1	67	11	56
35	Generic Office	0	TSF	710	1.56	1.37	0.19	1.49	0.25	1.24		0	0	0	0	0	0	0	1	0	0	0
	Spec. Commercial	30	TSF	814	0.71	0.43	0.28	2.59	1.11	1.48		21	13	8	78	33	44	0	0.4	31	13	18
	Park-n-Ride	100	Stalls	90	0.75	0.6	0.15	0.62	0.14	0.48	4.5	75	60	15	62	14	48	450	1	62	14	48
36	Spec. Commercial	130	TSF	814	0.71	0.43	0.28	2.59	1.11	1.48		92	56	36	337	144	192	0	0.63	212	91	121
	Mid rise Apts	300	DU	223	0.3	0.09	0.21	0.39	0.23	0.16		90	27	63	117	69	48	0	1	117	69	48
37	Generic A4 Office	65	TSF	710	1.56	1.37	0.19	1.49	0.25	1.24		101	89	12	97	16	81	0	1	97	16	81
39	Generic A6 Office	65	TSF	710	1.56	1.37	0.19	1.49	0.25	1.24		101	89	12	97	16	81	0	1	97	16	81
40	Kamaaha N1 Office	39	TSF	710	1.56	1.37	0.19	1.49	0.25	1.24		61	53	7	58	10	48	0	1	58	10	48
49	Generic D3 Office	100	TSF	710	1.56	1.37	0.19	1.49	0.25	1.24		156	137	19	149	25	124	0	1	149	25	124
50	Generic B1 Retail	170	TSF	814	0.71	0.43	0.28	2.59	1.11	1.48		121	73	48	440	189	252	0	0.65	286	123	164
51	Generic B2 Retail	195	TSF	814	0.71	0.43	0.28	2.59	1.11	1.48		138	84	55	505	216	289	0	0.67	338	145	193
55	Generic B3 Retail	100	TSF	814	0.71	0.43	0.28	2.59	1.11	1.48		71	43	28	259	111	148	0	0.62	161	69	92
60	Generic D1 Office	250	TSF	710	1.56	1.37	0.19	1.49	0.25	1.24		390	343	48	373	63	310	0	1	373	63	310
	Total											**1930**	**1493**	**436.7**	**3724**	**1349**	**2373**	**1364**		**2850**	**955**	**1894**
	Parcel 2																					
21	North Kalaeloa Retail	120	TSF	820	1.03	0.63	0.4	3.75	1.8	1.95		124	76	48	450	216	234	0	0.62	279	134	145
	Total											**124**	**76**	**48**	**450**	**216**	**234**	**0**		**279**	**134**	**145**
	Parcel 3 Farrington																					
31	NE Discount Store	156	TSF	815	0.84	0.57	0.27	5.06	2.53	2.53		131	89	42	789	395	395	0	0.67	529	264	264
	Restaurant	6	TSF	931	0.81	0.66	0.15	7.49	5.02	2.47		5	4	1	45	30	15	0	0.67	30	20	10
	Shopping Ctr Retail	19	TSF	820	1.03	0.63	0.4	3.75	1.8	1.95		20	12	8	71	34	37	0	0.67	48	23	25
	Total											**155**	**105**	**51**	**906**	**459**	**447**			**607**	**308**	**299**
	Grand Total											**2209**	**1673**	**535.3**	**5079**	**2024**	**3054**	**1364**		**3736**	**1396**	**2338**

11/8/2006

Table D-6

VEHICLE TRIP GENERATION FOR 2020
MAKAIWA HILLS
With NonResident Homes

				ITE	Trip Generation Rates							Vehicle Trips To/From Area							Trips Less Passbys			
					AM Peak Hour			PM Peak Hour				AM Peak Hour			PM Peak Hour					PM Peak Hour		
ZONE	Activity	Quantity	Units	Use	Total	In	Out	Total	In	Out	Daily	Total	In	Out	Total	In	Out	Daily	%	Total	In	Out
68	**Makaiwa Central Res**																					
	Single Family	291	DU	210	0.75	0.19	0.56	1.01	0.65	0.36	9.57	218	55	163	294	189	105	2785	1	294	189	105
	Duplexes	216	DU	231	0.67	0.17	0.5	0.83	0.47	0.36	7.9	145	37	108	179	102	78	1706	1	179	102	78
	Non Resident Homes	30	DU	260	0.16	0.1	0.06	0.26	0.11	0.15	3.16	5	3	2	8	3	5	95	1	8	3	5
												368	**95**	**273**	**481**	**294**	**187**	**4586**		**481**	**294**	**187**
79	**Makaiwa E Mauka**																					
	Single Family	296	DU	210	0.75	0.19	0.56	1.01	0.65	0.36	9.57	222	56	166	299	192	107	2833	1	299	192	107
	Low Density	0	DU	231	0.67	0.17	0.5	0.83	0.47	0.36	7.9	0	0	0	0	0	0	0	1	0	0	0
	Non Resident Homes	74	DU	260	0.16	0.1	0.06	0.26	0.11	0.15	3.16	12	7	4	19	8	11	234	1	19	8	11
	Total											**234**	**64**	**170**	**318**	**201**	**118**	**3067**		**318**	**201**	**118**
80	**Makaiwa Commercial**																					
	Shopping Center	150	TSF	820	1.03	0.63	0.4	3.75	1.8	1.95	42.92	155	95	60	563	270	293	6438	0.65	366	176	190
	Townhouse-Condo 6plex	327	DU	230	0.44	0.07	0.37	0.54	0.36	0.18	5.86	144	23	121	177	118	59	1916	1	177	118	59
	Elementary School	950	Student	520	0.29	0.17	0.12	0.07	0.04	0.03	1.29	276	162	114	67	38	29	1226	1	67	38	29
	Total											**574**	**279**	**295**	**806**	**426**	**380**	**9580**		**609**	**331**	**277**
81	**Makaiwa SE Res**																					
	MF Duplex-Zoned	98	DU	231	0.67	0.17	0.5	0.83	0.47	0.36	7.9	66	17	49	81	46	35	774	1	81	46	35
	Single Family-Zoned	33	DU	210	0.75	0.19	0.56	1.01	0.65	0.36	9.57	25	6	18	33	21	12	316	1	33	21	12
	MF - 4plex	24	DU	231	0.67	0.17	0.5	0.83	0.47	0.36	7.9	16	4	12	20	11	9	190	1	20	11	9
	Single Family	162	DU	210	0.75	0.19	0.56	1.01	0.65	0.36	9.57	122	31	91	164	105	58	1550	1	164	105.3	58.3
	Total											**228**	**58**	**170**	**298**	**184**	**114**	**2830**		**298**	**184**	**114**
82	**Makaiwa SW Res**																					
	MF 2-3 Flrs	361	DU	230	0.44	0.07	0.37	0.54	0.36	0.18	5.86	159	25	134	195	130	65	2115	1	195	130	65
	Non Resident Homes	542	DU	260	0.16	0.1	0.06	0.26	0.11	0.15	3.16	87	54	33	141	60	81	1713	1	141	60	81
	Neighborhood Commercia	50	TSF	820	1.03	0.63	0.4	3.75	1.8	1.95	42.92	52	32	20	188	90	98	2146	0.45	84	41	44
	Total											**297**	**111**	**186**	**523**	**280**	**244**	**5974**		**420**	**230**	**190**
85	**Makaiwa E Midlevel Res**																					
	Single Family	224	DU	210	0.75	0.19	0.56	1.01	0.65	0.36	9.57	168	43	125	226	146	81	2144	1	226	145.6	80.6
	MF - Duplex	16	DU	231	0.67	0.17	0.5	0.83	0.47	0.36	7.9	11	3	8	13	8	6	126	1	13	8	6
	Total											**179**	**45**	**133**	**240**	**153**	**86**	**2270**		**240**	**153**	**86**
86	**Makaiwa Village Ctr**																					
	High Rise Condo	923	DU	232	0.34	0.07	0.27	0.36	0.23	0.13	4.18	314	65	249	332	212	120	3858	1	332	212	120
	MF 4-plex	72	DU	230	0.44	0.07	0.37	0.54	0.36	0.18	5.86	32	5	27	39	26	13	422	1	39	26	13
	Village Offices	25	TSF	710	1.56	1.37	0.19	1.29	0.13	1.16	11.01	39	34	5	32	3	29	275	1	32	3	29
	Village Commercial	40	TSF	820	1.03	0.63	0.4	3.29	1.62	1.67	42.92	41	25	16	132	65	67	1717	0.45	59	29	30
	Total											**426**	**129**	**297**	**535**	**306**	**229**	**6272**		**463**	**271**	**192**
87	**Makaiwa W Mauka**																					
	Single Family	434	DU	210	0.75	0.19	0.56	1.01	0.65	0.36	9.57	326	82	243	438	282	156	4153	1	438	282	156
	Low Density	0	DU	231	0.67	0.17	0.5	0.83	0.47	0.36	7.9	0	0	0	0	0	0	0	1	0	0	0
	Non Resident Homes	108	DU	260	0.16	0.1	0.06	0.26	0.11	0.15	3.16	17	11	6	28	12	16	341	1	28	12	16
	Total											**343**	**93**	**250**	**466**	**294**	**172**	**4495**		**466**	**294**	**172**
	Grand Total											**2648**	**874**	**1774**	**3667**	**2137**	**1530**	**39073**		**3295**	**1958**	**1337**

11/11/2006

Bryant T. Brothers
Transportation Engineer
1195 Chanceys Lane
Elizabeth City, NC 27909

September 18, 2007

Mr. Jeffrey Overton
Group 70 International
925 Bethel Street, 5th Floor
Honolulu, HI 96813

Subject: Makaiwa Hills Traffic Impact Analysis Report (TIAR)
Change in Planned Type and Location of Schools

Dear Mr. Overton:

Plans for the Makaiwa Hills development are being revised to include a middle school with approximately 600 students. Associated with this change, the middle school previously planned for the Kapolei West development would be changed to an elementary school and the elementary school in Makaiwa Hills would be reduced in size to 550 students versus the previously planned 950 students. The changes are intended to reduce the potential travel by elementary school students across Farrington Highway from the Kapolei West community to attend the Makaiwa Hills elementary school by providing a school within their neighborhood. This letter describes the general changes that might be expected to the travel patterns and traffic flows from those presented in the TIAR for the Makaiwa Hills development.

Estimated Numbers of Students

The numbers of elementary and middle school students have been estimated for the Makaiwa Hills and Kapolei West developments based on the Hawaii Department of Education (DOE) enrollment calculation factors. These provide an average rate for the number of students residing in typical single-family and multi-family dwellings, with these enrollment factors presented in Table 1.

The enrollment rates were applied to the estimated numbers of resident-occupied dwellings in each development. The total numbers of dwellings units in each community has been reduced by the estimated numbers that are projected to be occupied by persons who are not year-round residents since such units would not be expected to have children enrolled in local schools. Marketing studies have indicated that about 18.6% of the dwellings in Makaiwa Hills and 40.5% of those in Kapolei West may be sold and used by such part-time residents. The dwellings listed in Table 1 reflect the estimated number occupied by year-round residents.

Based on the DOE rates, Makaiwa Hills is estimated to have approximately 319 middle school students and 675 elementary school students residing within the community and Kapolei West a total of 90 and 210 middle and elementary school students, respectively.

Comparison of Students to School Capacities
Table 2 compares the estimated students that would reside within the Makaiwa Hills and Kapolei West communities to the enrollment capacity for the schools in each community. The comparison is made for both the previous plan of school sites, as described in the Draft TIAR, and the present plan for middle and elementary schools in these two communities.

Previous Plan

- The absence of a middle school within Makaiwa Hills would result in an estimated outflow of 319 students from the community, likely to Kapolei West.
- The very large elementary school in Makaiwa Hills would likely attract an inflow into the community of about 275 students, with most of these from Kapolei West.
- About 86% (560) of the Kapolei West middle school students would have to travel into the community from other areas, with a large portion from Makaiwa Hills.
- The Kapolei West elementary school students would have to travel outside the community to school, most likely to Makaiwa Hills.

Present Plan

- The revised location of the middle school to Makaiwa Hills would result in a net inflow of about 281 middle school students into that community. In addition to Kapolei West students, this inflow could largely be comprised of Makakilo students since they must now travel to the Kapolei Middle School. The planned connection of Nohona Street to Makaiwa Hills in the vicinity of the planned middle school site would provide convenient access for those Makakilo residences located west of Makakilo Drive.
- The Makaiwa Hills community would produce an outflow of about 125 elementary students, most likely to the Kapolei West elementary school.
- The estimated 90 Kapolei West middle school students would have to travel outside the community, most likely to Makaiwa Hills.
- The Kapolei West elementary school would have to draw about 340 of its students from outside the community, with many of these likely coming from Makaiwa Hills.

Anticipated Effect on Student Travel Patterns
The effects of the changed plans for the schools on area student travel patterns would likely be as follows:

- The revised plans would reduce the number of students that cross Farrington Highway along Road D, with the estimated reduction of about 200 students in the

morning peak hour. This would be expected to provide a small reduction in vehicle trips along Road D in the morning peak hour from those presented in the Draft TIAR.

- Most of the reduction to the school trips along Road D as a result of the revised plans should be in the numbers of elementary students.

- The location of the middle school close to Makakilo would likely result in attendance by many Makakilo students, which could result in a small reduction in morning student-related trips crossing the H-1 Freeway along Makakilo Drive-Fort Barrette Road.

- The neighborhood accessibility provided by elementary school in Kapolei West would likely encourage some Kapolei West elementary students to walk or bike to the school who would otherwise have been transported to school by motor vehicle. The reduced size of the Makaiwa Hills elementary school would not be expected to reduce student walking and biking to school there since the reduced capacity likely exceeds the numbers of students who would potentially access the school by non-vehicular modes. Therefore, the present plan should increase the actual combined numbers of elementary students walking and biking to school in the two communities.

- The relocated middle school site in Makaiwa Hills is likely to attract comparable numbers of students who walk or bike to school as the previous site in Kapolei West.

- The net result of the school changes should be a reduction of the total student-related vehicle trips along Road D and a slight improvement to morning peak hour traffic conditions at intersections along Road as compared to the previous plan, including those at the Farrington Highway intersection.

Effect On Vehicle Trip Generation for the Makaiwa Hills Project
The combined middle and elementary schools in Makaiwa Hills are estimated to generate increased vehicle trips based on standard ITE trip generation rates for these schools. As summarized in Table 3, the combined middle and elementary schools would generate an estimated 478 vehicle trips to or from the school sites in the morning peak hour, an increase of 202 vehicle trips over the previous plan. This is estimated to increase the total numbers of trips generated by the land uses within Makaiwa Hills by 7.1% above the scenario presented in the project Draft TIAR. In the afternoon peak hour, the estimated 129 peak hour trips would be an increase of 62 vehicles above the previous plan. This would increase the vehicle trips generated in the afternoon peak hour by the Makaiwa Hills development by 1.8% over those analyzed in the Draft TIAR.

However, the effect of the school changes on total area vehicle trips may be less than these increases:

- The Kapolei West elementary school is estimated to generate about 158 fewer morning peak hour vehicle trips that the previously planned middle school, which would offset about one-third of the Makaiwa Hills increase.

- A greater proportion of the school-related trips would be made internal to the Makaiwa Hills and Kapolei West communities, which would lessen potential travel and impacts outside the community.

- More students may walk or bike to a school within their communities, which could lessen the number of vehicle trips.

Potential Traffic Effects of Changes to School Plans
Based upon he preceding assessment, the proposed revisions to the plans for the Makaiwa Hills and Kapolei West schools could have the following traffic effects:

1. There may be slightly lower vehicle traffic volumes along Road D during the morning peak hour, with a small improvement in intersection conditions along this roadway.

2. Makakilo traffic to/from the middle school would increase traffic volumes along Nohona Street, but the morning peak hour volumes would be expected to be at levels appropriate for a residential area collector street.

3. The relocated sites for the middle school and elementary school in the southeast section of Makaiwa Hills could increase traffic and pedestrian volumes along Road A and Road C, which could result in traffic conditions that satisfy warrants and hasten the need for traffic signal control at the Road A-Road C intersection.

If you have questions or need additional information regarding the change in school plans, please contact me at 919-812-6139 or bryantbrothers@gmail.com.

Sincerely,

Bryant T. Brothers
Hawaii PE 6755

Table 1
Estimated Elementary and Middle School Students
Makaiwa Hills and Kapolei West Developments

Item	School Type	Housing Types: Single Family	Multi-Family	Combined
Average Students per Dwelling (DOE Rates)	Middle	0.143	0.040	NA
	Elementary	0.279	0.109	NA
Makaiwa Hills				
Number of Resident-Occupied Housing Units		1,742	1,725	3,467
Estimated Students	Middle	250	69	319
	Elementary	486	189	675
Kapolei West				
Number of Resident-Occupied Housing Units		313	1,113	1,426
Estimated Students	Middle	45	45	90
	Elementary	88	122	210

Table 2
Estimated Students Compared to On-Site School Capacity
Makaiwa Hills and Kapolei West Developments

Scenario and Community	School	On-Site School Capacities (Students)	Students Within Community	Students Compared to On-site School Capacity
Previous Plan				
Makaiwa Hills	Middle	None	319	+319
	Elementary	950	675	-275
Kapolei West	Middle	650	90	-560
	Elementary	None	210	+210
Present Plan				
Makaiwa Hills	Middle	600	319	-281
	Elementary	550	675	+125
Kapolei West	Middle	None	90	+90
	Elementary	550	210	-340

Table 3
Vehicle Trips Generated by Makaiwa Hills Schools

	AM Peak Hour			PM Peak Hour		
	Enter	Exit	Total	Enter	Exit	Total
Present Scenario						
Middle School	174	144	318	48	42	90
Elementary	94	66	160	22	17	39
Combined	268	210	478	70	59	129
Previous Scenario						
Elementary	162	114	276	38	29	67
Net Change of Present Trips from Previous						
Numbers of Trips	+106	+96	+202	+32	+30	+62
Percent Change			+7.1%			+1.8%

Appendix E
Agricultural Impact Assessment

MAKAIWA HILLS:
IMPACT ON AGRICULTURE

DECISION ANALYSTS HAWAI'I, INC.

MAKAIWA HILLS: *IMPACT ON AGRICULTURE*

PREPARED FOR:

Makaiwa Hills, LLC

PREPARED BY:

Decision Analysts Hawai'i, Inc.

March 2007

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A. Selected State and City Goals, Objectives, Policies and Guidelines Related to Agricultural Lands. A-1

EXECUTIVE SUMMARY

1. PROPOSED DEVELOPMENT

Makaiwa Hills, LLC proposes to develop Makaiwa Hills ("the Project"), a planned community to be located on 1,780.705 acres on on the southern slopes of the Wai'anae Mountain Range, 'Ewa District, O'ahu. The Project will include about 4,100 single- and multi-family residential units; a community commercial center; a neighborhood retail center; parks and open space; an elementary school; and associated infrastructure. About 126 acres will remain available for agriculture.

The Project is within the State Urban District and is consistent with the City's Ewa Development Plan; however, City zoning is Agricultural. Thus, the Project will require a change in zoning from Agriculture to a mix of Residential and Business zoning.

2. AGRICULTURAL CONDITIONS

Of the approximately 1,781 acres proposed for development, about 100 acres of the flatlands between the H-1 Freeway and old Farrington Highway have favorable agronomic conditions for crop production. This area has good soils, gently sloping terrain, high solar radiation, low pumping costs for irrigation water, and good access. The remaining lands are poorly suited for growing crops because the soils are rocky, slopes are steep, pumping costs would be high, and access is difficult.

3. LOCATIONAL ADVANTAGES AND DISADVANTAGES FOR CROP PRODUCTION

The Project Area flatlands are well-located for serving the Honolulu consumer market and export markets. This is due to the short trucking distance to the Honolulu markets, the Honolulu International Airport, and Honolulu Harbor.

4. SURROUNDING LAND USES

The only nearby agricultural operation is a grazing operation to the north (*mauka*). Except for landfill to the west, all of the other current and planned land uses surrounding the Project Area are urban. Thus, the good agricultural land located on the flatlands is an agricultural remnant and so is suitable for limited agricultural use, such as nursery operations and grazing.

5. IMPACT ON EXISTING AGRICULTURAL OPERATIONS

a. Kapolei Nursery and Garden

Kapolei Nursery and Garden leases about 11 acres of flatland between the H-1 Freeway and old Farrington Highway. This nursery, which is affiliated with Tien Nursery in Waimanalo, serves as a grow-out area for ornamental trees destined for projects in 'Ewa and elsewhere. The nursery provides 2 to 3 jobs.

The impact of the Project on Kapolei Nursery and Garden will depend on whether about 11 acres of suitable land with water can be obtained at acceptable terms. If it can, then the nursery will relocate with no significant impact on its operation.

If suitable land with water cannot be obtained, then this nursery will close. In turn, other nurseries are likely to increase their operations to compensate for the loss in the supply of ornamental trees, or one or more new nurseries may enter the market.

Thus, there could be a shift in nursery operations, but no significant island-wide loss of nursery production, revenues, employment or payroll. Also, the affiliated Tien Nursery will remain in operation.

Since other agricultural lands are available on O'ahu and the Project is not expected to have a significant impact on island-wide nursery operations, mitigating measures are not recommended.

b. Pasture Operations on the Flatlands

A husband and wife lease about 76 acres of the flatland to pasture 7 to 8 horses. The horses are occasionally moved to Maunawili were the couple owns a home and land, and keeps a few additional horses. The horses are kept for the personal enjoyment by the family; the operation is not a commercial enterprise and provides no employment.

The eventual development of the Project will require the operator to find other grazing land on O'ahu.

Because the pasture operation is not a commercial operation and provides no employment, and grazing lands are available elsewhere on O'ahu, mitigation measures for the loss of pasture lands are not recommended.

c. Rocker G Livestock Company

Rocker G. Livestock Company (Rocker G) grazes cattle on about 1,694 acres of the Project Area. This area includes about 73 acres of the flatlands between the H-1 Freeway and old Farrington Highway plus the hillside above the Highway up to Palehua Road. The entire Rocker G ranch encompasses about 4,009 acres located on each side and above Makakilo up to the Honouliuli Forest Reserve, most of which is leased from the James Campbell Company.

The current herd of 267 cow / calf units is being rebuilt to about 300 units, reflecting the carrying capacity of the lands during dry periods. The carrying capacity is low because of low rainfall in the area, rocky soils, and the presence of gulches and very steep slopes on much of the land. The ranch provides employment and a desired lifestyle to three full-time workers and one part-time worker.

Development of the Project will remove about 1,568 acres (39%) from the Rocker G ranch, and leave about 126 acres available for grazing. This loss of grazing land will result in the following estimated impacts:

— about 150 fewer cow / calf units (down 50%)

— about 120 fewer calves per year

— about $36,000 less gross annual revenues

— about 1.2 fewer full-time-equivalent jobs (down 33%)

— about $20,000 less annual payroll

For the foreseeable future, no further reduction of Rocker G acreage is anticipated.

From a Statewide perspective, this loss of grazing land is very small—about 0.15% of Hawaii's supply of grazing land. Furthermore, the Makaiwa Hills project is not expected to adversely affect the growth of Hawaii's cattle industry because land is not the limiting factor. The supply of grazing land in Hawaii is very large, encompassing an area about three times that of the entire land area of O'ahu. Furthermore, the supply of grazing land has increased statewide and on O'ahu due to the contraction of plantation agriculture. In contrast, the number of range cattle in Hawaii has not exhibited any long-term growth since at least 1980. This suggests that other ranches in the State could increase their herd sizes to compensate for the loss in beef production that will result from the loss of grazing land with the Makaiwa Hills project.

In view of the relatively small impact of the Project on the cattle industry and on employment, the availability of grazing lands elsewhere in the State, mitigation measures for the loss of grazing lands are not recommended.

6. GROWTH OF DIVERSIFIED CROP FARMING

a. Potential Acreage Requirements for Diversified Crops

Crops to Replace Imports of Fruits and Vegetables

For low-elevation fruits and vegetables that have a history of profitable production in Hawai'i, potential land requirements in 2010 for 100% import substitution for the Hawai'i and O'ahu markets are estimated at 12,700 acres and 8,600 acres, respectively, plus additional acreage for fallowing land between crop plantings. When allowing for competition from imports, these estimates drop to about half.

Export Crops

The many entrepreneurial agricultural efforts being undertaken on former plantation lands may lead to one or more major new export crops over the next 20+ years. However, the history of agricultural efforts in Hawai'i reveals that developing major new export crops that are successful in overseas markets is difficult. For example, over the past 50 years in Hawai'i, farmers have explored numerous possibilities for export crops, but they have developed overseas markets for just one diversified crop that requires more than 10,000 acres (macadamia nuts at 18,000 acres in 2004); one additional crop that requires more than 5,000 acres (coffee at 7,300 acres); and only five additional crops or crop categories that require more than 1,000 acres each.

Feed Crops

If feed crops could be grown in Hawai'i and priced competitively against mainland imports, they could replace some of the grains and hay that are now being imported to the State. Unfortunately, a number of commercial attempts in Hawai'i to grow grains and alfalfa have been unsuccessful.

Biofuel Crops

Crops can be grown to produce biomass to fuel a boiler, or as feedstock to produce fuels. In Hawai'i, the common practice is to produce biomass as a byproduct of some principal crop. However, O'ahu Ethanol Corporation plans to build an ethanol plant at Campbell Industrial Park using conventional technology but, at least initially, using imported molasses as the feedstock. For the longer term, this company is exploring the economics of growing sweet sorghum on O'ahu to supply feedstock to its ethanol plant. Acreage requirements for a new sorghum biofuel plantation on O'ahu would range from about 6,000 acres for viability to 15,000 to replace all imported molasses.

However, a number of substantial difficulties must be overcome to develop a sorghum biofuel plantation on O'ahu. For example, it will be difficult to lease the 6,000+ acres required for economic viability. Most major landowners will be reluctant to lease their land at comparatively low rents for the approximately 30-year period desired by O'ahu Ethanol. Also, emerging technology that is in the early stages of commercialization promises a more plentiful and cheaper source of feedstock for ethanol. Instead of producing ethanol using sugars from conventional sources, the sugar would come from "cellulosic" sources. This would include green waste for which there would be no land rent and no growing costs, but there could be a disposal fee paid to the processor. In the long term, this less expensive source of feedstock could result in an unprofitable biofuel plantation.

These and other difficulties and risks suggest that the probability of successfully developing and sustaining a sorghum biofuel plantation on O'ahu is low.

Recent Crop-acreage Trends

For all diversified crops—i.e., all crops other than sugarcane and pineapple, including crops to replace imports and crops for export—Statewide land requirements grew by an average of 240 acres per year from 1984 through 2004, or less than 2,400 acres per decade.

b. Land Available for Diversified Crops

A vast amount of land has been released from plantation agriculture on O'ahu and the Neighbor Islands, and most of this land remains available for diversified crops. By 2007, about 14,700 acres of farm land will be available on O'ahu. This includes about 9,600 acres on the North Shore plus about 5,100 acres in Kunia due to the 2006 closure of the Del Monte pineapple plantation. However, it excludes any adjustment for the farm land in 'Ewa and Kunia that is already leased for diversified crops but is not farmed intensively. Statewide, an estimated 160,000+ acres remain available for diversified crops. Cultivating crops on the Neighbor Islands for the Honolulu market, and vice versa, will become more economically feasible once the Superferry begins its scheduled operations in 2007.

The above information indicates that ample land is available in Hawai'i to accommodate the growth of diversified crops, whether demand is based on potential or recent trends. In other words, the limiting factor to the growth of diversified crops is *not* the *land supply*, but rather the *size of the market* for crops that can be grown *profitably* in Hawai'i.

c. Impact on the Growth of Diversified Crop Farming

The Project will commit 1,781 acres of agricultural land to a non-agricultural use, of which about 100 acres are good for farming. If this much good land were used to grow a typical vegetable or fruit crop, it could support about 12.5 farm jobs (based on 100 acres and about 12.5 jobs per 100 acres).

More realistically, the development of this agricultural land—combined with other developments in Hawai'i—involves the loss of too little good agricultural land to significantly affect (1) the availability of land to farmers in Hawai'i, (2) agricultural land rents, (3) the growth of diversified crops, or (4) potential agricultural employment. This conclusion is based on the above finding that ample land is available for diversified crops, with the available supply far exceeding likely or potential demand.

More to the point, the good agricultural land in the Project Area has already been lost to crop farming because it is an agricultural remnant.

d. Mitigating Measures

In view of the negligible impact of the Project on the growth of diversified agriculture, mitigation measures for the loss of good agricultural land are not recommended.

7. ADVERSE AGRICULTURAL IMPACTS AND OFFSETTING BENEFITS

a. Summary of Adverse Agricultural Impacts

Most of the Project Area consists of sloping mountain hillside having poor soils. As a result, Makaiwa Hills will have only a small adverse impact on agriculture. Specifically, the Project will (1) result in the loss of about 100 acres of good agricultural land on the flatlands between the H-1 Freeway and Old Farrington Highway; (2) displace an 11-acre nursery, a non-commercial 76-acre pasture operation for horses, and cattle grazing on about 1,694 acres; and (3) result in the loss of 0 to 4 agricultural jobs, depending on whether other operations replace lost production.

b. Direct Benefits of the Project

These adverse impacts to agriculture will be offset by the following benefits of the Project:

- about 4,100 homes for Hawai'i residents, along with a community commercial center, a neighborhood retail center, parks and open space, and an elementary school;
- construction and other jobs provided by development activity;
- at full development of the Project, about 1,100 on-site jobs provided by commercial activities and home services;
- tax revenues (excise taxes, personal income taxes, corporate income taxes, property taxes, etc.) generated by development activity; and
- tax revenues generated by the families and businesses that occupy the Project.

c. Indirect Benefits to Agriculture

If the Project does not proceed, then most of the proposed homes would be built as part of other planned and proposed residential projects elsewhere in 'Ewa and Central O'ahu that are within the City's Urban Growth Boundary. Inasmuch as a large portion of this land is prime agricultural land and is currently farmed, not developing Makaiwa Hills would accelerate the loss of prime agricultural land in 'Ewa and Central O'ahu, and would accelerate the displacement of crop farmers who now lease these lands.

Thus, the Project will benefit agriculture by delaying development on prime agricultural in 'Ewa and in Central O'ahu, and by delaying the displacement of crop farming from these lands.

8. CONSISTENCY WITH STATE AND CITY POLICIES

a. Availability of Lands for Agriculture

The *Hawaii State Constitution*, the *Hawaii State Plan*, the *State Agriculture Functional Plan*, and the *General Plan of the City and County of Honolulu* call directly or implicitly for preserving the economic viability of plantation agriculture and promoting the growth of diversified crops. To accomplish this, an adequate supply of agriculturally suitable lands and water must be assured.

With regard to plantation agriculture, the Project Area is no longer part of a sugar plantation since about 100 acres of sugarcane fields were fallowed in the early 1980s and the plantation closed in 1995, both for reasons unrelated to the Project.

With regard to diversified crops, development of the Project Area will result in a small loss of good farm land, but this loss will not limit the growth of diversified crops since ample agricultural land is available on O'ahu and on other islands. This is due to the enormous supply of agricultural land that is now available due to the contraction of plantation agriculture.

From a broader perspective, development of the Project on mostly poor agricultural land will delay development on prime agricultural land in 'Ewa and Central O'ahu. In turn, this will contribute at least temporarily to the availability of high-quality land for agriculture. Much of this high-quality land is currently leased to farmers.

b. Conservation of Agricultural Lands

In addition to the above, State policies call for conserving and protecting prime agricultural lands, including protecting agricultural lands from urban development.

However, these policies—which were written before the major contraction of plantation agriculture in the 1990s—assume implicitly that profitable agricultural activities eventually will be available to utilize all available agricultural lands. This has proven to be a questionable assumption in view of the enormity of the contraction of plantation agriculture, the abundant supply of land that came available for diversified agriculture, and the slow growth in the amount of land being utilized for diversified agriculture.

Furthermore, discussions in the Agriculture portion of the *State Functional Plan* recognize that redesignation of lands from Agricultural to Urban should be allowed "… upon a demonstrated change in economic or social conditions, and where the requested redesignation will provide greater benefits to the general public than its retention in …agriculture;" that is, when an "overriding public interest exists." The enormous contraction in plantation agriculture, resulting in the supply of agricultural land far exceeding demand, constitutes a major change in economic conditions. Moreover, development in the Project Area will provide community benefits (about 1,100 on-site jobs at full development) that far exceed those provided by agriculture (about 3 or 4 jobs with the current nursery and a portion of the ranching operations, or about 12.5 jobs if the flatlands were farmed). In practice, however, development of the Project Area is likely to have little or no impact on Statewide agricultural employment.

Again, from a broader perspective, development of the Project on mostly poor agricultural land will delay development on prime agricultural land in 'Ewa and Central O'ahu. In turn, this will contribute at least temporarily to the conservation of prime agricultural land.

c. State Districting

The Project Area was redesignated from Agricultural to Urban in 1993. Thus, the Project is consistent with State land-use policies.

d. City's 'Ewa Development Plan

The Project Area is within the City's designated Urban Growth Boundary of the 'Ewa Development Plan in an area designated for residential and commercial development. Thus, the Project is consistent with the 'Ewa Development Plan.

MAKAIWA HILLS:
IMPACT ON AGRICULTURE

1. INTRODUCTION[1]

Makaiwa Hills, LLC proposes to develop Makaiwa Hills ("the Project"), a planned community to be located on 1,780.705 acres on on the southern slopes of the Wai'anae Mountain Range, 'Ewa District, O'ahu. Figure 1 shows the location of the Project, Figure 2 shows the Tax Map Keys (TMKs), and Figure 3 shows the Project Master Plan—the figures are located at the end of this report.

The Project is within the State Urban District and is consistent with the City's Ewa Development Plan; however, City zoning is Agricultural (Figures 4, 5 and 6). Thus, the Project will require a change in zoning from Agriculture to a mix of Residential and Business zoning.

This report addresses the impacts on agriculture of developing the Project. The material below gives the following information on the Project: its location; a description of the Project; the agricultural conditions of the Project Area, along with supporting Figures 7, 8 and 9; potential crops; locational advantages and disadvantages for crop production; surrounding land uses; past and current agricultural land uses; the impact of the Project on existing agricultural operations; the impact the Project on the growth of diversified crop farming, along with supporting Figure 10 that shows the release of land from plantation agriculture and the increase in acreage in diversified crops; benefits of the Project that will offset adverse agricultural impacts; and consistency of the Project with State and City agricultural policies.

Following the ten figures at the end of the report, an Appendix provides a summary of State and City goals, objectives, policies and guidelines related to agricultural lands.

2. LOCATION OF THE PROJECT [1]

The Project Area is *mauka* of the H-1 Freeway and below Palehua Road, and between Makakilo on the east and Waimanalo Gulch on the west (Figure 1). As shown in Figure 2, the Project Area is also defined by six TMK parcels:

—TMK 9-1-015-005 (por) 59.077 acres

—TMK 9-1-015-017 (por)	95.885 acres
—TMK 9-2-03-002 (por)	849.147 acres
—TMK 9-2-03-005 (por)	200.171 acres
—TMK 9-2-03-084 (por)	576.425 acres

3. PROJECT DESCRIPTION[1]

Makaiwa Hills will include about 4,100 single- and multi-family homes; a community commercial center; a neighborhood retail center; parks and open space; an elementary school; and associated infrastructure (e.g., roadways, utilities, a potable water system, sewers, drainage, and other utilities). About 126 acres will remain available for agriculture.

4. AGRICULTURAL CONDITIONS

a. Soil Types[2]

As shown in Figure 7, the Project Area consists of 14 soil types plus former reservoir sites. The complete names of the soil types and their slopes are as follows:

— EaB	Ewa silty clay loam, 0 to 3% slopes
— EwC	Ewa stony silty clay, 6 to 12% slopes
— HLMG	Helemano silty clay, 30 to 90% slopes
— HxA	Honouliuli clay, 0 to 2% slopes
— HxB	Honouliuli clay, 2 to 6% slopes
— LPE	Lualualei extremely stony clay, 3 to 35% slopes
— LvB	Lualualei stony clay, 2 to 6% slopes
— MBL	Mahana-Badland complex
— McC2	Mahana silty clay loam, 6 to 12% slopes, eroded
— McD2	Mahana silty clay loam, 12 to 20% slopes, eroded
— McE2	Mahana silty clay loam, 20 to 35% slopes, eroded
— MuC	Molokai silty clay loam, 7 to 15% slopes
— rRK	Rock land
— rSY	Stony steep land
— W	Former reservoirs

Table 1 shows the estimated acreage of each soil type according to its quality as rated by the Natural Resources Conservation Service (NRCS), formerly known as the Soil Conservation Service.

As indicated, rSY (stony steep land) is the predominant soil type, comprising 70.4% of the Project Area.

b. Soil Ratings

Three classification systems are commonly used to rate Hawai'i soils: (1) Land Capability Grouping, (2) Agricultural Lands of Importance to the State of Hawai'i, and (3) Overall Productivity Rating.

<u>Land Capability Grouping (NRCS Rating)</u>[2]

The 1972 Land Capability Grouping by the U.S. Department of Agriculture, NRCS rates soils according to eight levels, ranging from the highest classification level I to the lowest VIII.

Table 1 shows that about 26 acres (1.5%) of the Project Area have soils that are rated I. Class I soils have few limitations that restrict their use.

About 43.5 acres (2.4%) of the Project Area have soils that are rated IIe. Class II soils have moderate limitations that reduce the choice of plants or require moderate conservation practices. The subclassification “e” indicates that the soils are subject to erosion.

About 65.8 acres (3.7%) have soils rated IIIe. Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.

About 2.9 acres (0.2%) have soils rated IVe. Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both.

About 56 acres (3.1%) have a mixed rating of IVc/VIIIe which reflects a mix of soils (40 to 70%) and badland (30% to 60%). For the soils, the subclassification “c” indicates that the limitation is due to climate (i.e., low rainfall). Class VIII soils are badland that have limitations that preclude their use for commercial plants. Badland consists of steep or very steep, nearly barren land.

About 19.8 acres (1.1%) have soils rated VIe. Class VI soils have severe limitations that make them generally unsuitable for cultivation and restrict their use largely to pasture.

About 1,564.6 acres (87.9%) have soils rated VIIe or VIIs. Class VII soils have very severe limitations that make them unsuitable for cultivation and restrict their use largely to pasture. The subclassification “s” indicates that the soils are rocky or stony.

Table 1. Makaiwa Hills Project Area: Soil Types and NRCS Ratings

Soil Types	Acres	%	NRCS Ratings[1]
Higher-quality			
HxA	26.0	1.5%	I
EaB	14.1	0.8%	IIe
HxB	29.4	1.7%	IIe
Moderate-quality			
EwC	5.3	0.3%	IIIe
LvB	16.4	0.9%	IIIe
McC2	38.2	2.1%	IIIe
MuC	5.9	0.3%	IIIe
McD2	2.9	0.2%	IVe
Mix of quality			
MBL	56.0	3.1%	IVc / VIIIe
Lower-quality			
McE2	19.8	1.1%	VIe
HLMG	160.4	9.0%	VIIe
LPE	149.2	8.4%	VIIs
rRK	1.7	0.1%	VIIs
rSY	1,253.3	70.4%	VIIs
W (former reservoirs)	2.1	0.1%	Not rated
Total	1,780.7	100.0%	

1. Assuming all soils are irrigated except HLMG, LPE, MBL, rRK and rSY which are not irrigated.

Source: U.S. Department of Agriculture, Soil Conservation Service, *Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii*, August 1972.

Agricultural Lands of Importance in the State of Hawai'i (ALISH)[3]

ALISH ratings were developed in 1977 by the NRCS, the UH College of Tropical Agriculture and Human Resources, and the State of Hawai'i, Department of Agriculture. This system classifies land into three broad categories: (a) Prime agricultural land which is land that is best suited for the production of crops because of its ability to sustain high yields with relatively little input and with the least damage to the environment; (b) Unique agricultural land which is non-Prime agricultural land used for the production of specific high-value crops; and (c) Other agricultural land which is non-Prime and non-Unique agricultural land that is important to the production of crops.

About 97.7 acres (5.5%) of the Project Area have soils that are rated Prime; about 74.6 acres (4.2%) are rated Other; and about 1,608.4 acres (90.3%) are unclassified (Figure 8 – ALISH map).

Overall Productivity Rating (LSB Rating)[4]

In 1972, the University of Hawai'i (UH) Land Study Bureau (LSB) developed the Overall Productivity Rating, which classifies soils according to five levels, with A representing the class of highest productivity and E the lowest.

About 9.6 acres (0.5%) of the Project Area have soils rated A, about 95 acres (5.3%) are rated B, about 1.4 acres (0.1%) are rated C, about 161.4 acres (9.1%) are rated D, and about 1,513.3 acres (85%) are rated E (see Figure 9).

Summary Evaluation of Soil Quality

These soil-rating systems suggest that about 100 acres (5.6%) of the Project Area is comprised of higher-quality soils (I and II for the NRCS ratings, Prime for ALISH, and A and B for the LSB). Nearly all of these higher-quality soils are located on the flatlands in the southeast corner of the property between the H-1 Freeway and old Farrington Highway.

c. Soil Characteristics[2,4]

Consistent with the above soil ratings, the 100 or so acres of higher quality lands located on the flatlands exhibit a number of favorable characteristics: the soils are deep (over 30 inches), the texture is fine to moderately fine; the soils have moderate to good machine tillability; soils are moderately drained to well-drained; the slopes are gentle (see below), and the soil pH is neutral to mildly alkaline.

d. Terrain[1,2]

Except for about 100 acres of flatland between the H-1 Freeway and old Farrington Highway, most of the Project Area consists of sloping mountain hillside. Elevations range from about 50 feet to 1,300 feet; slopes range from 0 to over 30%; and three large and three small gulches transect the Project Area.

e. Climatic Conditions

Like other areas in Hawai'i, the 'Ewa plain has a mild *semi*tropical climate which is due primarily to three factors: (1) Hawai'i's mid-Pacific location near the Tropic of Cancer, (2) the surrounding warm ocean waters that vary little in temperature between the winter and summer seasons, and (3) the prevailing northeasterly tradewinds that bring air having temperatures that are close to those of the surrounding waters.

Solar Radiation[5]

The 'Ewa region of O'ahu is one of the sunniest areas on the island. It is semi-arid, with a relatively warm and dry climate, and an average daily insolation of nearly 500 calories per square centimeter at the lower elevations.

Rainfall[6]

Rainfall in the Project Area is low: an average of about 20 to 30 inches per year. Most of this rainfall occurs during the winter rainy season (October through April), while the summer months (May through September) are hot and dry.

Temperatures[6]

At the lower elevations, average low temperatures range from about 61° Fahrenheit in the winter to about 70° in the summer. Average high temperatures range from about 80° in the winter to 88° in the summer. Temperatures are slightly lower at the higher elevations.

Winds and Storms[6]

The prevailing surface winds are tradewinds that blow from a northeasterly direction, with occasional southerly winds. Low-velocity surface winds of less than 10 miles per hour occur frequently. The tradewinds tend to break down during the fall, giving way to lighter, more variable wind conditions through the winter and into the early spring. Storms are infrequent, occurring mostly from the south in the winter months.

f. Irrigation Water[7]

About 100 acres of the flatlands were once irrigated by O'ahu Sugar Co., Ltd. Currently, both potable and non-potable water are available on the flatlands from existing water pipes.

g. Road Access

Access is good to the lower-elevation lands in the Project Area, but not the higher-elevation ones. Lower-elevation lands are reached via old Farrington Highway which connects to Farrington Highway and the H-1 Freeway. Higher-elevation lands are reached via Palehua Road, which connects to Kikaha Street at the top of Makakilo Drive which, in turn, connects to the H-1 Freeway.

h. Summary

Of the approximately 1,781 acres proposed for development, about 100 acres of the flatlands between the H-1 Freeway and old Farrington Highway have favorable agronomic conditions for crop production. This area has higher-quality soils, gently sloping terrain, high solar radiation, low pumping costs for irrigation water, and good access.

The remaining lands are poorly suited for growing crops because the soils are rocky (rSY is the predominant soil type), slopes are steep, pumping costs would be high, and access is difficult.

5. POTENTIAL CROPS[8]

Based on the above agronomic conditions, about 100 acres within the Project Area are suitable for low-elevation crops commercially grown in Hawai'i, including but not limited to: asparagus, beans (green, bush, and snap), bell peppers, bittermelon, cantaloupe, Chinese peas, cucumbers, daikon, dry onions, eggplant, flowers / nursery products, ginger root, green onions, green peppers, head and semi-head lettuces, herbs, honeydew melons, limes, lotus root, lychee, Manoa lettuce, mango, mustard cabbage, Oriental squash, parsley, pumpkins, seed crops, sweet corn, sweet potatoes, tangerines and watermelons.

6. LOCATIONAL ADVANTAGES AND DISADVANTAGES FOR CROP PRODUCTION

The Project Area flatlands are well-located for serving the Honolulu consumer market and export markets. This is due to the short trucking distance to the Honolulu markets, the Honolulu International Airport, and Honolulu Harbor.

In the U.S. mainland market, farmers in Hawai'i must compete against farmers on the mainland and in Mexico, Central and South America, the Caribbean, Australia, New Zealand, Southeast Asia, etc. Most of the competing farm areas have lower production and delivery costs than Hawai'i does. Competing against Mexico is particularly difficult given the North America Free Trade Agreement (NAFTA) and Mexico's proximity to major U.S. markets.

7. SURROUNDING LAND USES[1]

Existing and planned land uses surrounding the Project Area are shown in Figures 1 through 6, and include:

- — to the north (*mauka*), grazing lands of Rocker G. Livestock Company, communication towers, several private homes, and Camp Timberline (a privately operated camp facility);
- — to the east, Makakilo residential community;
- — to the south (*makai*), Ko 'Olina Resort, Honokai Hale residential community and the planned Kapolei West residential community; and
- — to the west, Waimanalo Gulch Sanitary Landfill.

As indicated, the only agricultural operation is the grazing operation to the north. The good agricultural land located on the flatlands is an agricultural remnant that is suitable for limited agricultural use, such as nursery operations and grazing.

8. PAST AND CURRENT AGRICULTURAL LAND USES

a. Historic Agricultural Uses[7,9-11]

Following the Mahele of 1848, the Project Area was part of a 43,250-acre grant which, from 1871 to 1877, was leased for cattle grazing. In 1877, James Campbell purchased most of the property (including the Project Area) for cattle ranching.

In 1889, Campbell leased most of the 'Ewa Plain to Benjamin Dillingham who, in turn, subleased the land to the 'Ewa Plantation Company to cultivate sugarcane. The 'Ewa Plantation Company grew quickly and continued operating until 1970 when the O'ahu Sugar Company, Ltd. (OSCo) took over operations. Sugarcane cultivation continued until 1995 when OSCo closed.

Approximately 100 acres of the Project Area were once cultivated in sugarcane by OSCo on fields located on the flatlands between the H-1 Freeway and old Farrington Highway—these are the above-mentioned flatlands that are best-suited for crop production. However, the fields were fallowed in the early

1980s, primarily because of difficult access problems after the H-1 Freeway was built, but also because of relatively low yields, rocky soils on much of the land, and the long hauling distance to the mill.

Since the 1980s, the flatlands have been used for grazing cattle and horses, and for a nursery.

Since the 1870s, most of the foothills have been used for grazing cattle. From about 1947 to about 1990, much of this land was part of the 4,700-acre Tongg Ranch. Since about 1990, most of the foothills have been leased to Rocker G Livestock Company for its cattle operation.

b. Current Agricultural Uses[11]

Currently, three agricultural operations are located within the Project Area:

- — Kapolei Nursery and Garden leases about 11 acres of the flatland between the H-1 Freeway and old Farrington Highway
- — a husband and wife lease 75.885 acres of the flatland to pasture a few horses
- — Rocker G Livestock Company leases the remainder of the Project Area for grazing cattle

9. IMPACT ON EXISTING AGRICULTURAL OPERATIONS

a. Kapolei Nursery and Garden

<u>Nursery Operations</u>[11,12]

Since the early 1990s, Kapolei Nursery and Garden has leased about 11 acres of flatland between the H-1 Freeway and old Farrington Highway. The lease is month-to-month at a current rate of $200 per acre per year, plus property taxes.

This nursery, which is affiliated with Tien Nursery in Waimanalo, serves as a grow-out area for ornamental trees destined for projects in 'Ewa and elsewhere. The nursery provides 2 to 3 jobs that pay $9 to $16 per hour.

<u>Impact on Kapolei Nursery and Garden</u>

The impact of the Project on Kapolei Nursery and Garden will depend on whether about 11 acres of suitable land with water can be obtained at acceptable terms. If it can, then the nursery will relocate with no significant impact on its operation. Lands are available in Kunia and on the North Shore (see Section 10.b).

If suitable land with water cannot be obtained, then this nursery will close. In turn, other nurseries are likely to increase their operations to compensate for the loss in the supply of ornamental trees, or one or more new nurseries may enter the market.

Thus, there could be a shift in nursery operations, but no significant island-wide loss of nursery production, revenues, employment or payroll. Also, the affiliated Tien Nursery will remain in operation.

Mitigating Measures

Since other agricultural lands are available on O'ahu and the Project is not expected to have a significant impact on island-wide nursery operations, mitigating measures are not recommended.

b. Pasture Operations on the Flatlands

Operations[11,13]

Since 1997, a husband and wife have leased 75.885 acres of the flatland to pasture horses. The lease is month-to-month at a current rate of $12 per acre per year, plus property taxes.

About 7 to 8 horses are kept on the land and are occasionally moved to Maunawili were the couple owns a home and land, and keeps a few additional horses. The horses are kept for the personal enjoyment by the family; the operation is not a commercial enterprise and provides no employment.

Impact on Pasture Operations

The eventual development of the Project will require the couple to find other grazing land on O'ahu. Lands are available in Kunia and on the North Shore (see Section 10.b).

Mitigating Measures

Because the pasture operation is not a commercial operation and provides no employment, and grazing lands are available elsewhere on O'ahu, mitigation measures for the loss of pasture lands are not recommended.

c. Rocker G Livestock Company

Ranching Operations[8,11,14]

Rocker G Livestock Company (Rocker G) grazes cattle on about 1,694 acres of the Project Area. This area includes about 73 acres of the flatlands between

the H-1 Freeway and old Farrington Highway plus about 1,621 acres of hillside bounded by Palehua Road on the north, Makakilo on the east, the old Farrington Highway on the south, and Waimanalo Gulch on the west.

The entire Rocker G ranch encompasses about 4,009 acres located on each side and above Makakilo up to the Honouliuli Forest Reserve. The size of the ranch is about 400 acres greater than it was in 1998 due to land added in the foothills of lower Kunia. The ranch includes good grazing lands and gulch lands. Land is leased from the James Campbell Company (3,235 acres), the University of Hawai'i (658 acres), and D.R. Horton (116 acres). Water comes from the municipal system.

The Campbell lease is being renegotiated for an additional 5 years, subject to withdrawal rights. The lessee currently pays no lease rent and no property taxes. In return, Rocker G provides land stewardship: on-site management of the ranch and livestock reduces illegal dumping of cars, refrigerators, etc., and cattle grazing on dry grass in the summer months reduce the risk of brush fires.

Rocker G currently grazes 267 cow / calf units on the ranch, which is down from about 450 units following a drought that lasted from 1997 to 2003. The herd is being rebuilt to about 300 units, which better reflects the carrying capacity of the lands during dry periods. The carrying capacity is low because of low rainfall in the area, rocky soils, and the presence of gulches and very steep slopes on much of the land. At 267 units, this small herd accounted for about 0.33% of the 81,300 beef cows in Hawai'i in 2005.

The Rocker G herd is split into three groups: (1) 96 Brahman purebreds that graze on lands west of Makakilo, (2) 44 Brahman purebreds that also graze on lands west of Makakilo, and (3) 127 Brahman crossbreeds that graze on lands east of Makakilo. Brahman stock are well adapted to the heat and rough country found in the area and provide a superior lean grade of meat. But the calves grow more slowly than most other stock.

In the winter months, the cattle graze at the higher elevations on green Guinea grass; in the summer months, they graze at the lower elevations on dry Buffelgrass.

After the calves reach a weight of about 400 to 500 pounds, they are flown to mainland feedlots for finishing. When slaughtered, they provide about 600 pounds of dressed meat.

In recent years, annual production has been about 120,000 to 140,000 pounds of dressed meat per year, and gross revenues have been about $65,000 to over $90,000 per year, net of shipping. Profitability has been marginal, which is an improvement over the late 1990s when revenues were insufficient to cover operating costs.

Benefits provided by this family-operated ranch include employment and a desired lifestyle to three full-time workers and one part-time worker, payroll of about $60,000 per year, open space and greenery, managed care of the property, and reduced risk of fire because dry summer grass is grazed.

Impact on Rocker G

Development of the Project will remove about 1,568 acres from Rocker G, reducing the size of the ranch from about 4,009 acres to about 2,441 acres—a reduction of about 39%. Much of this land has Buffelgrass, which provides better feed than Guinea grass found at the higher elevations. About 126 acres of the Project Area will continue to be used for grazing (shown as AG-2 in Figure 3).

Rocker G estimates that this loss in acreage will require its total herd size to be reduced by half and its employment to be reduced by one-third. Thus, the Project will result in the following impacts to Rocker G operations:

— about 150 fewer cow / calf units (down 50% from about 300 units after the herd is built up)

— about 120 fewer calves per year (150 cows x 80%)

— about 60,000 fewer pounds of dressed meat per year (600 pounds on the mainland x 100 calves per year)

— about $36,000 less gross annual revenues ($300 per calf x 120 calves per year)

— no change in total annual rents since Rocker G pays no rent on land it leases from Campbell

— about 1.2 fewer full-time-equivalent jobs (33.3% x 3.5 jobs)

— about $20,000 less annual payroll (33.3% x $60,000)

Potential Cumulative Impacts

For the foreseeable future, no further reduction of Rocker G acreage is anticipated.

Availability of Replacement Lands in the Immediate Area

Some time in the future, up to 1,200 acres of grazing land in the foothills above lower Kunia might come available for use by Rocker G, thereby partially offsetting Rocker G's loss of grazing land at Makaiwa Hills. Currently, these lands are leased to three separate ranches that are operated as hobbies.

If Rocker G eventually leases all of these lands, then the size of the ranch would decrease from about 4,009 acres to about 3,641 acres, a reduction of about 368 acres or about 9% (a 1,568-acre loss to Makaiwa Hills offset by a 1,200-acre gain). However, these potential replacement lands host Guinea grass, which is inferior to the Buffelgrass found at Makaiwa Hills. Rocker G would likely reduce the size of its herd, but the reduction would be much less than the 150 cow / calf units assumed above.

But even if Rocker G eventually leases lands that are now used by other nearby ranches, there would be a net loss of about 1,568 acres of grazing lands in the area, and a corresponding reduction in calf production.

Statewide Availability of Grazing Land[8,15]

The total supply of grazing land in Hawaii is very large—an estimated 1.15 million acres in 2004, most of which is located on the Big Island. For comparison, this is about three times the entire land area of O'ahu (381,632 acres). Thus, the Project will have a relatively small impact on the supply of grazing land in the State, a decrease of about 0.14%.

Furthermore, the supply of grazing land has increased statewide and on O'ahu due to the contraction of plantation agriculture (see Section 10.b and Figure 10). In contrast, the number of range cattle in Hawaii has remained at about 80,500 ± 3,300 beef cows since at least 1980.

This combination of a large and increasing supply of grazing land combined with no growth in the number of cattle indicates that land is not the limiting factor to the growth of the cattle industry. It further suggests that other ranches in the State could increase their herd sizes to compensate for the loss in beef production that will result from the loss of grazing land due to the Project.

Mitigating Measures

In view of the relatively small impact of the Project on the cattle industry and on employment, the availability of grazing lands elsewhere in the State, mitigation measures for the loss of grazing lands are not recommended.

10. GROWTH OF DIVERSIFIED CROP FARMING

The Project will commit agricultural land to a non-agricultural use. The impact of this commitment on the growth of diversified crops is addressed below. The material covers the (1) amount of land required for the future growth of diversified crops, (2) availability of land for diversified crops, (3) impact of the Project on the growth of diversified crops and (4) mitigating measures.

a. Potential Acreage Requirements for Diversified Crops

Crops to Replace Imports of Fruits and Vegetables[16]

For low-elevation fruits and vegetables that have a history of profitable production in Hawai'i, potential land requirements in 2010 for 100% import substitution for the Hawai'i and O'ahu markets are estimated at 12,700 acres and 8,600 acres, respectively, plus additional acreage for fallowing land between crop plantings. When allowing for competition from imports, these estimates drop to about half. These estimates take into account estimated consumption, production trends, seasonal and annual market shares, yields, and the number of crops per year. Also, these figures are for acreage in crop—not harvested acreage as is typically reported in government publications.

For many crops grown in Hawai'i, market shares for Hawai'i growers are limited by the following factors: (1) local varieties are not perfect substitutes for all imports (e.g., premium-priced sweet Maui onions versus inexpensive storage onions); (2) some crops cannot be produced profitably in the summer due to competition from low-cost imports of fruits and vegetables from California, other states, and Mexico; and (3) over-production must be avoided in order to maintain profitable price levels.

Since Hawai'i farmers already supply a portion of the Hawai'i market, land requirements for increased import substitution are a fraction of the above estimates.

Export Crops[8,15,17]

The potential market for export crops is far larger than the Hawai'i market. In 2005, the U.S. population was 296.41 million, compared to Hawai'i's resident-plus-visitor population of 1.45 million. To take advantage of this large potential, Hawai'i farmers are exploring various export crops on lands released from plantation agriculture. Over the next 20+ years, one or more of these crops may prove to be successful and may grow into a major export crop.

However, the history of agricultural efforts in Hawai'i reveals that the successful development of major new export crops requiring large amounts of land is infrequent. For example, over the past 50 years in Hawai'i, farmers have explored numerous possibilities for export crops, but they have developed overseas markets for just one diversified crop that requires more than 10,000 acres (macadamia nuts at 18,000 acres in 2004); one additional crop that requires more than 5,000 acres (coffee at 7,700 acres); and only five additional crops or crop categories that require more than 1,000 acres each (papaya at 2,105 acres, bananas at 1,360 acres, tropical specialty fruits at 1,260 acres, flowers / nursery products at 3,874 acres, and seed crops at 3,870 acres). Tropical specialty fruits include longan, lychee, mango, rambutan, star-fruit, etc.

Feed Crops[18]

If feed crops could be grown in Hawai'i and priced competitively against mainland imports, they could replace some of the grains and hay that are now being imported to the State. Unfortunately, a number of commercial attempts in Hawai'i to grow grains and alfalfa have been unsuccessful. The major problems have been (1) pests, particularly birds that eat the grains before they are harvested; (2) humidity that is too high for drying alfalfa properly; and (3) high production costs compared to those of mainland farms.

Biofuel Crops[19-25]

Crops can be grown to produce biomass to fuel a boiler, or as feedstock to produce fuels. Examples of the latter include sugarcane, corn or sorghum used to produce ethanol. In turn, the ethanol is used to produce E-10 gasohol (90% gasoline and 10% ethanol).

In Hawai'i, the common practice is to produce biomass as a by-product of some principal crop. For example, at HC&S on Maui and at Gay & Robinson on Kaua'i, the sugarcane by-product bagasse is burned to help fuel their respective power plants. In addition, the biofuel company Maui Ethanol plans to use the sugarcane by-product molasses from the two sugarcane plantations as a feedstock to produce ethanol. Using conventional technology, the sugar in the molasses will be fermented to produce ethanol, followed by distillation to extract the alcohol.

However, O'ahu Ethanol Corporation plans to build an ethanol plant at Campbell Industrial Park using conventional technology but, at least initially, using imported molasses as the feedstock. The rated capacity will be 15 million gallons of ethanol per year. For the longer term, this company is exploring the economics of growing sweet sorghum to supply feedstock to its ethanol plant. The sorghum would have to be grown on O'ahu because it would be too expensive to ship the sorghum juice from a Neighbor Island to O'ahu. Sorghum juice is mostly water having a low concentration of sugar compared to molasses.

Acreage requirements for a new sorghum biofuel plantation on O'ahu would range from about 6,000 acres for viability to 15,000 acres if it were to replace all imported molasses. This acreage would comprise either a substantial share or all of the estimated 14,700 acres of crop land that are now available on O'ahu following the 2006 closure of Del Monte. However, this would comprise only a small share of the 160,000+ acres of crop land that will be available Statewide (see Section 10.b.).

Also, substantial investment capital will be required to cover the cost of a mill to extract the juice from the sorghum, a generating plant to provide power, improvements and upgrades to irrigation systems that are in disrepair, trucks and equipment to harvest and haul the sorghum to the mill and haul the sorghum juice to the ethanol plant, etc.

Annual revenues from selling the ethanol plus direct subsidies are estimated by the consultant at about $2,700 per acre (based on an estimated 900 gallons per acre per year of ethanol at about $3 per gallon). Even with subsidies, this is low compared to revenues from other crops in Hawai'i.

A number of substantial difficulties must be overcome to develop a sorghum biofuel plantation on O'ahu for supplying feedstock for ethanol production. First, it will be difficult to lease the 6,000+ acres required for economic viability. With the possible exception of Kamehameha Schools, major landowners will be reluctant to lease their land at comparatively low rents for the approximately 30-year period desired by O'ahu Ethanol. A long lease period is needed to capitalize the substantial investment in a new plantation. Over time, other farmers—including those displaced from areas designated by the City for eventual urban development—and other users of land are likely to make higher offers for lease rents or land purchases. In view of this potential, the current market value of available agricultural lands is likely to be higher if the lands are <u>not</u> committed long-term at rents that would be low enough to be affordable for a biofuel plantation.

A second difficulty will be the cost of growing a sorghum biofuel crop on O'ahu compared to the cost of importing molasses. For similar crops (e.g., feed crops), importing has proven to be less expensive than growing and processing crops locally. Also, the U.S. Department of Agriculture has found sorghum to be an expensive feedstock for producing ethanol—about 3.7 times as expensive as corn and 63% more expensive than molasses.

A third difficulty will be attracting the capital investment required to develop a plantation given the long-term risks. For example, there is a risk that the combined Federal and State subsidies for ethanol (nearly $1 per gallon) could eventually be reduced, thereby compromising the profitability of a biofuel crop.

Another long-term risk for potential investors in a biofuel plantation arises from emerging technology that promises a cheaper source of feedstock for ethanol. Instead of producing ethanol using sugars from conventional sources (e.g., molasses, sugarcane, grains, fruits, etc.), the sugar would come from "cellulosic" sources. Using new technology that is in the early stages of commercialization, sugar that is locked in complex carbohydrates of plants is separated into fermentable sugars. Feedstock would include agricultural wastes, yard clippings, discarded paper, wood waste, etc.—i.e., the green waste that is now used for composting. This new technology promises (1) much higher ethanol yields per ton of biomass because the entire plant can be used as feedstock, and (2)

lower costs, particularly if there are no growing costs when waste product is used, and if the operator is paid a fee to dispose of municipal and agricultural waste. O'ahu's municipal waste could produce an estimated 160 million gallons of ethanol compared to annual consumption of about 400 million gallons of gasoline. This would allow far higher use of ethanol in gasohol than is needed in E-10. In Hawai'i, this new technology is being explored by ClearFuels Technology Inc. In the long term, this less expensive source of feedstock could result in an unprofitable sorghum biofuel plantation.

The above difficulties and risks suggest that the probability of successfully developing and sustaining a sorghum biofuel plantation on O'ahu is low.

<u>Recent Crop-acreage Trends</u>[8]

For all diversified crops—i.e., all crops other than sugarcane and pineapple, including crops to replace imports and crops for export—Statewide land requirements grew by an average of 240 acres per year from 1984 through 2004, or about 2,400 acres per decade (see Figure 10).[1]

From 1999 to 2004, acreage <u>increased</u> for just three of the <u>major export crop categories</u>: tropical specialty fruits up 350 acres, flowers / nursery products up 1,162 acres, and seed crops up 1,420 acres. During this same period, acreage <u>declined</u> for three of the major export crops: macadamia nuts down 1,900 acres, papaya down 1,395 acres, and bananas down 400 acres. Coffee remained unchanged. The net change was a decrease of 763 acres.

<u>Factors Limiting the Growth of Diversified Crops</u>[16]

A great many crops can be grown in Hawai'i's year-round subtropical climate, and a number of them can be grown profitably in volumes that require a few hundred acres. However, the modest growth in land requirements for diversified crops reflects the fact that few crops can be grown profitably on a large scale. The primary factors that have limited the growth of diversified agriculture in Hawai'i are given below.

— Hawai'i's subtropical climate is not well-suited to the commercial production of major crops that grow better in the temperate mainland climates.

— For certain crops, special hybrids adapted to Hawai'i's subtropical climate are yet to be developed.

1. In Figure 10, the temporary bump in diversified-crop acreage that occurred in the late 1990s reflects the fact that some former sugarcane fields were newly planted with grasses for future cattle grazing. After cattle grazing began in 2000, much of this acreage was recategorized from crop land to grazing land.

- — Crop pests are more prevalent and more expensive to control in Hawai'i than they are on the mainland where the cold winters kill many pests.
- — Fruit-fly infestations prevent exports of many crops, or require expensive treatment.
- — Most soils in Hawai'i have low nutrient levels and therefore require high expenditures for fertilizer.
- — Hawai'i suffers from high farm-labor costs, largely because the agriculture industry must compete against the visitor industry and related industries for its labor.
- — Compared to many other farm areas that supply U.S. markets, the cost of shipping agricultural supplies and equipment to Hawai'i is high, as is the cost of exporting produce from Hawai'i to mainland markets. High shipping costs are a result of Hawai'i's remote location and to Federal regulations that require use of American-built ships and U.S. crews between U.S. ports.
- — For a number of crops, consumption volumes in Hawai'i are too small to support large, efficient farms (i.e., the volumes are too small to realize economies of scale).
- — Trends towards crops that are certified as safe and towards a single supplier of many food items favor large farms.
- — Hawai'i farmers must compete against highly efficient mainland and foreign farms which, in a number of cases, can deliver produce to Hawai'i more cheaply than it can be produced locally. This is due to economies of scale and, in comparison to Hawai'i, low costs for land, labor, supplies, fertilizer, pest control, equipment, etc.

b. Land Available for Diversified Crops

State

Statewide, a vast amount of land has been released from plantation agriculture: about 249,900 acres between 1968 and 2004 —an average decrease of over 6,940 acres per year over a 36-year period (see Figure 10).[8,26] The 2006 closure of Del Monte's pineapple plantation in Kunia, O'ahu increased this acreage by about 5,100 acres, resulting in a total release of at least 255,000 acres from plantation agriculture between 1968 and 2007.[27]

Over this same period, the demand for land for diversified crops increased by about 26,500 acres, or an average of about 740 acres per year.[8,26] Since 1984, the growth has slowed to an average of 240 acres per year, as previously mentioned.

As the above indicates, the release of land from plantation agriculture has far outpaced the demand for land for diversified crops. The net decrease in crop land amounted to 223,400 acres, and will amount to 228,500 acres after adding the land fallowed by Del Monte. While some of the released land has been converted or is scheduled to be converted to urban uses and tree plantations, an estimated 160,000+ acres remain available for diversified crops.[25] Because of the increased availability of agricultural land, a number of landowners report lower per-acre land rents on O'ahu and the Neighbor Islands compared to rents that were charged before the major contraction in plantation agriculture.[24]

Once the Superferry begins operations in 2007, cultivating crops on the Neighbor Islands for the Honolulu market, and vice versa, will become more economically feasible. For a full load carried in a large pick-up truck, the one-way fare will be about 2¢ per pound.[28]

The above information indicates that ample land is available in Hawai'i to accommodate the growth of diversified crops, whether demand is based on potential or recent trends. In other words, the limiting factor to the growth of diversified crops is *not* the *land supply*, but rather the *size of the market* for crops that can be grown *profitably* in Hawai'i.

O'ahu

A similar release of land occurred on O'ahu. Between 1968 and 2004, about 47,500 acres were released from plantation agriculture due to the contractions and eventual closures of three sugar plantations, and the contractions of two pineapple plantations.[8,9] By 2007, this figure will increase to 52,600 acres due to the 2006 closure of the Del Monte pineapple plantation. Between 1990 and 2004, the land released from plantation agriculture on O'ahu totaled about 28,300 acres, and this will increase to 33,400 acres by 2007.

Much of this 33,400 acres released from sugar and pineapple production since 1990 remains available. Fields in Kunia and 'Ewa are regarded as being among the best farm land in the State, based on the high solar radiation, high-quality soils, and the short trucking distance to the large Honolulu market and, for export markets, to the Honolulu International Airport and Honolulu Harbor.[18] Except for the Del Monte fields, these lands have been leased for diversified agriculture. However, on average, only about one-third to one-half of this land is in crop.[29] The large amount of fallowing reflects best management practices when farm land is abundant and land rents are low. Fallowing increases soil fertility and helps control unwanted volunteers, weeds, insects and disease. When demand for farm land is strong and rents are high in response to a strong demand for agricultural products, then more intensive farming of the land is warranted even if this increases farmers' costs for pest control and soil additives.

On the North Shore, various crops are being grown, but about 9,600 acres of the former sugarcane and pineapple lands remain fallow or are in a low-value use.[24,30] However, portions of the North Shore water systems need repair, and the types of crops on fields irrigated with water from Lake Wilson will be restricted so long as partially-treated waste water is discharged into the lake. Even though the water is disinfected, water from Lake Wilson cannot be used to irrigate certain crops (e.g., vegetable crops) unless they are processed sufficiently to kill pathogens.

By 2007, about 14,700 acres of farm land will be available on O'ahu. This includes the 9,600 acres on the North Shore plus the 5,100 acres that came available following the 2006 closure of the Del Monte pineapple plantation. However, it excludes any adjustment for the farm land in 'Ewa and Kunia that is already leased for diversified crops but is not farmed intensively.

c. Impact on the Growth of Diversified Crop Farming

The Project will commit 1,781 acres of agricultural land to a non-agricultural use, of which about 100 acres are good for farming. If this much good land were used to grow a typical vegetable or fruit crop, it could support about 12.5 farm jobs (based on 100 acres and about 12.5 jobs per 100 acres).

More realistically, the development of this agricultural land—combined with other developments in Hawai'i—involves the loss of too little good agricultural land to significantly affect (1) the availability of land to farmers in Hawai'i, (2) agricultural land rents, (3) the growth of diversified crops, or (4) potential agricultural employment. This conclusion is based on the above finding that ample land is available for diversified crops, with the available supply far exceeding likely or potential demand.

More to the point, the good agricultural land in the Project Area has already been lost to crop farming because it is an agricultural remnant.

d. Mitigating Measures

In view of the negligible impact of the Project on the growth of diversified agriculture, mitigation measures for the loss of good agricultural land are not recommended.

11. ADVERSE AGRICULTURAL IMPACTS AND OFFSETTING BENEFITS

a. Summary of Adverse Agricultural Impacts

Most of the Project Area consists of sloping mountain hillside having poor soils. As a result, Makaiwa Hills will have only a small adverse impact on agriculture. Specifically, the Project will (1) result in the loss of about 100 acres of good agricultural land on the flatlands between the H-1 Freeway and Old Farrington Highway; (2) displace an 11-acre nursery, a non-commercial 76-acre pasture operation for horses, and cattle grazing on about 1,694 acres; and (3) result in the loss of 0 to 4 agricultural jobs, depending on whether other operations replace lost production.

b. Direct Benefits of the Project[31]

These adverse impacts to agriculture will be offset by the following benefits of the Project:

— about 4,100 homes for Hawai'i residents, along with a community commercial center, a neighborhood retail center, parks and open space, and an elementary school;

— construction and other jobs provided by development activity;

— at full development of the Project, about 1,100 on-site jobs provided by commercial activities and home services;

— tax revenues (excise taxes, personal income taxes, corporate income taxes, property taxes, etc.) generated by development activity; and

— tax revenues generated by the families and businesses that occupy the Project.

c. Indirect Benefits to Agriculture

If the Project does not proceed, then most of the proposed homes would be built as part of other planned and proposed residential projects elsewhere in 'Ewa and Central O'ahu that are within the City's Urban Growth Boundary. Inasmuch as a large portion of this land is prime agricultural land and is currently farmed, not developing Makaiwa Hills would accelerate the loss of prime agricultural land in 'Ewa and Central O'ahu, and would accelerate the displacement of crop farmers who now lease these lands.

Thus, the Project will benefit agriculture by delaying development on prime agricultural in 'Ewa and in Central O'ahu, and by delaying the displacement of crop farming from these lands.

12. CONSISTENCY WITH STATE AND CITY POLICIES[32]

a. Availability of Lands for Agriculture

The *Hawaii State Constitution*, the *Hawaii State Plan*, the *State Agriculture Functional Plan*, and the *General Plan of the City and County of Honolulu* call directly or implicitly for preserving the economic viability of plantation agriculture and promoting the growth of diversified crops. To accomplish this, an adequate supply of agriculturally suitable lands and water must be assured.

With regard to plantation agriculture, the Project Area is no longer part of a sugar plantation since about 100 acres of sugarcane fields were fallowed in the early 1980s and the plantation closed in 1995, both for reasons unrelated to the Project.

With regard to diversified crops, development of the Project Area will result in a small loss of good farm land, but this loss will not limit the growth of diversified crops since ample agricultural land is available on O'ahu and on other islands. This is due to the enormous supply of agricultural land that is now available following the contraction of plantation agriculture (see Section 10 and Figure 10).

From a broader perspective, development of the Project on mostly poor agricultural land will delay development on prime agricultural land in 'Ewa and Central O'ahu. In turn, this will contribute at least temporarily to the availability of high-quality land for agriculture. Much of this high-quality land is currently leased to farmers.

b. Conservation of Agricultural Lands

In addition to the above, State policies call for conserving and protecting prime agricultural lands, including protecting agricultural lands from urban development.

However, these policies—which were written before the major contraction of plantation agriculture in the 1990s—assume implicitly that profitable agricultural activities eventually will be available to utilize all available agricultural lands. This has proven to be a questionable assumption in view of the enormity of the contraction of plantation agriculture, the abundant supply of land that came available for diversified agriculture, and the slow growth in the amount of land being utilized for diversified agriculture (see Section 10 and Figure 10).

Furthermore, discussions in the Agriculture portion of the *State Functional Plan* recognize that redesignation of lands from Agricultural to Urban should be allowed "… upon a demonstrated change in economic or social conditions, and where the requested redesignation will provide greater benefits to the general public than its retention in …agriculture;" that is, when an "overriding public

interest exists." The enormous contraction in plantation agriculture, resulting in the supply of agricultural land far exceeding demand, constitutes a major change in economic conditions. Moreover, development in the Project Area will provide community benefits (about 1,100 on-site jobs at full development) that far exceed those provided by agriculture (about 3 or 4 jobs with the current nursery and a portion of the ranching operations, or about 12.5 jobs if the flatlands were farmed). In practice, however, development of the Project Area is likely to have little or no impact on Statewide agricultural employment.

Again, from a broader perspective, development of the Project on mostly poor agricultural land will delay development on prime agricultural land in 'Ewa and Central O'ahu. In turn, this will contribute at least temporarily to the conservation of prime agricultural land.

c. State Districting

The Project Area was redesignated from Agricultural to Urban in 1993 (see Figure 4). Thus, the Project is consistent with State land-use policies.

d. City's 'Ewa Development Plan

As shown in Figure 6, the Project Area is within the City's designated Urban Growth Boundary of the 'Ewa Development Plan in an area designated for residential and commercial development. Thus, the Project is consistent with the 'Ewa Development Plan.

13. REFERENCES

[1] Group 70 International. "Makaiwa Hills, Environmental Impact Statement Preparation Notice." October 2006.

[2] U.S. Department of Agriculture, Soil Conservation Service in cooperation with The University of Hawai'i Agricultural Experiment Station. *Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawai'i.* Washington, D.C. August 1972.

[3] Harold L. Baker. *Agricultural Lands of Importance in the State of Hawai'i.* University of Hawai'i College of Tropical Agriculture and Human Resources, Honolulu, Hawai'i. 1977.

[4] Land Study Bureau. *Detailed Land Classification – Island of O'ahu.* Honolulu, Hawai'i. December 1972.

[5] State of Hawai'i, Department of Business and Economic Development. *O'ahu Sunshine Map.*

[6] Juvik, Sonia P. and James O., *Atlas of Hawai'i, Third Edition*. University of Hawai'i Press. Honolulu, Hawai'i. 1998.

[7] Decision Analysts Hawai'i, Inc. *Hawai'i's Sugar Industry and Sugarcane Lands: Outlook, Issues and Options.* April 1989.

[8] Hawai'i Agricultural Statistics Service. *Statistics of Hawaiian Agriculture.* Honolulu, Hawai'i. Annual.

[9] Decision Analysts Hawai'i, Inc. *Hawai'i's Sugar Industry: Problems, Outlook and Urban Growth Issues.* State of Hawai'i, Department of Planning and Economic Development. Honolulu, Hawai'i. April 1981.

[10] Tracy Hoffman and Hallett H. Hammatt. "Field Inspection of Approximately 124 Acres at Kapolei, Honouliuli Ahupua'a, 'Ewa District, O'ahu." February 2004.

[11] James Campbell Company, LLC. 2006.

[12] Kapolei Nursery and Garden. 2006.

[13] Pasture lessee. 2006.

[14] Rocker G. Livestock Company. 1990, 1998 and 2006.

[15] Department of Business, Economic Development and Tourism. *The State of Hawai'i Data Book.* Honolulu, Hawai'i. Annual.

[16] Decision Analysts Hawai'i, Inc. "State Lands at Kalepa, Kaua'i: Assessment of Agricultural Potential and Recommendations." Prepared for the Department of Land and Natural Resources. Honolulu, Hawai'i. February 2002.

[17] U.S. Census Bureau. 2006.

[18] Decision Analysts Hawaii, Inc. *Agricultural Lands of Kunia and Central Ewa: Agronomic and Locational Advantages, Potential Crops, and Crop Budgets.* Honolulu, Hawai'i. December 1993.

[19] Ford Gunter. "Mill to Help Meet State's Ethanol Mandate." *The Garden Island.* April 22, 2006.

[20] Stewart Yerton. "Ethanol Producers Not Ready to Fill Mandate." *The Honolulu Star Bulletin.* March 15, 2006.

[21] O'ahu Ethanol. 2006.

[22] ClearFuels Technology, Inc. "Ethanol Progress Report Workshop." February 9, 2006.

[23] US Department of Agriculture. *The Economic Feasibility of Ethanol Production from Sugar in the United States.* July 2006.

[24] Discussions with major landowners on O'ahu. 2005 and 2006.

[25] Decision Analysts Hawai'i, Inc. 2006.

[26] Schmitt, Robert C. *Historical Statistics of Hawai'i.* The University Press of Hawai'i, Honolulu, Hawai'i. 1977.

[27] "More than 500 Laid Off in Del Monte Closure." Pacific Business News. November 17, 2006.

[28] Hawai'i Superferry. 2006.

[29] Discussions with farmers. 2006.

[30] Decision Analysts Hawai'i, Inc. "North Shore Planning District, O'ahu: Agricultural Resources, Situation and Outlook." July 1997.

[31] Decision Analysts Hawai'i, Inc. "Makaiwa Hills: Economic and Fiscal Impacts." December 2006.

[32] Appendix A. "Selected State and City Goals, Objectives, Policies and Guidelines Related to Agricultural Lands."

FIGURES

Figure 1. Project Location Map

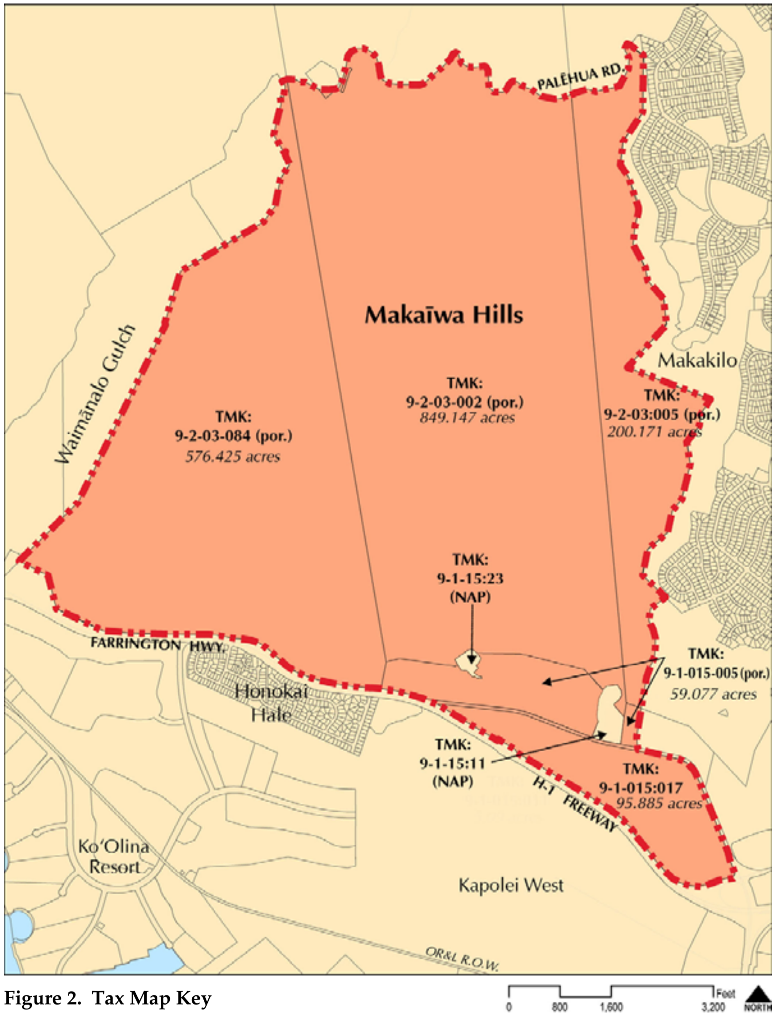


Figure 2. Tax Map Key

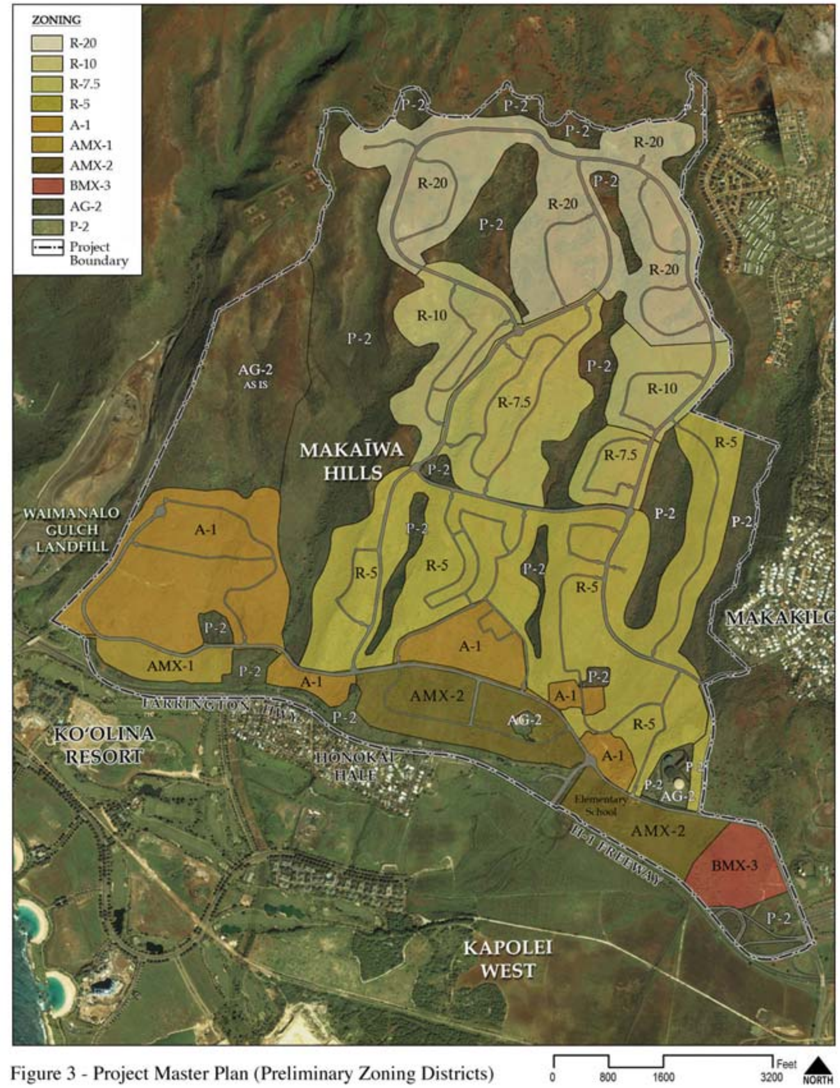


Figure 3 - Project Master Plan (Preliminary Zoning Districts)

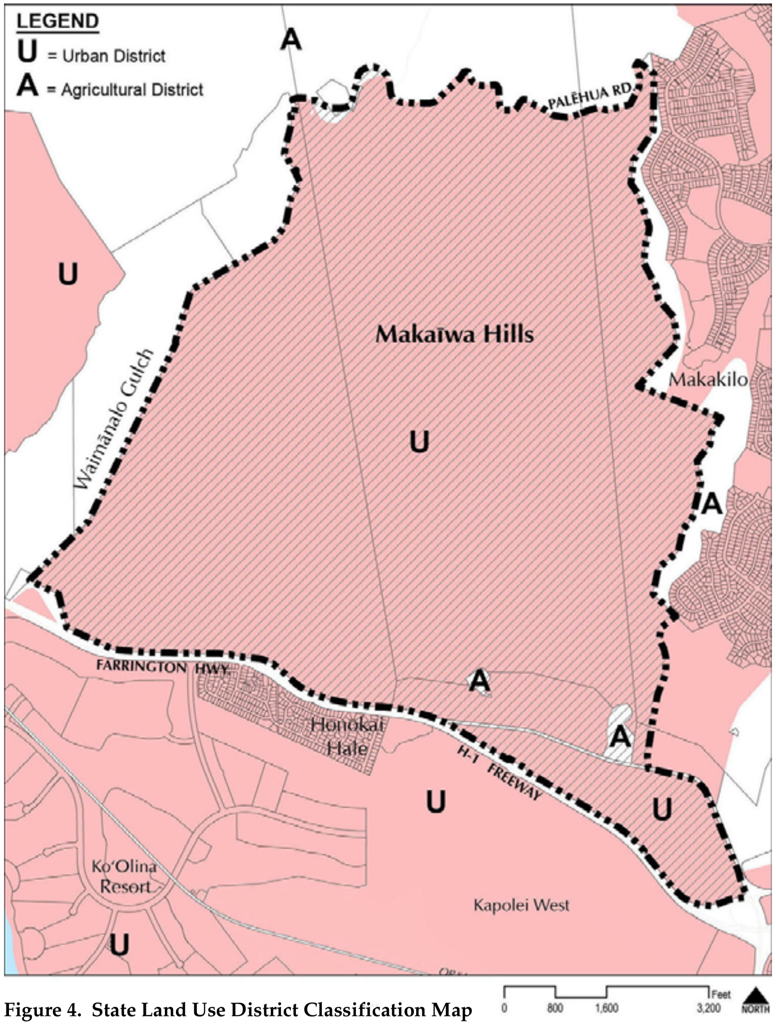


Figure 4. State Land Use District Classification Map

MAKAĪWA HILLS
Environmental Impact Statement Preparation Notice

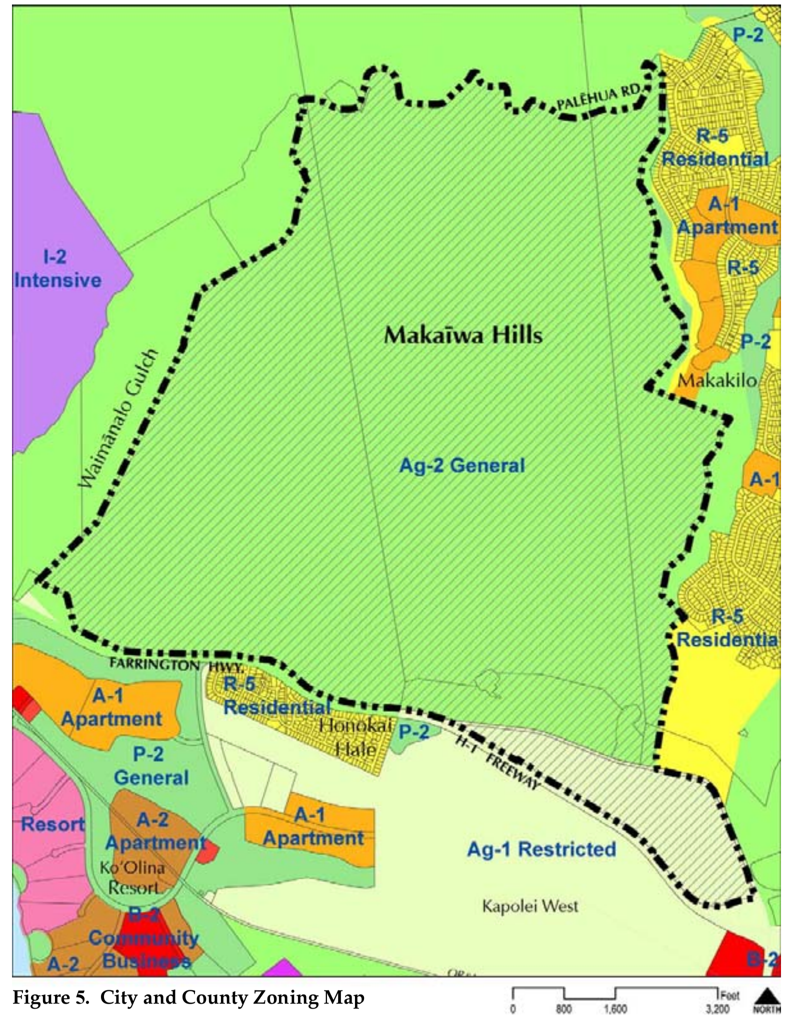


Figure 5. City and County Zoning Map

Makaiwa Hills, LLC

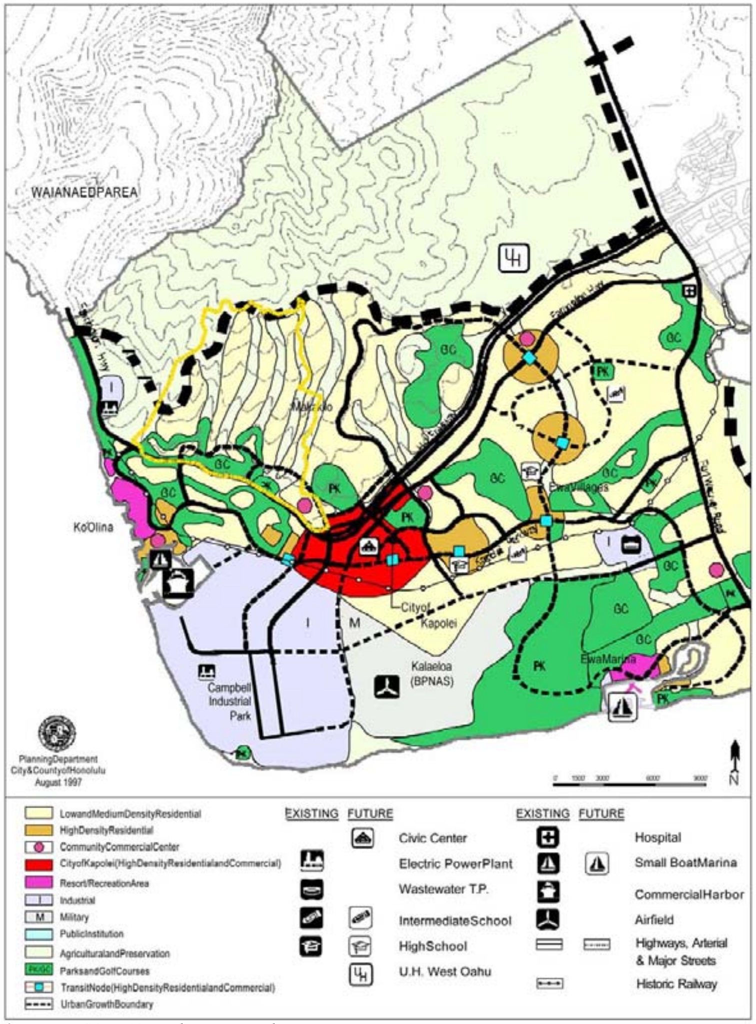
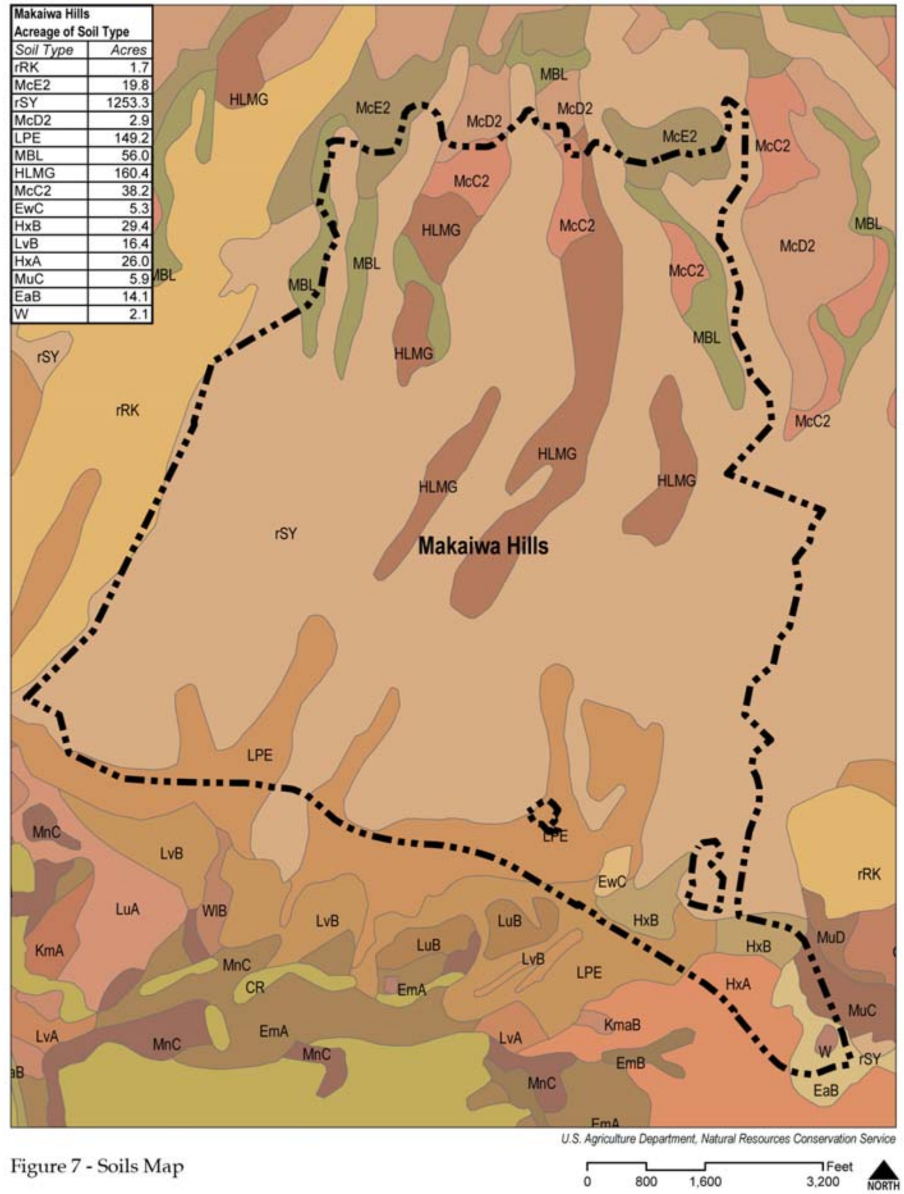


Figure 6. 'Ewa Development Plan



Makaiwa Hills Acreage of Soil Type	
Soil Type	Acres
rRK	1.7
McE2	19.8
rSY	1253.3
McD2	2.9
LPE	149.2
MBL	56.0
HLMG	160.4
McC2	38.2
EwC	5.3
HxB	29.4
LvB	16.4
HxA	26.0
MuC	5.9
EaB	14.1
W	2.1

Figure 7 - Soils Map

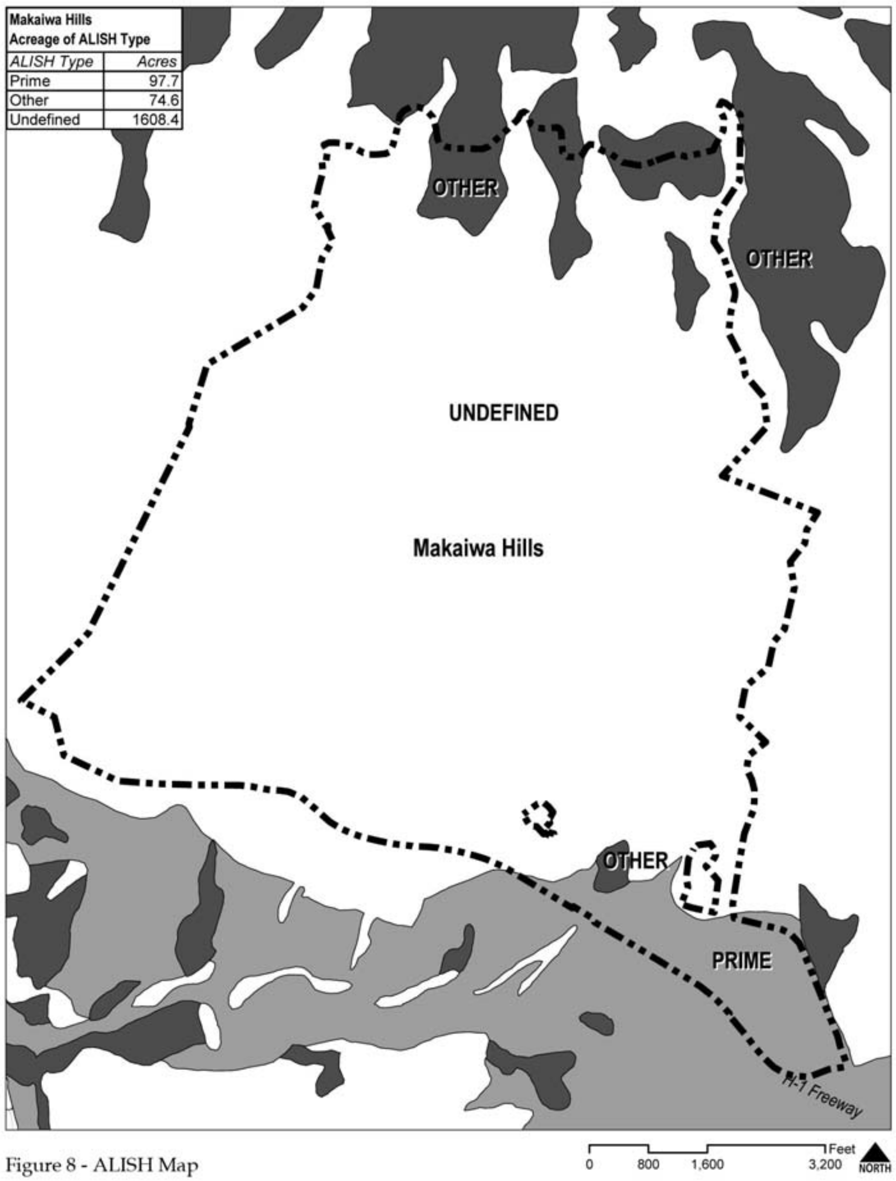


Figure 8 - ALISH Map

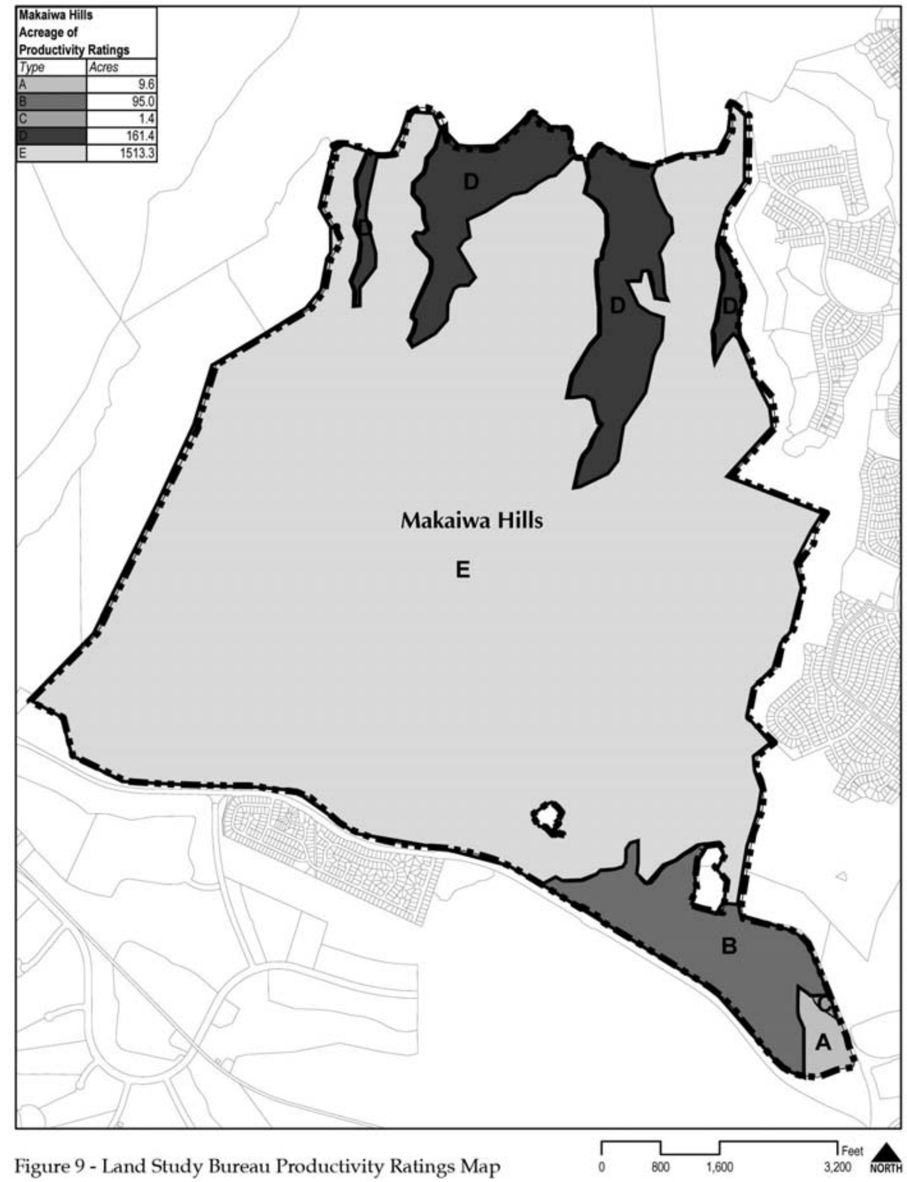
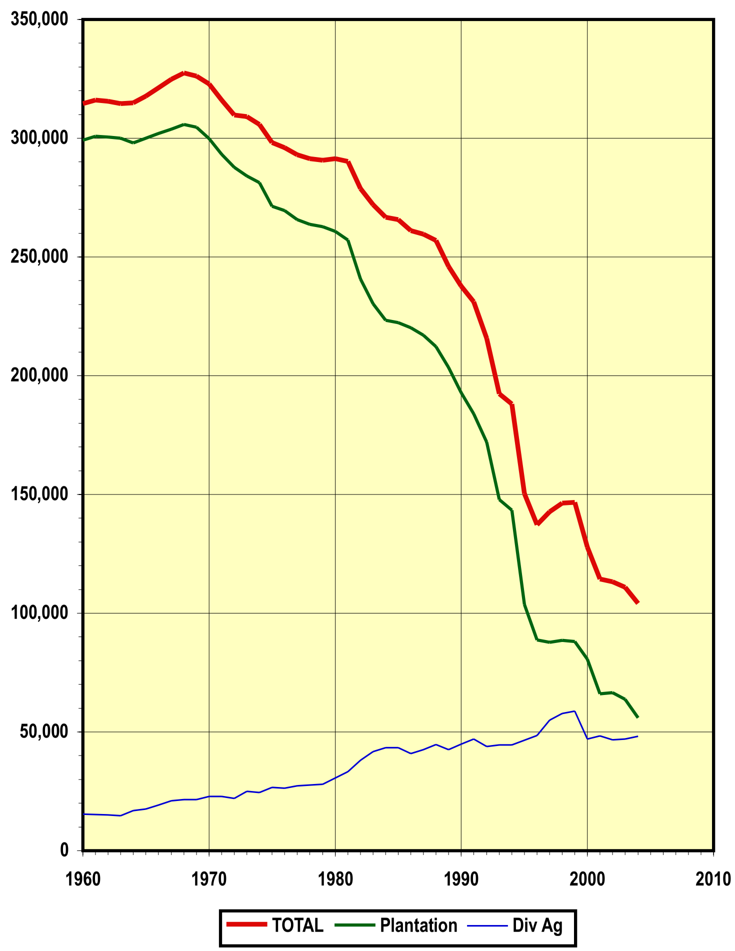


Figure 9 - Land Study Bureau Productivity Ratings Map

Figure 10 - Statewide Acreage in Crop: 1960 to 2004



APPENDIX A:
SELECTED STATE AND CITY GOALS, OBJECTIVES, POLICIES AND GUIDELINES RELATED TO AGRICULTURAL LANDS

1. HAWAI'I STATE CONSTITUTION (Article XI, Section 3):

> …to conserve and protect agricultural lands, promote diversified agriculture, increase agricultural self-sufficiency and assure the availability of agriculturally suitable lands…

2. HAWAI'I STATE PLAN (Chapter 226, Hawaii Revised Statutes, as amended):[1,2]

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) Viability in Hawaii's sugar and pineapple industries.

(2) Growth and development of diversified agriculture throughout the State.

(3) An agriculture industry that continues to constitute a dynamic and essential component of Hawaii's strategic, economic, and social well-being.

(b) To achieve the agricultural objectives, it shall be the policy of the State to:

(2) Encourage agriculture by making best use of natural resources.

(10) Assure the availability of agriculturally suitable lands with adequate water to accommodate present and future needs.

(16) Facilitate the transition of agricultural lands in economically nonfeasible agricultural production to economically viable agricultural uses.

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.

(10) Support the continuation of land currently in use for diversified agriculture.

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.

Section 226-106 Affordable Housing

Priority guidelines for the provision of affordable housing:

(1) Seek to use marginal or nonessential agricultural land and public land to meet housing needs of low- and moderate-income and gap-group households.

3. AGRICULTURAL STATE FUNCTIONAL PLAN (1991)[3]
(Functional plans are guidelines for implementing the State Plan. They are approved by the Governor, but not adopted by the State Legislature.)

Objective H: Achievement of Productive Agricultural Use of Lands Most Suitable and Needed for Agriculture.

Policy H(2): Conserve and protect important agricultural lands in accordance with the Hawaii State Constitution.

Action H(2)(a): Propose enactment of standards and criteria to identify, conserve, and protect important agricultural lands and lands in agricultural use.

Action H(2)(c): Administer land use district boundary amendments, permitted land uses, infrastructure standards, and other planning and regulatory functions on important agricultural lands and lands in agricultural use, so as to ensure the availability of agriculturally suitable lands and promote diversified agriculture.

4. CITY AND COUNTY OF HONOLULU
GENERAL PLAN, Objectives and Policies (Resolution No. 87-211)[4]

Economic Activity

Objective C. To maintain the viability of agriculture on Oahu.

Policy 1. Assist the agricultural industry to ensure the continuation of agriculture as an important source of income and employment.

Policy 2. Support agricultural diversification in all agricultural areas on Oahu.

Policy 3. Support the development of markets for local products, particularly those with the potential for economic growth.

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.

Policy 6. Encourage the more intensive use of productive agricultural land.

Policy 7. Encourage the use of more efficient production practices by agriculture, including the efficient use of water.

Policy 8. Encourage the more efficient use of nonpotable water for agricultural use.

5. CITY AND COUNTY OF HONOLULU
'EWA DEVELOPMENT PLAN[5]

3.1. Open Space Preservation and Development

3.1.1 General Policies

Open space will be used to:

- Provide long range protection for diversified agriculture on lands outside the Urban Growth Boundary.

6. REFERENCES

[1] State of Hawaii, Office of State Planning, Office of the Governor. The Hawaii State Plan, 1991. Honolulu, Hawaii. 1991.

[2] Act 25, S.B. No. 1158, April 15, 1993.

[3] Hawaii Department of Agriculture. The Hawaii State Plan: Agriculture, State Functional Plan. Honolulu, Hawaii. 1991.

[4] City and County of Honolulu, Department of General Planning. General Plan Objectives and Policies. Honolulu, Hawaii. 1992.

[5] City and County of Honolulu, Planning Department. 'Ewa Development Plan. Honolulu, Hawaii. August 1997 (Revised May 2000).

Appendix F
Economic Impact Assessment

Makaiwa Hills:
Economic and Fiscal Impacts

Decision Analysts Hawai'i, Inc.

Makaiwa Hills:
Economic and Fiscal Impacts

PREPARED FOR:

Makaiwa Hills, LLC

PREPARED BY:

Decision Analysts Hawai'i, Inc.

October 2007

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EXECUTIVE SUMMARY

1. PROPOSED DEVELOPMENT

Makaiwa Hills, LLC proposes to develop Makaiwa Hills ("the Project"), a planned residential community to be located on 1,780.705 acres on the southern slopes of the Wai'anae Mountain Range, 'Ewa District, O'ahu. The Project will include multi- and single-family homes; a Neighborhood Shopping Center; a Town Center; parks and open space; an elementary school and a middle school; and associated infrastructure (e.g., roadways, utilities, a potable water system, sewers, and drainage).

In total, about 4,100 homes are to be provided, including about 1,230 affordable homes (30%), about 1,102 typical market homes (27%), and about 1,768 upscale market homes (43%).[1]

Most buyers of the upscale homes are expected to be executives, managers and professionals who work in the Kapolei region. Thus, the upscale homes at Makaiwa Hills will allow these workers to become part of and contribute to the Kapolei community instead of commuting to Kapolei from distant communities. To a lesser extent, buyers of the upscale homes will also include wealthier retirees who are new to O'ahu, and part-time residents who desire vacation homes or second homes on O'ahu. The more expensive upscale homes are required for the Project success because of expensive infrastructure costs of hillside development.

2. MAJOR ECONOMIC IMPACTS AND BENEFITS

a. Employment

Figure ES-1 provides a plot of the approximate number of jobs that will be provided by Makaiwa Hills. The plot reflects the following job creation:

— Development Activities

- Average construction employment of about 640 workers during the 12-year development period.

1. The developer may provide the affordable homes on-site, off-site, pay an in-lieu fee, or some combination of these. For the economic and fiscal study, it is assumed that all of the affordable homes would be provided on-site.

- Average employment of about 980 additional workers dependent on construction activities.

— Operations

- On-site operating employment that grows to about 1,100 jobs at full development (versus 3 or 4 jobs for current activities on the property).

In addition to the above, about 155 public-school jobs will be attributable to Makaiwa Hills at full development, with about 100 jobs located at the two public schools within the Project Area and about 55 jobs located at nearby schools.

b. Fiscal

Figure ES-2 provides a plot of the approximate net revenues to the City and the State. The plot partially reflects the following major fiscal impacts and benefits:

— City

- Generated by 12 years of development activities:
  + Average revenues of about $1.4 million per year for funding highway and mass-transit improvements (not shown in Figure ES-2 because these items are also expenses)
- Generated by operations:
  + Net revenues that grow to about $4.6 million per year at full development of the Project
  + Revenues that grow to $1.1 million per year for funding mass transit (not shown in Figure ES-2 because this item is also an expense)

— State

- Generated by 12 years of development activities:
  + Net revenues averaging about $11.2 million per year
  + Average revenues of about $1.3 million per year for funding highway and school improvements (not shown in Figure ES-2 because these items are also expenses, although the revenue and expenditure amounts differ)
- Generated by operations:
  + Net revenues that grow to about $18.9 million per year at full development of the Project

As summarized above and in Figure ES-2, the Project will provide a net financial gain to both the City and the State. Sufficient tax revenues and other revenues will be available to provide the same level of service to residents living in the Project that is currently provided to other residents on O'ahu, and to help fund various government facilities and services that will benefit communities throughout O'ahu and the State.

For the City, net tax revenues are positive largely because of high property values for upscale homes, no homeowner exemption for second homes and vacation homes, few services when these homes are vacant, and high property tax rates on commercial property. The financial gain to the City differs from that of many other residential communities on O'ahu which are subsidized by tax revenues from resort, commercial, and industrial properties.

For the State, net revenues are high because of the many upscale homes that will be subject to higher-rate conveyance taxes, the amount of economic activity associated with building and selling upscale homes, the high incomes of many Project occupants combined with exposure to higher income-tax rates, high consumption expenditures of residents, and reduced services provided to retirees and part-time residents (e.g., no children in Hawai'i's schools so no school improvements or services, and few services when homes are vacant).

c. Affordable Housing

Makaiwa Hills will contribute to more affordable home prices by supplying:

— about 1,230 homes at affordable prices that are below market prices

— about 1,102 homes at market prices in competition with other residential projects in the Kapolei region and Central O'ahu

— about 1,768 upscale homes which will divert demand away from other projects and existing communities.

d. New Retirees and Part-time Residents

At full development of the Project, an estimated 349 upscale homes will be owned and occupied by wealthier retirees new to O'ahu, and about 173 upscale homes will be owned and occupied by wealthier part-time residents. Consumption expenditures by these two groups are estimated at about $25.8 million per year and $6.8 million per year, respectively. These expenditures will introduce a stable source of new income to Hawai'i coming from overseas. As such, they will amount to export income to Hawai'i similar in nature to visitor expenditures.

Figure ES-1. Employment

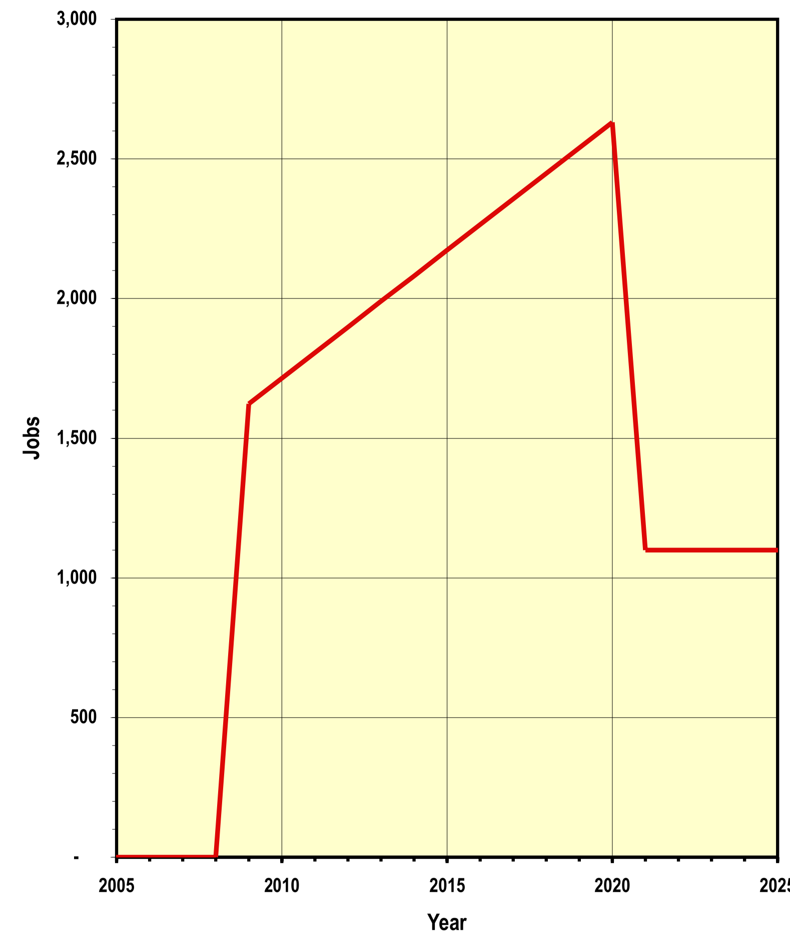
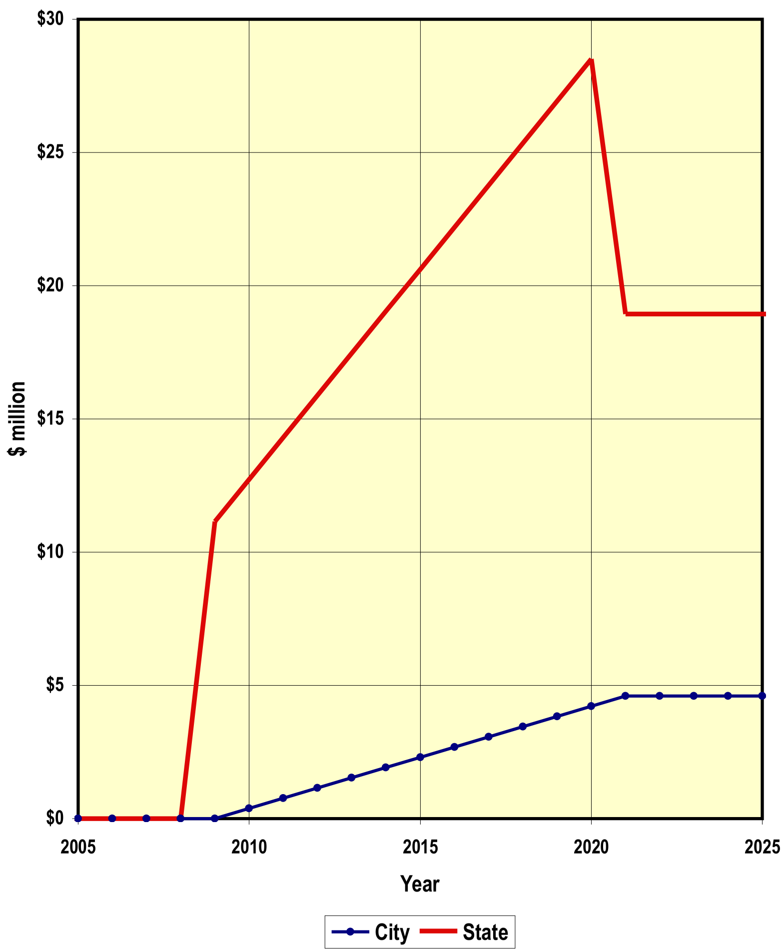


Figure ES-2. Net Revenues to the City and State



MAKAIWA HILLS:
ECONOMIC AND FISCAL IMPACTS

1. INTRODUCTION[1]

a. Content and Purpose

Makaiwa Hills, LLC proposes to develop Makaiwa Hills ("the Project"), a planned residential community to be located on 1,780.705 acres on the southern slopes of the Wai'anae Mountain Range, 'Ewa District, O'ahu. Figure 1 shows the location of the Project, Figure 2 shows the Tax Map Keys (TMKs), Figure 3 shows the Conceptual Site Plan, and Figure 4 shows the Proposed Zoning—the figures and tables are located at the end of this report.

The Project is within the State Urban District and is consistent with the City's Ewa Development Plan; however, City zoning is Agricultural (Figures 5, 6 and 7). Thus, the Project will require a change in zoning from Agriculture to a mix of Residential and Commercial zoning.

This report addresses the economic and fiscal impacts of the Project, along with associated benefits. Its purpose is to provide City officials with information relevant to their decisions about City zoning.

The economic impacts cover sales and expenditures, profits, employment, and payroll related to the (1) development activities and (2) operations at full development of the Project.

Fiscal impacts address the impact of the Project on City and State revenues and expenditures. The material covers the increase in City and State tax revenues, the increase in government support expenditures, and the resulting net revenues to the City and State.

b. Methodology

Multipliers

Proposed development is translated into economic and fiscal impacts based on a number of multipliers (for example, average price per home of a given type, construction cost as a percentage of price, indirect sales as a percentage of direct sales, jobs per $1 million in sales, indirect jobs per direct jobs, and tax rates).

The multipliers used reflect the professional judgment of the consultant, and were derived based on information from the following sources: 'Ewa developers; Hawai'i projects similar to the proposed Project; U.S. Census data for O'ahu and 'Ewa; the *State of Hawai'i Data Book; The 2002 Input-Output Study for Hawai'i;* employment and labor rates from the State Department of Labor and Industrial Relations (DLIR); research reports on residential projects; and revenue and expenditure data from the City and the State.[2-7]

2006 Dollars

Throughout the report, dollar amounts are expressed in terms of 2006 purchasing power and market conditions. Values, prices, costs and dollar amounts for prior years are adjusted for inflation to 2006 dollars based on the Honolulu Consumer Price Index (CPI) for Urban Consumers.[4] Dollar amounts after 2006 are not increased to account for inflation, appreciation in property values, changes in labor rates, changes in building costs, or other changes in market conditions.

Accuracy of Estimates

Much of the economic analysis contained in this report is quantitative in nature, where numbers are used to help communicate anticipated impacts. However, these numbers should not be interpreted as precise predictions. Rather, they represent the best estimates of what is expected to occur based on available information about future development, market conditions, and tax rates. As a general rule, economic and fiscal impact estimates in this report are accurate within about 20%.

c. Organization of the Report

The material below gives the following information on the Project and the economic environment: the Project's location; a description of the Project; current economic activities within the Project Area; the economic impacts of development activities, the economic impacts of operations at full development, assistance programs for new workers and businesses; the impact on City revenues and expenditures, the impact on State revenues and expenditures, other economic impacts and benefits, and a summary of major economic and fiscal impacts and benefits.

The detailed assumptions, multipliers, and calculations are shown in six tables at the end of the report. These tables cover the following:

- — Table 1: Proposed Development
- — Table 2: Economic Impacts of Development Activities
- — Table 3: Economic Impacts of Operations at Full Development
- — Table 4: Impacts on City Revenues and Expenditures
- — Table 5: Impacts on State Revenues and Expenditures
- — Table 6: Public School Staff Attributable to Makaiwa Hills

Figures in the table that are in **bold** highlight the more significant economic and fiscal impacts.

d. Economic Consultant

The analysis was conducted by Decision Analysts Hawai'i, Inc., a Hawai'i-based economic-consulting firm established in 1979, and specializing in economic development, land and housing economics, feasibility studies, valuations, market analysis, public policy analysis, and the economic and fiscal impacts of projects.

2. LOCATION OF THE PROJECT[1]

The Project Area is *mauka* of the H-1 Freeway and below Palehua Road, and between Makakilo on the east and Waimanalo Gulch on the west (Figure 1). As shown in Figure 2, the Project Area is also defined by five TMK parcels:

—TMK 9-1-015-005 (por)	59.077 acres
—TMK 9-1-015-017 (por)	95.885 acres
—TMK 9-2-003-002 (por)	849.147 acres
—TMK 9-2-003-005 (por)	200.171 acres
—TMK 9-2-003-084 (por)	576.425 acres

3. PROJECT DESCRIPTION[1,8]

a. Overview

As indicated in Figures 3 and 4 and Table 1, the Project will include multi- and single-family homes; a Neighborhood Shopping Center; a Town Center; parks and open space that will provide limited recreational use; an elementary school and a middle school; and associated infrastructure (e.g., roadways, a potable water system, sewers, drainage, and other utilities). About 105 acres will remain in agriculture.

b. Homes[1]

The anticipated number of homes by type is summarized in Section 1.b. of Table 1. They include:

— Affordable and market multi-family medium-density homes

Affordable and market homes in six-plexes and in buildings of three to four stories will be located at lower elevations in areas designated as A-1, AMX-1, AMX-2 and BMX-3 (see Figures 3 and 4). They will be similar to and competitive with medium-density multi-family homes offered in Makakilo, other Kapolei communities, and Central O'ahu. However, homes having views overlooking Kapolei will command higher prices. The affordable units

1. The developer may provide the affordable homes on-site, off-site, pay an in-lieu fee, or some combination of these. For the economic and fiscal study, it is assumed that all of the affordable homes would be provided on-site.

will be priced for families having incomes near or below median O'ahu incomes.

— Market multi-family low-density homes

Market homes in two- and four-plexes and in buildings of two to three stories will be located at lower elevations in areas designated as A-1, AMX-2 and AMX-3 (see Figures 3 and 4). They will be similar to and competitive with low-density multi-family homes offered in Makakilo, other Kapolei communities, and Central O'ahu. However, homes having views overlooking Kapolei will command higher prices.

— Upscale market multi-family low-density homes

Upscale market homes in two- and four-plexes and in buildings of two to three stories will be located at lower elevations in areas designated as A-1 and AMX-1, and mauka of Ko 'Olina Resort (see Figures 3 and 4). These units will offer more and higher-quality amenities than are typical of most multi-family homes offered in Makakilo, other Kapolei communities, and Central O'ahu. Also, they will have views of Ko 'Olina Resort and the ocean beyond. They are expected to sell at higher prices that reflect their amenities and views.

— Affordable and market single-family medium-density homes

Affordable and market homes on lots of at least 5,000 sq. ft. will be located at low- to mid-elevations in areas designated as R-5, but excluding the westernmost R-5 area (see Figures 3 and 4). These homes will be similar to and competitive with medium-density single-family homes offered in Makakilo, other Kapolei communities, and Central O'ahu. However, homes having views overlooking Kapolei will command higher prices. The affordable units will be priced for families having incomes near or slightly higher than median O'ahu incomes.

— Upscale market, single-family homes, various lot sizes

Upscale homes will be offered on lots ranging in size from at least 5,000 sq. ft. to over 20,000 sq. ft. The smaller lots will be in the westernmost R-5 area, while the larger lots will be located at higher elevations in areas designated as R 7.5, R-10 and R-20 (see Figures 3 and 4). These homes will feature more and higher-quality amenities than most homes offered in Makakilo, other Kapolei communities, and Central O'ahu. And nearly all of them will feature sweeping views of Kapolei, Ko 'Olina, and the ocean. Homes on lots of 20,000+ sq. ft. are common on the Neighbor Islands, but are rarely offered on O'ahu. Prices will reflect the larger lots, amenities, and sweeping views.

In total, about 4,100 multi-family and single-family homes are to be provided, including about 1,230 affordable homes (30%), about 1,102 typical market homes (27%), and about 1,768 upscale market homes (43%).

Most buyers of the upscale homes are expected to be executives, managers and professionals working in the Kapolei region. Thus, the upscale homes at Makaiwa Hills will allow these workers to become part of and contribute to the Kapolei community instead of commuting to Kapolei from distant communities. To a lesser extent, buyers of the upscale homes will also include wealthier retirees who are new to O'ahu, and part-time residents who desire vacation homes or second homes on O'ahu. Upscale homes for these buyers are a common product on the Neighbor Islands.

The more expensive upscale homes are required for the Project's success due to the expensive infrastructure costs for hillside development.

c. Commercial Space

The Project will include about 240,000 sq. ft. of commercial space in a Neighborhood Shopping Center located in an area designated as BMX-3, a Town Center in an area designated as AMX-2, and other commercial space in an area designated as AMX-1 (see Figures 3 and 4, and Table 1).

The commercial areas will be similar to other neighborhood commercial centers on O'ahu. Tenants may include supermarkets, family and fast-food restaurants, ice-cream parlors, hair salons, bookstores, video rental stores, boutique clothing stores, banks, veterinarian clinics, pet stores, garden supply stores, automobile service stations, auto parts stores, accountants, attorneys, dentists, and medical doctors.

Most customers are expected to come from Makaiwa Hills, thereby reducing travel to stores outside the community. Most employees are expected to come from nearby communities.

4. CURRENT ECONOMIC ACTIVITIES[9]

Currently, three agricultural operations are located within the Project Area and, in total, provide about 3 or 4 jobs.

a. Kapolei Nursery and Garden

Located on about about 11 acres of flatland between the H-1 Freeway and old Farrington Highway, the nursery serves as a grow-out area for ornamental trees destined for projects in 'Ewa and elsewhere. The nursery provides 2 to 3 jobs.

The impact of the Project on Kapolei Nursery and Garden will depend on whether about 11 acres of suitable land can be obtained at acceptable terms. If it can, then the nursery will relocate with no significant impact on its operation. If suitable land cannot be obtained, then the nursery will close. In turn, other nurseries are likely to increase their operations to compensate for the loss in the supply of ornamental trees, or one or more new nurseries may enter the market. Thus, there could be a shift in nursery operations, but no significant island-wide loss of nursery production, revenues, employment, or payroll.

b. Pasture Operations on the Flatlands

A husband and wife lease about 76 acres of the flatland to pasture 7 to 8 horses. The horses are kept for personal enjoyment by the family; the operation is not a commercial enterprise and provides no employment. The eventual development of the Project will require the operator to find other grazing land on O'ahu.

c. Rocker G Livestock Company

Rocker G Livestock Company (Rocker G) grazes cattle on about 1,694 acres of the Project Area. This area includes about 73 acres of the flatlands between the H-1 Freeway and old Farrington Highway plus the hillside above the Highway up to Palehua Road. The entire Rocker G ranch encompasses about 4,009 acres located on each side and above Makakilo up to the Honouliuli Forest Reserve.

Development of the Project will remove about 1,568 acres (39%) of Rocker G's grazing land. This loss in acreage will result in a reduction of about $36,000 in gross annual revenues, about 1.2 jobs, and about $20,000 in annual payroll.

5. ECONOMIC IMPACTS OF DEVELOPMENT ACTIVITIES

The development of Makaiwa Hills will involve the following activities: (1) construction of internal roads, water delivery systems, sewer systems, utilities systems, etc.; (2) construction and sale of homes; (3) sale of improved lots for commercial development; (4) construction of buildings by companies that buy the lots; and (5) sale of some improved buildings to other companies. Table 2 summarizes the direct and indirect economic impacts of these development activities. The material in the table gives the development period, construction expenditures, indirect sales generated by construction activity, property sales and values, profits, employment and payroll, and the number of residents and homes supported by the development activities.

a. Development Period

As indicated in Table 2, Section 2.a, development is expected to occur over a 12-year period starting in about 2008. However, development could require more or less time, depending on future market conditions and home sales.

b. Expenditures, Sales and Profits

Over the 12-year development period, total construction expenditures for infrastructure, homes and commercial space are estimated at about $1.53 billion. This translates into average construction expenditures of about $127.4 million per year (Table 2, Section 2.b). In practice, construction expenditures will vary from year to year.

In addition to construction expenditures, development activities will generate indirect sales associated with supplying goods and services to construction companies and to the families of the employees of these companies. In turn, the companies supplying goods and services, and the families of the employees of these companies will purchase goods and services from other companies, and so on. The indirect sales will include sales by companies that supply building materials (cement, steel, lumber, roofing materials, plumbing equipment, electrical equipment, hardware supplies, lighting, flooring, etc.); rent out construction equipment; repair equipment; provide warehousing services; provide shipping and trucking services; etc. Indirect sales also include sales by grocery stores, drug stores, restaurants, service stations, hair salons, medical providers, accountants, attorneys, insurance agents, etc. Based on State economic multipliers, these indirect sales are expected to average about $105.3 million per year.

Although not estimated, additional development costs include planning, permitting, design, financing, City and State exactions, and marketing and sales (see footnote for Table 2, Section 2.d).

Home sales are expected to reach about $2.45 billion, or an average of about $204.4 million per year during the 12-year development period (Table 2, Section 2.e). As indicated in the table, average prices for the homes are expected to range from about $315,000 for the affordable multi-family homes to about $1.3 million for estates on the largest lots. Prices for the affordable units are based on U.S. Department of Housing and Urban Development (HUD) price guidelines for Honolulu.[10] Prices for market homes and upscale homes are based on (1) similar products being sold at Makakilo, Ocean Pointe, Mililani Mauka, and Ko 'Olina; and (2) appropriate adjustments for lot sizes, planned amenities, and views.

At full development, the commercial property is expected to have a value of about $96 million.

Section 2.f of Table 2 summarizes anticipated expenditures and sales. As indicated, home sales, construction expenditures and indirect sales related to development activities are expected to total about $437.1 million per year during the 12-year development period. About $247.9 million per year will be subject to the 4.5% excise tax on final sales, while about $189.3 million per year will be subject to the 0.5% excise tax on intermediate sales. Development and sales in some years may be much higher or lower than the average, depending on market conditions.

Profits on these sales are estimated at about $50.1 million per year (Table 2, Section 2.g).

c. Employment

Construction employment is expected to average about 640 jobs (Table 2, Section 2.h). These jobs will include supervisors, heavy-equipment operators (grading, roads, water mains, sewer lines, etc.), cement workers to lay foundations, metal workers, carpenters, plumbers, electricians, roofers, glass and window installers, cabinet makers, carpet and tile layers, painters, equipment installers, interior decorators, landscapers, etc. Other jobs related to construction will include architects, civil engineers, draftsmen, government inspectors, etc. These jobs will range over a variety of skills, including entry-level, semi-skilled, skilled, management, and professional positions.

As with indirect sales, development activities will generate indirect jobs associated with supplying goods and services to construction companies and to the families of the employees of these companies. In turn, the companies supplying goods and services, and the families of the employees of these companies will purchase goods and services from other companies, and so on. Indirect jobs will include those at companies that supply building materials (cement, steel, lumber, roofing materials, plumbing equipment, electrical equipment, hardware supplies, lighting, flooring, etc.); rent construction equipment; repair equipment; provide warehousing services; provide shipping and trucking services; etc. Other indirect jobs will include those involved with supplying goods and services to employees and their families: grocery workers, store clerks, restaurant workers, service-station workers, beauty technicians, barbers, bankers, druggists, veterinarians, computer technicians, medical workers, accountants attorneys, etc. The jobs will range over a variety of skills, including entry-level, semi-skilled, skilled, and management positions.

Based on State employment multipliers, indirect employment related to Project development is expected to average nearly 980 jobs. Thus, total direct-plus-indirect employment associated with Project development activities will average about 1,620 jobs. It is estimated that about 1,130 of these jobs will be in the Kapolei region. The actual job count will fluctuate over time, depending on the pace of construction.

Development activities will provide jobs to construction workers and other workers who already live on O'ahu. As other construction projects are completed on the island, O'ahu construction workers will be hired to work on the various components of the Project.

d. Payroll

Development activities are expected to generate a total payroll of about $70.3 million per year, of which about $32.2 million will be for construction workers and $38.1 million for indirect employment (Table 2, Section 2.i). These estimates are based on the average number of direct and indirect jobs that will be supported and average wages as reported to the DLIR.

Wages will range from about $25,000 annually to over $100,000, and are expected to average about $50,000 per year for construction jobs, and about $38,900 for indirect jobs.

e. Population and Housing

During the 12-year development period, jobs provided by the Project development will support about 3,570 residents housed in about 1,070 homes (Table 2, Sections 2.j and 2.k). About 1,420 residents and 425 homes will be supported by construction jobs, and the remainder will be supported by indirect jobs. Development activities will support the families of many construction workers and other workers who already live on O'ahu.

Most of the residents are expected to live in the Kapolei region: estimated at about 2,210 residents housed in about 660 homes.

6. ECONOMIC IMPACTS OF OPERATIONS AT FULL DEVELOPMENT

Table 3 summarizes the estimated number of people who will live or stay in homes in the Project at full development, and the estimated on-site economic activity at full development. As indicated above, full development is expected to occur about 12 years after construction starts.

a. Housing Uses and Characteristics, Detailed

Section 3.a of Table 3 summarizes the assumptions that are used to estimate many of the impacts. For each type of home, the material covers:

- — the percentage split among homes rented by kama'aina residents, homes owned and occupied by kama'aina residents, homes owned and occupied by retirees new to O'ahu, and homes occupied by part-time residents who purchase a second or vacation home.
- — for each type of unit and use, the average percentage of units that are occupied;
- — for occupied units, the average number of occupants;
- — for rented units, the average monthly rent;
- — for resident owners and renters, the estimated household income subject to Hawai'i income taxes;
- — anticipated consumption expenditures that are subject to the 4.5% excise tax; and
- — average property values.

b. Housing Uses and Characteristics, Summary

Section 3.b of Table 3 summarizes housing use based on the given assumptions. As shown, it is expected that, at full development, about 613 homes (15%) will be rented by kama'aina residents, about 2,965 homes (72%) will be owned and occupied by kama'aina residents, about 349 homes (8.5%) will be owned and occupied by retirees new to O'ahu, and about 173 homes (4.2%) will be owned and occupied by part-time residents.

The Project will house about 11,600 people, including about 10,790 kama'aina residents, about 680 retirees new to O'ahu, and about 130 part-time residents. The low number of part-time residents reflects the fact that many vacation and second homes are occupied only a few months each year.

An estimated 1,380 students will be enrolled in public schools.

Total annual rental income for the homes is estimated at about $17.7 million per year.

Household income taxable by the State of Hawai'i and taxable consumption expenditures are about $358.6 million per year and $174.8 million per year, respectively.

Total home value is expected to amount to about $2.45 billion.

c. On-site Economic Activities

At full development, on-site economic activities are expected to generate about $130.7 million per year in revenues (Table 3, Section 3.c) This estimate includes retail sales (about $72 million per year), rents from homes and commercial space, services provided from home offices, and home and grounds maintenance. Most of the retail sales are expected to come from the purchase of goods and services from Makaiwa Hills residents.

Corresponding profits will amount to about $13 million per year at full development of the Project.

On-site operating employment is expected to total about 1,100 jobs, including retail jobs, home and grounds maintenance jobs, and home-office jobs. The new jobs will provide employment to (1) workers who already live in the Kapolei region and nearby communities but who must commute to distant jobs, and (2) workers who will be new residents of the Kapolei region and nearby communities. Corresponding payroll is estimated at about $33.4 million per year.

In addition to the above jobs provided by the Project, about 155 public-school jobs will be attributable to Makaiwa Hills at full development, with about 100 jobs located at the two public schools within the Project Area and about 55 jobs located at nearby schools (see Table 6). Approximately 100 of the jobs (65%) will be professional education staff, most of whom will receive wages exceeding $50,000 per year.

7. ASSISTANCE PROGRAMS

a. Education, Job-Training and Placement Programs

Job training for construction, maintenance, restaurant, and retail workers includes formal education and training programs, apprenticeship programs, and on-the-job training. In particular, Honolulu Community College offers a large selection of work-training programs for various trades and professions, including courses in carpentry, electrical installation, cement finishing, tile work, drywall installation, sheet metal work, floor installation, window installation, ironworks, steel fabrication, plastering, plumbing, pipe-fitting, refrigeration and air conditioning, roofing, heavy equipment operation, welding, plastic fabrication, machine operation, power technology, automotive technology, drafting, computers, business, etc. In addition, Leeward Community College offers courses in businesses, culinary arts, and automotive technology.

Since existing programs to increase the number of construction, maintenance, restaurant, and retail workers are already in place or can be expanded as needed, special education and job-training programs for these occupations appear to be warranted.

Job-placement programs for workers are offered by high schools, community colleges and DLIR. Also, trade unions and informal networks already exist to inform available workers of employment opportunities. Thus, special job placement programs are not warranted.

b. Business Assistance Programs

Some businesses that locate at Makaiwa Hills or plan to locate there might benefit from business assistance programs. Public and private organizations offering assistance to businesses are listed below, along with brief descriptions of their programs.

— Alu Like Inc.

Alu Like helps Hawaiians interested in starting a business or in expanding their current operations. The Entrepreneurship Training Program provides classroom training in general business concepts, business planning, marketing and record keeping. The Management & Technical Assistance Program, underwritten by the Office of Hawaiian Affairs, offers individual consulting services by various specialists.

Alu Like also provides a wide range of office-support services and technical assistance, including bookkeeping and payroll support.

— Business Consulting Resources

Business Consulting Resources provides consulting services on managing businesses.

— Business Information and Counseling Center

The Business Information and Counseling Center combines one-on-one counseling with an up-to-date reference library that includes computer and audio-visual training facilities. Its focus is to guide prospective and present small business owners and managers in researching and preparing business plans, marketing plans, and loan applications. In addition, the Small Business Learning Center introduces business owners to computers and their business applications.

— Chamber of Commerce of Hawaii

The Small Business Center of the Chamber of Commerce in Honolulu provides business information, consulting services, referrals, networking opportunities, seminars, workshops, and training programs to entrepreneurs and established businesses.

— Department of Business, Economic Development and Tourism, State of Hawai'i

The Business Action Center of the Department of Business, Economic Development and Tourism (DBEDT) is a "one-stop" office for obtaining a General Excise Tax (GET) license, registering a new business and/or trade name, registering as an employer, obtaining information on required licenses and permits, and obtaining information on services offered by other organizations.

In addition, DBEDT has a number of programs to help businesses of all types. Programs cover loan guarantees; business loans to assist small businesses that are unable to secure private financing; assistance in applying for grants and loans; marketing assistance; information on Federal, State and County regulations; and referrals.

— Department of Labor and Industrial Relations, State of Hawaii

The Employment and Training Fund Program, administered by DLIR, works with employers to customize training programs to meet the specific needs of employers and of individuals who have become unemployed or are likely to become unemployed. Emphasis is given to jobs where a shortage of skilled workers exists, or where high growth is anticipated.

— Hawaii Business League

The Hawaii Business League interprets and provides information on laws, rules, and regulations that affect small businesses. Other services include business counseling and seminars.

— Hawaii Employers Council

The Hawaii Employers Council in Honolulu offers workshops, seminars and assistance on labor relations, collective bargaining procedures, and labor laws.

— The Immigrant Center

The Immigrant Center's Resource for Enterprise Development Manini program provides business training, loans and technical support for people who would like to start or expand "micro-businesses."

— Management Advisory Services, Inc.

Management Advisory Services, Inc. provides management consulting services to small businesses.

— Leeward Community College

Leeward Community College offers courses in business, accounting, and management.

— Minority Business Development Center

The Minority Business Development Center in Honolulu provides business consulting and technical assistance to businesses owned by ethnic minorities.

— National Federal of Independent Business

The Hawai'i branch of the National Federation of Independent Business is involved in legislation relating to small business and promoting the positions of its members. Its education and research department prepares studies on special problems of small businesses.

— Office of Hawaiian Affairs

Through its Native Hawaiian Revolving Loan Fund, the Office of Hawaiian Affairs offers low-interest loans for business start-ups or expansion of existing businesses that are owned entirely by native Hawaiians.

— Pacific Business Center Program, UH Manoa

The Pacific Business Center Program, University of Hawaii at Manoa, provides a wide range of business consulting services utilizing faculty and students at the University of Hawaii. The Center also provides workshops, training programs, and management audits.

— Small Business Administration, U.S. Department of Commerce

The Small Business Administration provides loan guarantees, loans, bonding assistance, business counseling, training, workshops, seminars, publications and educational materials.

— Small Business Development Center Network, UH Hilo

The Small Business Development Center Network provides management and technical assistance to small businesses and prospective businesses; consulting in business planning, loan proposals, marketing research, etc.; counseling; referrals; workshops; and management-training seminars. Teams of advanced business students perform management analysis and consultation.

— Small Business Hawaii

Small Business Hawaii in Honolulu provides business advisory and consulting services, seminars, a referral program, and other services.

In view of the many business assistance programs that are available, additional programs appear to be unwarranted.

8. IMPACTS ON CITY REVENUES AND EXPENDITURES

The impact of the Project on City finances is shown in Table 4. This table summarizes: (1) changes in the City's tax and expenditure base that is used to calculate revenues and expenditures, (2) revenues and expenditures related to development activities, and (3) revenues and expenditures related to operations at full development.

a. Development Activities

Most City revenues derived from Project development activities will come from (1) highway impact fees to support highway improvements in the Kapolei region, (2) the City's share of the excise tax on final sales that will be used to fund mass transit, (3) other connect charges and user fees for funding infrastructure. The first two items will generate about $16.8 million over the 12-year development period, or about $1.4 million per year (Table 4, Section 4.b).

As with other major projects on O'ahu, the developer will provide or finance its fair shares of infrastructure and facilities to support the Project. This will include mass transit, highways, interior roads, water source development, graded and landscaped land for parks, interior water distribution, drainage systems, sewer connections, collector sewers and trunks, a wastewater treatment plant, etc. A new fire station is not anticipated since the Project will be served by the Makakilo Fire Station and the Kapolei Fire Station. Also, a new police substation is not anticipated since the Project is close to the new police station in Kapolei.

As indicated in Table 4, Section 4.b, the City's expenditures on highways and mass transit to support the Project are assumed to equal the corresponding

highway-impact fees and excise-tax / mass transit revenues generated by Project development. City expenditures on park improvements for Project residents, including improvements within and near the Project, are estimated at about $13.9 million.

Construction activities require few on-site services from the City. Furthermore, the services that will be required (security, sanitation, transportation, etc.) will be provided by construction companies.

For the City, Project development activity will result in a net expenditure of about $13.9 million over the 12-year development period. Assuming that this expenditure is financed with bonds, the debt service at full development will be about $920,000 per year. This expenditure is carried over to Section 4.c of Table 4 which addresses City revenues and expenditures derived from Project operations at full development.

b. Operations at Full Development

At full development, the Project will generate increased revenues to the City of about $16.9 million per year (Table 4, Section 4.c). Most of this increase will come from property taxes: an increase of about $9.22 million per year above the $26,900 currently collected on the property.[11] Additional revenues will be derived from the City's share of the excise tax on final sales that will be used to fund mass transit, and from other business-related taxes and user fees which are assumed to be proportional to the number of Project residents and jobs. Other revenues include: fuel taxes; motor vehicle weight taxes; water and sewer fees; solid-waste disposal fees; other departmental earnings; public service company taxes; other licenses, permits and fees; and fines, forfeits and penalties.

Expenditures in support of operations are estimated at about $12.2 million per year. As before, the City's expenditures on mass transit to support the Project is assumed to equal the corresponding excise-tax / mass transit revenues generated by Project operations. Most of the City expenditures will be on services, which are assumed to be proportional to the number of Project residents and jobs. These services include: police, fire, road maintenance, bus service, operations and maintenance (O&M) of water delivery, O&M of sewer systems and the wastewater treatment plant, solid waste disposal, culture and recreation, housing, etc. And as previously mentioned, there will be expenditures on debt service to cover the cost of City improvements and facilities.

At full development, net revenues to the City are expected to reach about $4.6 million per year. Thus, the City will realize a net financial gain which can be used to fund other City projects and services.

This net financial gain to the City reflects the high property values of upscale homes, no homeowner exemption for second homes and vacation homes, few services when these homes are vacant, and high property tax rates on commercial property. Such a gain to the City differs from that of many other residential communities on O'ahu which are subsidized by tax revenues from resort, commercial, and industrial properties. For typical residential communities, the cross-subsidies reflect lower home values, homeowner exemptions, and low property taxes on homes ($3.75 per $1,000 of value) compared to those on other urban properties ($11.37 per $1,000 of value).

9. IMPACTS ON STATE REVENUES AND EXPENDITURES

The impact of the Project on State finances is shown in Table 5. This table summarizes: (1) changes in the State's tax and expenditure base which is used to calculate revenues and expenditures, (2) revenues and expenditures related to development activities, and (3) revenues and expenditures related to operations at full development.

a. Development Activities

State revenues derived from Project development activities generate about $194.1 million over the 12-year development period, or an average of about $16.2 million per year (Table 5, Section 5.b). Most of the revenues will be derived from (1) highway impact fees to support highway improvements in the Kapolei region, (2) school impact fees, (3) conveyance taxes, (4) excise taxes, and (5) corporate and personal income taxes.

State expenditures to support Project development activities are expected to total about $60.3 million over the 12-year development period, or an average of about $5.0 million per year. The major expenditures will be on highway improvements (about $5.1 million based on the impact fee) and on schools (about $55.2 million for K to 12). Other infrastructure and facilities to support the Project are primarily a City responsibility, with most of the fair share provided or financed by the developer or by companies that will occupy buildings at Makaiwa Hills. Construction activities will require few on-site services from the State. Furthermore, most required services will be provided by construction companies.

Unlike the City, the State derives substantial net revenues from development activity. Over the 12-year construction period, the State will net about $133.9 million from development activities, or an average of about $11.2 million per year. Net revenues are high because of the many upscale homes that will be subject to higher-rate conveyance taxes, and the amount of economic activity associated with building and selling upscale homes.

b. Operations at Full Development

At full development of the Project, operations will generate revenues to the State of about $53.4 million per year (Table 5, Section 5.c). State revenues will include excise taxes, corporate and personal income taxes, and other revenues which are assumed to be proportional to the number of Project residents and jobs. Other revenues include: the public service companies tax; fuel tax; motor vehicle weight tax; charges for various licenses, permits, and services; departmental earnings; etc.

Expenditures in support of operations are estimated at $34.5 million per year, including about $9.7 million for education (K to 12) and the remainder for other services. Other services—which are assumed to be proportional to the number of Project residents and jobs—include university and adult education, health, highway maintenance, natural resources, parks and recreation, government administration, and miscellaneous expenditures.

At full development, net revenues to the State are expected to reach about $18.9 million per year. Net revenues are high because of the high incomes of many Project occupants combined with their exposure to higher income-tax rates; high consumption expenditures; and reduced services provided to retirees and part-time residents (e.g., no children attending Hawai'i's schools so no school improvements or services and few services when the homes are vacant).

10. OTHER ECONOMIC IMPACTS AND BENEFITS

a. Contribution to Affordable Housing

The Project will contribute to more affordable home prices by supplying about 1,230 homes at affordable prices and about 1,102 homes at market prices in competition with other residential projects in the Kapolei region and Central O'ahu.

Even the Project's 1,768 upscale homes will contribute to more affordable housing because they will increase both the supply of homes and competition among developers, thereby diverting demand away from other projects and existing communities.

b. Economic Contribution of New Retirees and Part-time Residents

At full development of the Project, an estimated 349 upscale homes (8.5%) will be owned and occupied by wealthier retirees new to O'ahu, and about 173 upscale homes (4.2%) will be owned and occupied by wealthier part-time residents (see Table 3, Section 3.b). The addition to O'ahu's population will total about 680 retirees and about 130 part-time residents. The latter figure is low because vacation homes and second homes are occupied only a few months a year.

Consumption expenditures by these two groups are estimated at about $25.8 million per year and $6.8 million per year, respectively. These expenditures will introduce a stable source of new income to Hawai'i that comes from overseas. As such, they will provide what amounts to export income to Hawai'i similar in nature to visitor expenditures. Consumption expenditures by these new retirees and part-time residents would be equivalent to expenditures by visitors staying in a 470-room hotel (based on a 75% occupancy rate, 2.1 visitors per room, daily expenditures of $120 per person on consumption but excluding the portion of the room charge that covers a mortgage). But unlike a new hotel that comes on-line all at once, the homes for retirees and part-time residents would be built over a period of about 12 years. The economic contribution of the new retirees and part-time residents will be the equivalent of building about 39 hotel rooms per year (470 room-equivalent ÷ 12 years).

However, unlike expenditures by visitors who stay in hotels, expenditures on home maintenance and property taxes by part-time residents who own vacation and second homes will continue even when they are not in Hawai'i. But like visitors, retirees and part-time residents require fewer government services than do kama'aina residents: they require no expenditures on school facilities and services, and part-time residents require few (if any) services when they are not staying in Hawai'i.

To an undetermined extent, the new retirees and part-time visitors at Makaiwa Hills might make economic contributions far beyond just their expenditures in Hawai'i. Since many of them will be entrepreneurs, investors, and current or former members of the business community and high-technology industries, they will have access to other leaders in their fields, others in the business community, and to investment capital. Their entrepreneurial spirit, knowledge, and business connections could offer potential for significant economic development for O'ahu in fields that can help diversify the economy. One of the better examples is Henry J. Kaiser. After moving to Hawai'i when he was in his early 70s, he started what is now the Hilton Hawaiian Village, Hawai'i Kai, Kaiser Hospital, a cement plant, a television station, a radio station, and other businesses.

11. SUMMARY OF MAJOR ECONOMIC IMPACTS AND BENEFITS

Summarized below are the major economic impacts and benefits that will be provided by Makaiwa Hills.

a. Employment

Figure ES-1 provides a plot of the approximate number of jobs that will be provided by Makaiwa Hills. The plot reflects the following job creation:

— Development Activities
- Average construction employment of about 640 workers during the 12-year development period.
- Average employment of about 980 additional workers dependent on construction activities.

— Operations
- On-site operating employment that grows to about 1,100 jobs at full development (versus 3 or 4 jobs for current activities on the property).

In addition to the above, about 155 public-school jobs will be attributable to Makaiwa Hills at full development, with about 100 jobs located at the two public schools within the Project Area and about 55 jobs located at nearby schools.

b. Fiscal

Figure ES-2 provides a plot of the approximate net revenues to the City and the State. The plot partially reflects the following major fiscal impacts and benefits:

— City
- Generated by 12 years of development activities:
  + Average revenues of about $1.4 million per year for funding highway and mass-transit improvements (not shown in Figure ES-2 because these items are also expenses)
- Generated by operations:
  + Net revenues that grow to about $4.6 million per year at full development of the Project
  + Revenues that grow to $1.1 million per year for funding mass transit (not shown in Figure ES-2 because this item is also an expense)

— State
- Generated by 12 years of development activities:
  + Net revenues averaging about $11.2 million per year
  + Average revenues of about $1.3 million per year for funding highway and school improvements (not shown in Figure ES-2 because these items are also expenses, although the revenue and expenditure amounts differ)
- Generated by operations:
  + Net revenues that grow to about $18.9 million per year at full development of the Project

As summarized above and in Figure ES-2, the Project will provide a net financial gain to both the City and the State. Sufficient tax revenues and other revenues will be available to provide the same level of service to residents living in the Project that is currently provided to other residents on O'ahu, and to help fund various government facilities and services that will benefit communities throughout O'ahu and the State.

For the City, net tax revenues are positive largely because of high property values for upscale homes, no homeowner exemption for second homes and vacation homes, few services when these homes are vacant, and high property tax rates on commercial property. The financial gain to the City differs from that of many other residential communities on O'ahu which are subsidized by tax revenues from resort, commercial, and industrial properties.

For the State, net revenues are high because of the many upscale homes that will be subject to higher-rate conveyance taxes, the amount of economic activity associated with building and selling upscale homes, the high incomes of many Project occupants combined with exposure to higher income-tax rates, high consumption expenditures of residents, and reduced services provided to retirees and part-time residents (e.g., no children in Hawai'i's schools so no school improvements or services, and few services when homes are vacant).

c. Affordable Housing

Makaiwa Hills will contribute to more affordable home prices by supplying:

- — about 1,230 homes at affordable prices that are below market prices
- — about 1,102 homes at market prices in competition with other residential projects in the Kapolei region and Central O'ahu
- — about 1,768 upscale homes which will divert demand away from other projects and existing communities.

d. New Retirees and Part-time Residents

At full development of the Project, an estimated 349 upscale homes will be owned and occupied by wealthier retirees new to O'ahu, and about 173 upscale homes will be owned and occupied by wealthier part-time residents. Consumption expenditures by these two groups are estimated at about $25.8 million per year and $6.8 million per year, respectively. These expenditures will introduce a stable source of new income to Hawai'i coming from overseas. As such, they will amount to export income to Hawai'i similar in nature to visitor expenditures.

12. REFERENCES

[1] Group 70 International. "Makaiwa Hills, Environmental Impact Statement Preparation Notice." October 2006.

[2] Decision Analysts Hawai'i, Inc. "'Ewa Development, 2006 to 2025: Economic, Population, and Fiscal Impacts." September 2005.

[3] U.S. Census. 2006.

[4] Department of Business, Economic Development & Tourism, State of Hawai'i. *The State of Hawai'i Data Book.* Annual.

[5] Department of Business, Economic Development & Tourism, State of Hawai'i. *The 2002 State Input-Output Study for Hawai'i.* June 2006.

[6] Department of Labor and Industrial Relations, State of Hawai'i. *Employment and Payroll in Hawai'i.* Annual.

[7] Tax Foundation of Hawai'i. "Taxes in Hawai'i." Annual.

[8] Group 70 International, Inc. 2006.

[9] Decision Analysts Hawai'i, Inc. "Makaiwa Hills: Impact on Agriculture." December 2006.

[10] Decision Analysts Hawai'i, Inc. "Makaiwa Hills: Residential Market Study." December 2006.

[11] Real Property Office, City and County of Honolulu. 2006.

REPORT FIGURES

Figure 1. Project Location Map

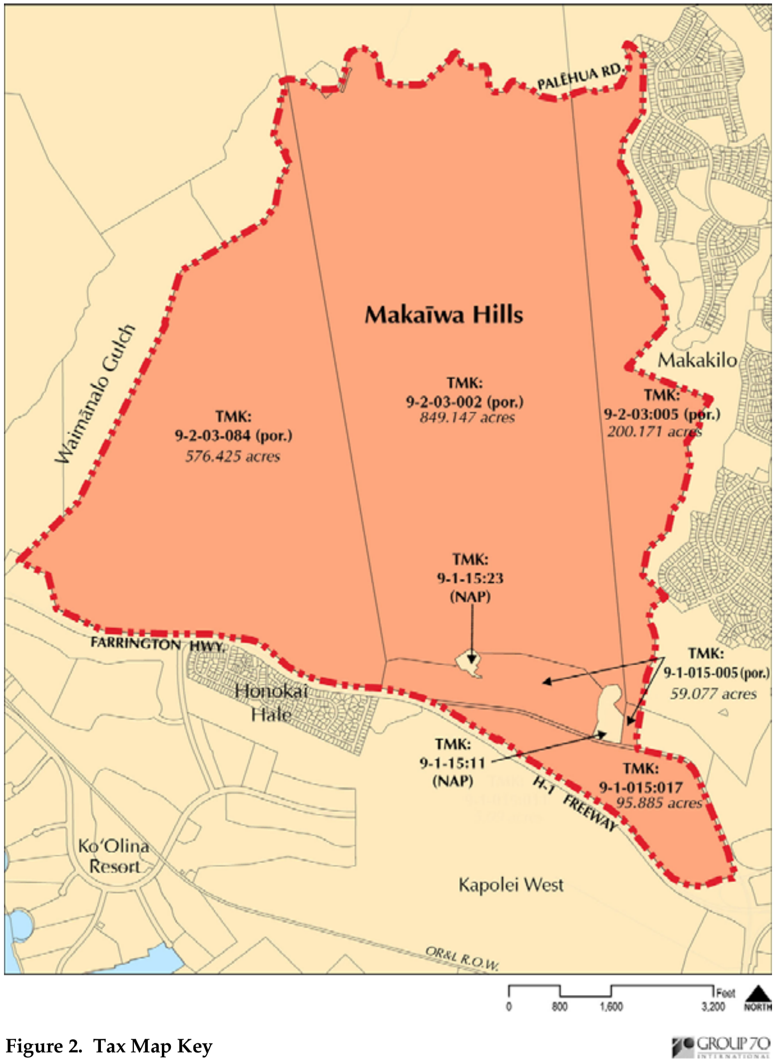


Figure 2. Tax Map Key

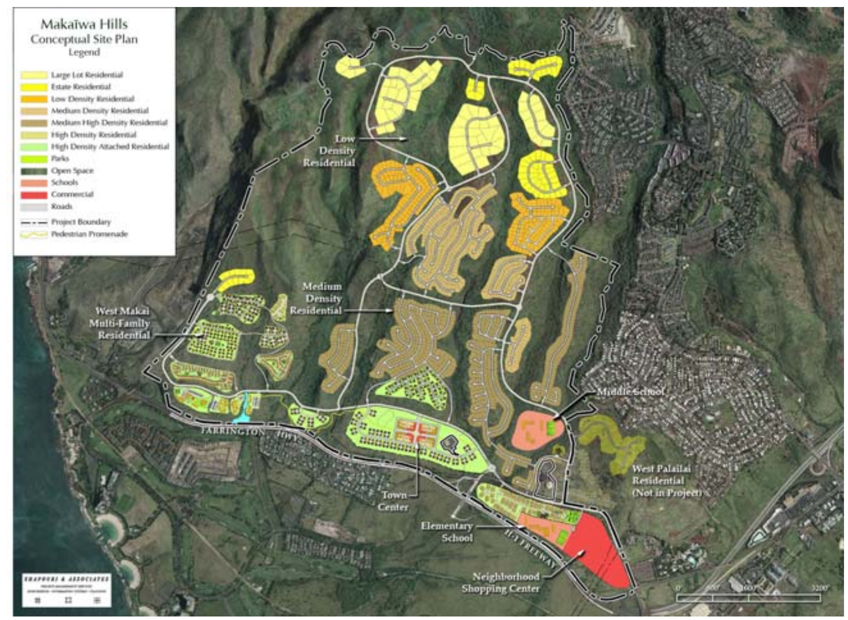


Figure 3 - Conceptual Site Plan

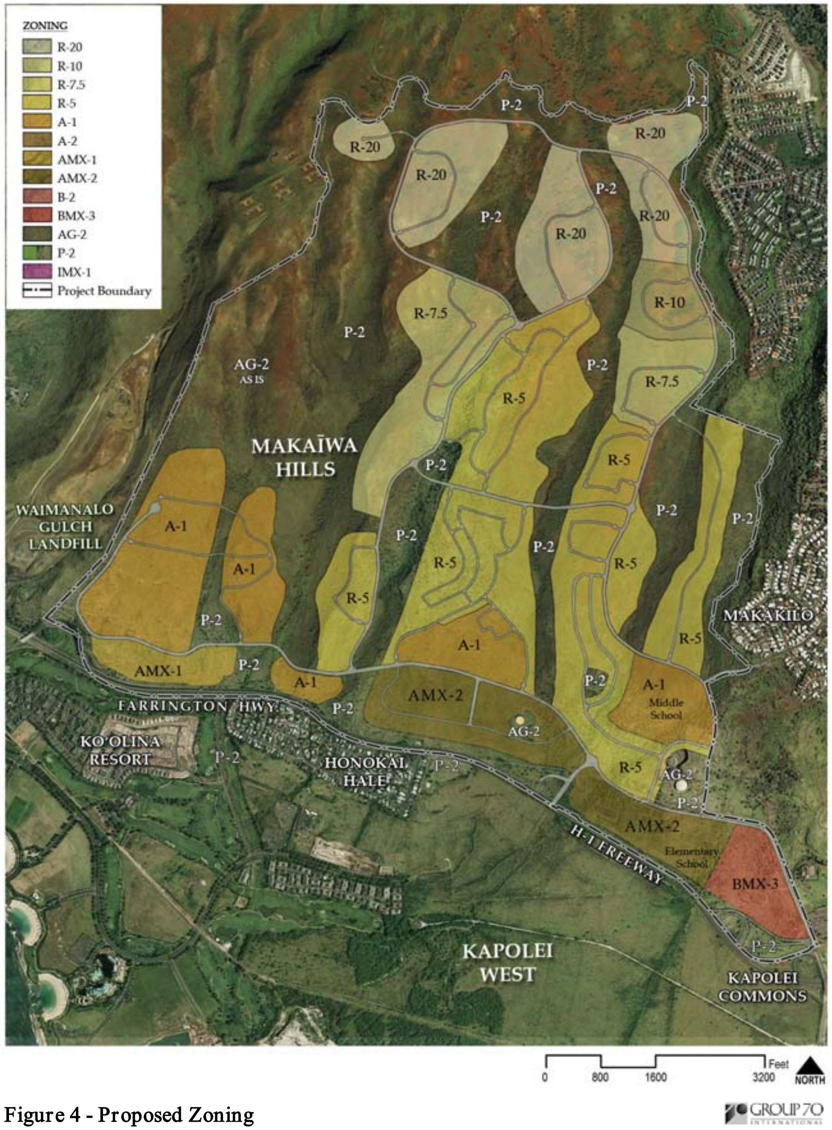


Figure 4 - Proposed Zoning

MAKAĪWA HILLS

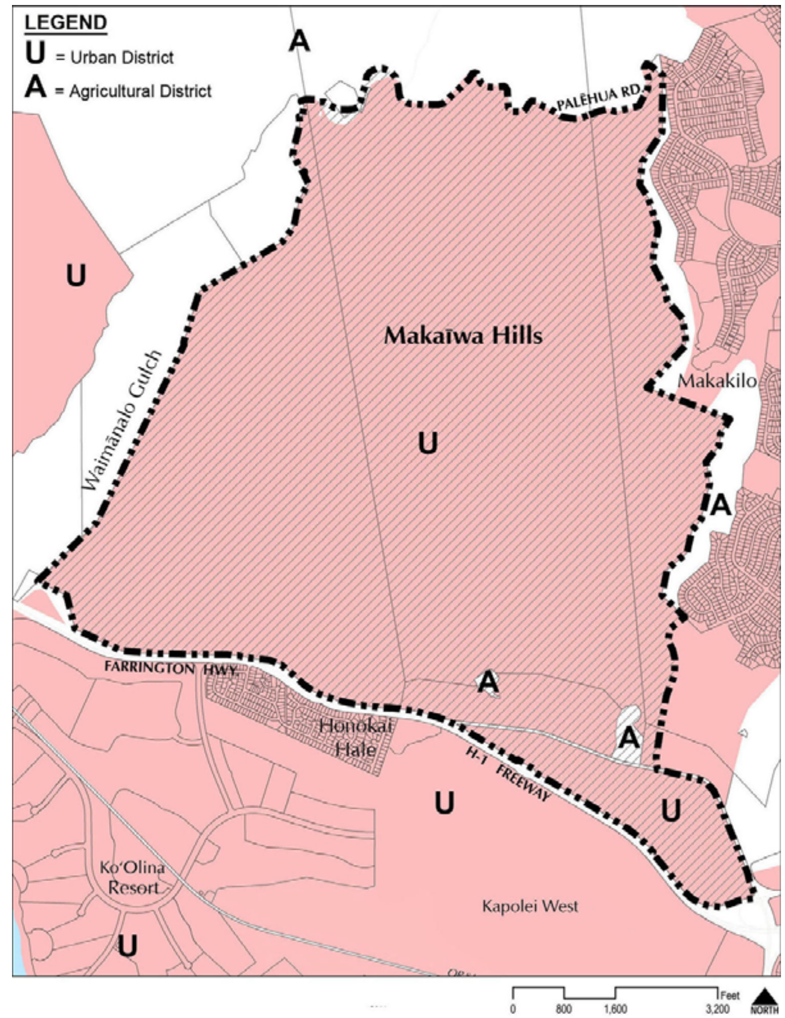


Figure 5. Existing State Land Use District Classification Map

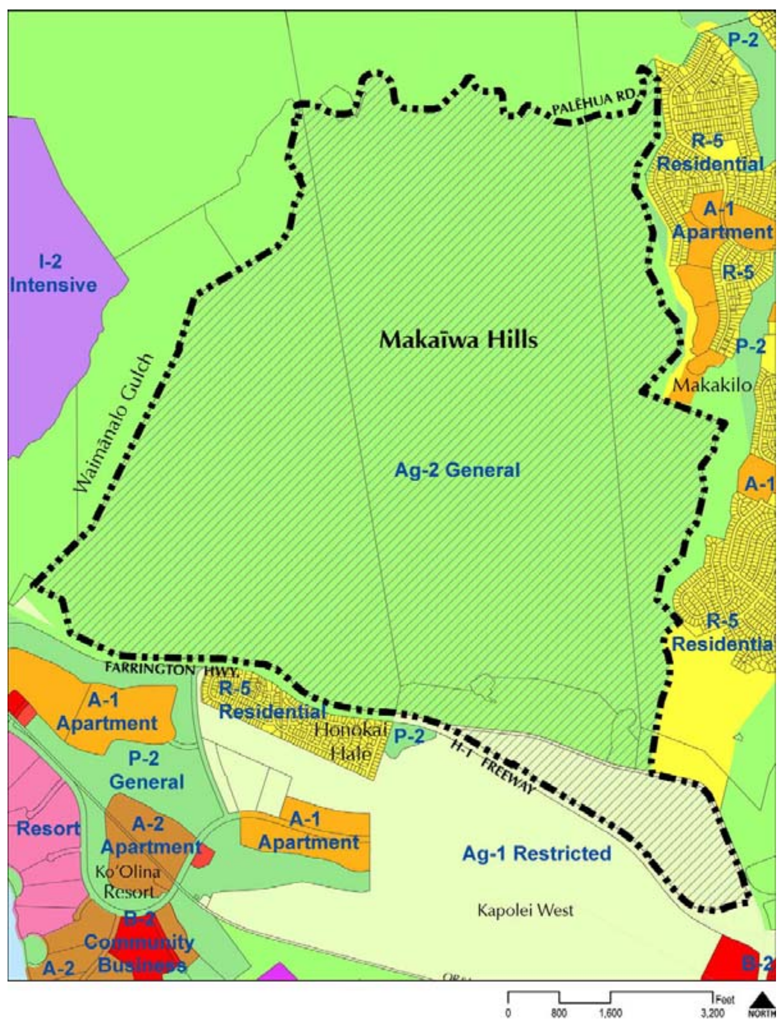


Figure 6. Existing City and County Zoning Map

MAKAĪWA HILLS

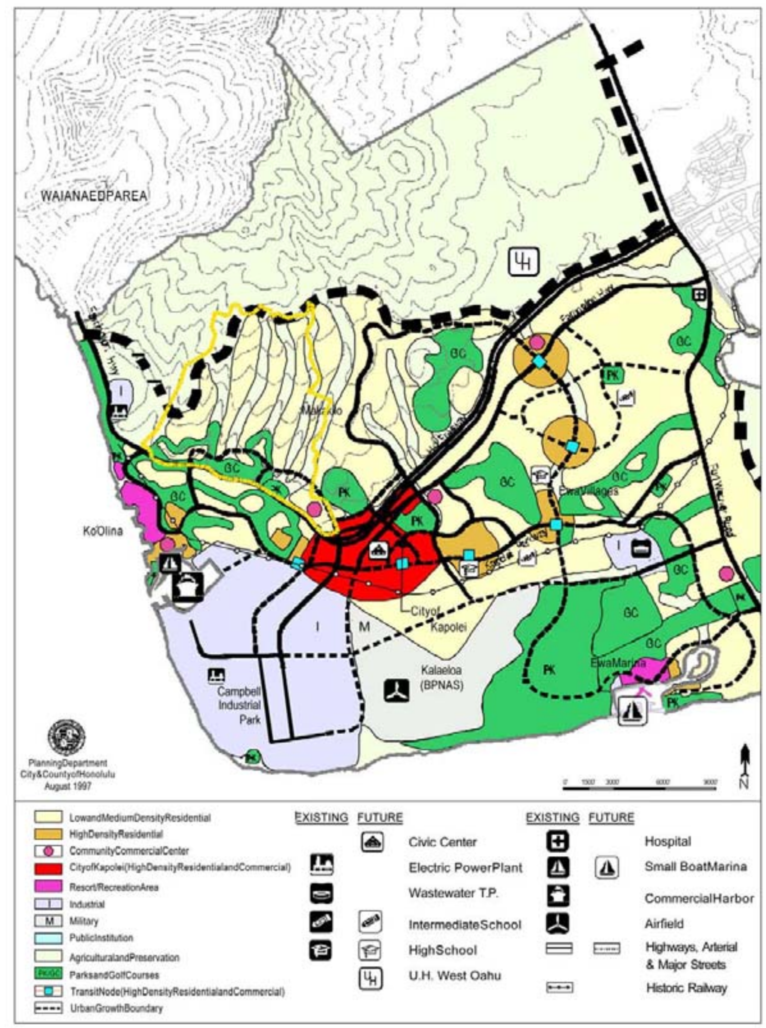


Figure 7. City and County 'Ewa Development Plan

TABLES

Table 1. Proposed Development
(Values in 2006 dollars)

Item	Source or Multiplier	Amount at Full Development	Units
1.a. LAND AREA			
Residential	Group 70	857	acres
Mixed Use		114	"
Commercial		30	"
Schools		30	"
Preservation and Agriculture		750	"
Total Area Developed		**1,781**	**acres**
1.b. HOMES			
Multi-family (MF) Homes			
Affordable, Medium-density (A-1; AMX-1,2; BMX-3)	Group 70	900	mf homes
Market, Medium-density (AMX-2, BMX-3)	"	437	"
Market, Low-density (A-1)	"	320	"
Upscale Market, Low-density (A-1, AMX-1)	"	849	"
Subtotal, Multi-family Homes		2,506	mf homes
Single-family (SF) Homes			
Affordable, Medium-density (R-5)	Group 70	330	sf homes
Market, Medium-density (R-5)	"	345	"
Upscale Market, Medium-density (R-5)	"	76	"
Upscale Market, Medium-low-density (R-7.5)	"	127	"
Upscale Market, Low-density (A-1, R-10)	"	594	"
Upscale Market, Estate (R-20)	"	122	"
Subtotal, Single-family Homes		1,594	sf homes
Total Homes		**4,100**	**homes**
Affordable Homes		1,230	"
1.c. COMMERCIAL FLOOR AREA			
Neighborhod Shopping Center (BMX-3)	Group 70	150,000	sq. ft.
Town Center (AMX-2)	"	65,000	"
Other Commercial (AMX-1)	"	25,000	"
Total Floor Area		**240,000**	**sq. ft.**

Table 2. Economic Impacts of Development Activities
(Values in 2006 dollars)

Item	Source or Multiplier	Amount or Annual Average	Units
2.a. DEVELOPMENT PERIOD			
First Year of Construction	Group 70	2008	
Last Year of Construction	"	2020	
Duration of Construction	"	**12**	**years**
2.b. CONSTRUCTION EXPENDITURES			
Expenditures Over Development Period			
Homes	60% of home sales Section 2.e	$ 1,471,788,000	
Commercial Space	$ 240 per sq. ft.	$ 57,600,000	
Total Construction Expenditures		**$ 1,529,388,000**	
Annual Construction Expenditures (average)			
Homes		$ 122,649,000	per year
Commercial Space		$ 4,800,000	"
Total Annual Construction Expenditures		**$ 127,449,000**	**per year**
2.c. INDIRECT SALES GENERATED BY CONSTRUCTION ACTIVITY			
Homes	82% of const. exp.	$ 100,572,180	per year
Commercial Space	98% "	$ 4,704,000	"
Total Indirect Sales		$ 105,276,180	per year
2.d. OTHER DEVELOPMENT COSTS [1]		n.e.	
2.e. PROPERTY SALES AND VALUES			
Home Sales	(approximate prices, subject to change)		
Multi-family Homes			
Affordable, Medium-density	$ 315,000 per home	$ 283,500,000	
Market, Medium-density	$ 440,000 "	$ 192,280,000	
Market, Low-density	$ 500,000 "	$ 160,000,000	
Upscale Market, Low-density	$ 600,000 "	$ 509,400,000	
Single-family Homes			
Affordable, Medium-density	$ 420,000 "	$ 138,600,000	
Market, Medium-density	$ 700,000 "	$ 241,500,000	
Upscale Market, Medium-density	$ 800,000 "	$ 60,800,000	
Upscale Market, Medium-low-density	$ 900,000 "	$ 114,300,000	
Upscale Market, Low-density	$ 1,000,000 "	$ 594,000,000	
Upscale Market, Estate	$ 1,300,000 "	$ 158,600,000	
Total Home Sales		$ 2,452,980,000	
Annual Home Sales		**$ 204,415,000**	**per year**
Value of Commercial Space	$ 400 per sq. ft.	$ 96,000,000	
Total Property Value		$ 2,548,980,000	

[1] Before realizing profits, developers must pay a number of development-related costs in addition to construction costs. These "Other Development Costs" include planning, permitting, design, financing, City and State exactions, and marketing and sales commissions.

Table 2. Economic Impacts of Development Activities
(Values in 2006 dollars)
(continued)

Item	Source or Multiplier	Amount or Annual Average	Units
2.f. SUMMARY OF EXPENDITURES & SALES			
Final Sales (taxed at 4.5%)			
Home Sales	Section 2.e	$ 204,415,000	per year
Construction Expenditures, Commercial	Section 2.b	$ 4,800,000	"
Consumption	55% of payroll Section 2.i	$ 38,655,705	"
Total Sales at 4.5%		$ 247,870,705	per year
Intermediate Sales (taxed at 0.5%)			
Construction Expenditures, Homes	Section 2.b	$ 122,649,000	per year
Indirect Sales Related to Construction	Section 2.c	$ 105,276,180	"
Less Consumption	above	$ (38,655,705)	"
Total Sales at 0.5%		$ 189,269,475	per year
Total Sales		$ 437,140,180	per year
2.g. PROFITS			
Profits on Total Expenditures & Sales	10.0%	$ 43,714,018	per year
Risk Premium for Construction	5.0%	$ 6,372,450	"
Total Profit from Construction & Related Activity		$ 50,086,468	per year
2.h. EMPLOYMENT (on-site & off-site)			
Construction Jobs	5.05 x sales/$1 mil	644	jobs
Indirect Employment Generated by Construction Expenditures	1.52 x direct jobs	979	"
Total Employment		**1,623**	**jobs**
In Kapolei Region	residual	1,133	"
Outside Kapolei Region	50% of indirect jobs	490	"
2.i. PAYROLL			
Construction	$ 50,000 per job	$ 32,200,000	per year
Indirect Employment	$ 38,900 "	$ 38,083,100	"
Total Payroll		**$ 70,283,100**	**per year**
2.j. POPULATION SUPPORTED BY DEVELOPMENT ACTIVITIES			
Residents, O'ahu			
Supported by Construction Jobs	2.2 per job	1,417	residents
Supported by Indirect Jobs	2.2 "	2,154	"
Total Residents		3,571	residents
Residents, Kapolei Region			
Supported by Construction Jobs	65%	921	residents
Supported by Indirect Jobs	60%	1,292	"
Total Residents in Kapolei Region		2,213	residents

Table 2. Economic Impacts of Development Activities

(Values in 2006 dollars)
(continued)

Item	Source or Multiplier	Amount or Annual Average	Units
2.k. HOUSING FOR SUPPORTED POPULATION			
Homes, O'ahu			
Supported by Construction Jobs	0.3 per resident	425	homes
Supported by Indirect Jobs	0.3 "	646	"
Total Homes		1,071	homes
Homes, Kapolei Region			
Supported by Construction Jobs	0.3 per resident	276	homes
Supported by Indirect Jobs	0.3 "	388	"
Total Homes in Kapolei Region		664	homes

Table 3. Economic Impacts of Operations at Full Development

(Values in 2006 dollars)

Item	Source or Multiplier	Amount at Full Development	Units
3.a. HOUSING USES & CHARACTERISTICS, DETAILED			
MF Homes, Affordable, Medium-density		900	homes
Owner-occupied Homes, Kama'aina	100%	900	"
Occupied Homes	97%	873	"
Residents, Kama'aina	3.0 per household	2,619	residents
Household Income	$ 60,000 "	$ 52,380,000	per year
Consumption Expenditures	50% of income	$ 26,190,000	"
Property Value	$ 315,000 per home	$ 283,500,000	
MF Homes, Market, Medium-density		437	homes
Rented Homes, Kama'aina	35%	153	"
Occupied Homes	94%	144	"
Residents, Kama'aina	3.00 per household	432	residents
Rent	$ 1,850 per month	$ 3,196,800	per year
Household Income	$ 65,000 per household	$ 9,360,000	"
Consumption Expenditures	50% of income	$ 4,680,000	"
Property Value	$ 440,000 per home	$ 67,320,000	
Owner-occupied Homes, Kama'aina	65%	284	homes
Occupied Homes	97%	275	"
Residents, Kama'aina	3.00 per household	825	residents
Household Income	$ 80,000 "	$ 22,000,000	per year
Consumption Expenditures	50% of income	$ 11,000,000	"
Property Value	$ 440,000 per home	$ 124,960,000	
MF Homes, Market, Low-density		320	homes
Rented Homes, Kama'aina	35%	112	"
Occupied Homes	94%	105	"
Residents, Kama'aina	3.00 per household	315	residents
Rent	$ 2,100 per month	$ 2,646,000	per year
Household Income	$ 75,000 per household	$ 7,875,000	"
Consumption Expenditures	50% of income	$ 3,937,500	"
Property Value	$ 500,000 per home	$ 56,000,000	
Owner-occupied Homes, Kama'aina	65%	208	homes
Occupied Homes	97%	202	"
Residents, Kama'aina	3.00 per household	606	residents
Household Income	$ 90,000 "	$ 18,180,000	per year
Consumption Expenditures	50% of income	$ 9,090,000	"
Property Value	$ 500,000 per home	$ 104,000,000	

Table 3. Economic Impacts of Operations at Full Development

(Values in 2006 dollars)
(continued)

Item	Source or Multiplier	Amount at Full Development	Units
MF Homes, Upscale Market, Low-density		849	homes
Rented Homes, Kama'aina	20%	170	"
Occupied Homes	94%	160	"
Residents, Kama'aina	2.5 per household	400	residents
Rent	$ 2,500 per month	$ 4,800,000	per year
Household Income	$ 85,000 per household	$ 13,600,000	"
Consumption Expenditures	50% of income	$ 6,800,000	"
Property Value	$ 600,000 per home	$ 102,000,000	
Owner-occupied Homes, Kama'aina	40%	340	homes
Occupied Homes	97%	330	"
Residents, Kama'aina	2.5 per household	825	residents
Household Income	$ 105,000 "	$ 34,650,000	per year
Consumption Expenditures	50% of income	$ 17,325,000	"
Property Value	$ 600,000 per home	$ 204,000,000	
Owner-occupied Homes, Retirees New to O'ahu	25%	212	homes
Occupied Homes	98%	208	"
Retirees New to O'ahu	2.0 per household	416	retirees
Household Income, Taxable	$ 55,000 "	$ 11,440,000	per year
Consumption Expenditures	$ 100 per person-day	$ 15,184,000	"
Property Value	$ 600,000 per home	$ 127,200,000	
Vacation & Second Homes	15%	127	homes
Occupied Homes	25%	32	"
Part-time Residents New to O'ahu	2.5 per household	80	part-time res.
Consumption Expenditures + Maintenance	$ 120 per person-day $ 5,000 per home	$ 4,139,000	per year
Property Value	$ 600,000 per home	$ 76,200,000	
SF Homes, Affordable, Medium-density		330	homes
Owner-occupied Homes, Kama'aina	100%	330	"
Occupied Homes	97%	320	"
Residents, Kama'aina	3.6 per household	1,152	residents
Household Income	$ 80,000 "	$ 25,600,000	per year
Consumption Expenditures	50% of income	$ 12,800,000	"
Property Value	$ 420,000 per home	$ 138,600,000	

Table 3. Economic Impacts of Operations at Full Development

(Values in 2006 dollars)
(continued)

Item	Source or Multiplier	Amount at Full Development	Units
SF Homes, Market, Medium-density		345	homes
Rented Homes, Kama'aina	25%	86	"
Occupied Homes	94%	81	"
Residents, Kama'aina	3.4 per household	275	residents
Rent	$ 2,900 per month	$ 2,818,800	per year
Household Income	$ 95,000 per household	$ 7,695,000	"
Consumption Expenditures	50% of income	$ 3,847,500	"
Property Value	$ 700,000 per home	$ 60,200,000	
Owner-occupied Homes, Kama'aina	75%	259	homes
Occupied Homes	97%	251	"
Residents, Kama'aina	3.5 per household	879	residents
Household Income	$ 120,000 "	$ 30,120,000	per year
Consumption Expenditures	50% of income	$ 15,060,000	"
Property Value	$ 700,000 per home	$ 181,300,000	
SF Homes, Upscale Market, Medium-density		76	homes
Rented Homes, Kama'aina	10%	8	"
Occupied Homes	94%	8	"
Residents, Kama'aina	3.4 per household	27	residents
Rent	$ 3,300 per month	$ 316,800	per year
Household Income	$ 110,000 per household	$ 880,000	"
Consumption Expenditures	50% of income	$ 440,000	"
Property Value	$ 800,000 per home	$ 6,400,000	
Owner-occupied Homes, Kama'aina	70%	53	homes
Occupied Homes	97%	51	"
Residents, Kama'aina	3.5 per household	179	residents
Household Income	$ 135,000 "	$ 6,885,000	per year
Consumption Expenditures	50% of income	$ 3,442,500	"
Property Value	$ 800,000 per home	$ 42,400,000	
Owner-occupied Homes, Retirees New to O'ahu	15%	11	homes
Occupied Homes	97%	11	"
Retirees New to O'ahu	2.00 per household	22	retirees
Household Income, Taxable	$ 70,000 "	$ 770,000	per year
Consumption Expenditures	$ 110 per person-day	$ 883,300	"
Property Value	$ 800,000 per home	$ 8,800,000	
Vacation & Second Homes	5%	4	homes
Occupied Homes	30%	1	"
Part-time Residents New to O'ahu	3.5 per party	4	part-time res.
Consumption Expenditures + Maintenance	$ 120 per person-day $ 6,000 per home	$ 199,200	per year
Property Value	$ 800,000 per home	$ 3,200,000	

Table 3. Economic Impacts of Operations at Full Development

(Values in 2006 dollars)
(continued)

Item	Source or Multiplier	Amount at Full Development	Units
SF Homes, Upscale Market, Medium-low-density		127	homes
Rented Homes, Kama'aina	10%	13	"
Occupied Homes	94%	12	"
Residents, Kama'aina	3.4 per household	41	residents
Rent	$ 3,700 per month	$ 532,800	per year
Household Income	$ 120,000 per household	$ 1,440,000	"
Consumption Expenditures	50% of income	$ 720,000	"
Property Value	$ 900,000 per home	$ 11,700,000	
Owner-occupied Homes, Kama'aina	70%	89	homes
Occupied Homes	97%	86	"
Residents, Kama'aina	3.5 per household	301	residents
Household Income	$ 150,000 "	$ 12,900,000	per year
Consumption Expenditures	50% of income	$ 6,450,000	"
Property Value	$ 900,000 per home	$ 80,100,000	
Owner-occupied Homes, Retirees New to O'ahu	15%	19	homes
Occupied Homes	97%	18	"
Retirees New to O'ahu	2.00 per household	36	retirees
Household Income, Taxable	$ 75,000 "	$ 1,350,000	per year
Consumption Expenditures	$ 110 per person-day	$ 1,445,400	"
Property Value	$ 900,000 per home	$ 17,100,000	
Vacation & Second Homes	5%	6	homes
Occupied Homes	30%	2	"
Part-time Residents New to O'ahu	3.5 per party	7	part-time res.
Consumption Expenditures + Maintenance	$ 125 per person-day $ 7,000 per home	$ 361,375	per year
Property Value	$ 900,000 per home	$ 5,400,000	
SF Homes, Upscale Market, Low-density		594	homes
Rented Homes, Kama'aina	10%	59	"
Occupied Homes	94%	55	"
Residents, Kama'aina	3.4 per household	187	residents
Rent	$ 4,100 per month	$ 2,706,000	per year
Household Income	$ 135,000 per household	$ 7,425,000	"
Consumption Expenditures	50% of income	$ 3,712,500	"
Property Value	$ 1,000,000 per home	$ 59,000,000	
Owner-occupied Homes, Kama'aina	70%	416	homes
Occupied Homes	97%	404	"
Residents, Kama'aina	3.5 per household	1,414	residents
Household Income	$ 165,000 "	$ 66,660,000	per year
Consumption Expenditures	50% of income	$ 33,330,000	"
Property Value	$ 1,000,000 per home	$ 416,000,000	

Table 3. Economic Impacts of Operations at Full Development

(Values in 2006 dollars)
(continued)

Item	Source or Multiplier	Amount at Full Development	Units
SF Homes, Upscale Market, Low-density (continued)			
Owner-occupied Homes, Retirees New to O'ahu	15%	89	homes
Occupied Homes	97%	86	"
Retirees New to O'ahu	2.00 per household	172	retirees
Household Income, Taxable	$ 85,000 "	$ 7,310,000	per year
Consumption Expenditures	$ 110 per person-day	$ 6,905,800	"
Property Value	$ 1,000,000 per home	$ 89,000,000	
Vacation & Second Homes	5%	30	homes
Occupied Homes	30%	9	"
Part-time Residents New to O'ahu	3.5 per party	32	part-time res.
Consumption Expenditures + Maintenance	$ 125 per person-day $ 8,000 per home	$ 1,700,000	per year
Property Value	$ 1,000,000 per home	$ 30,000,000	
SF Homes, Upscale Market, Estate		122	homes
Rented Homes, Kama'aina	10%	12	"
Occupied Homes	94%	11	"
Residents, Kama'aina	3.20 per household	35	residents
Rent	$ 5,300 per month	$ 699,600	per year
Household Income	$ 160,000 per household	$ 1,760,000	"
Consumption Expenditures	50%	$ 880,000	"
Property Value	$ 1,300,000 per home	$ 15,600,000	
Owner-occupied Homes, Kama'aina	70%	86	homes
Occupied Homes	97%	83	"
Residents, Kama'aina	3.3 per household	274	residents
Household Income	$ 200,000 "	$ 16,600,000	per year
Consumption Expenditures	50%	$ 8,300,000	"
Property Value	$ 1,300,000 per home	$ 111,800,000	
Owner-occupied Homes, Retirees New to O'ahu	15%	18	homes
Occupied Homes	97%	17	"
Retirees New to O'ahu	2.0 per household	34	retirees
Household Income, Taxable	$ 100,000 "	$ 1,700,000	per year
Consumption Expenditures	$ 115 per person-day	$ 1,427,150	"
Property Value	$ 1,300,000 per home	$ 23,400,000	
Vacation & Second Homes	5%	6	homes
Occupied Homes	30%	2	"
Part-time Residents New to O'ahu	3.5 per party	7	part-time res.
Consumption Expenditures + Maintenance	$ 130 per person-day $ 10,000 per home	$ 392,150	per year
Property Value	$ 1,300,000 per home	$ 7,800,000	

Table 3. Economic Impacts of Operations at Full Development

(Values in 2006 dollars)
(continued)

Item	Source or Multiplier	Amount at Full Development	Units
3.b. HOUSING USES & CHARACTERISTICS, SUMMARY			
Housing Units, by Use			
Rented Homes, Kama'aina	Section 3.a	613	homes
Owner-occupied Homes, Kama'aina	"	2,965	"
Owner-occupied Homes, Retirees New to O'ahu	"	349	"
Vacation & Second Homes	"	173	"
Total Homes		**4,100**	**homes**
Population (on-site)			
Residents, Kama'aina	Section 3.a	10,786	people
Retirees New to O'ahu	"	680	"
Part-time Residents	"	130	"
Total Population		**11,596**	**people**
Student Population, Public Schools	DOE	1,380	students
Workforce	45% of kama'aina	4,854	people
Rental Income	Section 3.a	$ 17,716,800	per year
Household Income, Taxable by Hawai'i			
Residents, Kama'aina	Section 3.a	$ 336,010,000	per year
Retirees New to O'ahu	"	$ 22,570,000	"
Total Household Income		**$ 358,580,000**	**per year**
Consumption Expenditures			
Residents, Kama'aina	Section 3.a	$ 168,005,000	per year
Retirees New to O'ahu	"	$ 25,845,650	"
Part-time Residents	"	$ 6,791,725	"
Total Consumption Expenditures		**$ 174,796,725**	**per year**
Home Values			
Rented Homes, Kama'aina	Section 3.a	$ 378,220,000	
Owner-occupied Homes, Kama'aina	"	$ 1,686,660,000	
Owner-occupied Homes, Retirees New to O'ahu	"	$ 265,500,000	
Vacation & Second Homes	"	$ 122,600,000	
Total Home Value		$ 2,452,980,000	

Table 3. Economic Impacts of Operations at Full Development

(Values in 2006 dollars)
(continued)

Item	Source or Multiplier	Amount at Full Development	Units
3.c. ON-SITE ECONOMIC ACTIVITIES			
Revenues			
Retail Sales	$ 300 per sq. ft.	$ 72,000,000	per year
Rents			
Homes	Section 3.b	$ 17,716,800	"
Commercial Space	$ 40 per sq. ft. 50% rented	$ 4,800,000	"
Services, Home Office	$ 100,000 per job	$ 19,400,000	"
Maintenance, Homes & Grounds			
Multi-family Homes			
Affordable, Medium-density	$ 300 per month	$ 3,240,000	per year
Market, Medium-density	$ 300 "	$ 1,573,200	"
Market, Low-density	$ 350 "	$ 1,344,000	"
Upscale Market, Low-density	$ 450 "	$ 4,584,600	"
Single-family Homes			
Affordable, Medium-density	$ - "	$ -	"
Market, Medium-density	$ 250 "	$ 1,035,000	"
Upscale Market, Medium-density	$ 350 "	$ 319,200	"
Upscale Market, Medium-low-density	$ 400 "	$ 609,600	"
Upscale Market, Low-density	$ 450 "	$ 3,207,600	"
Upscale Market, Estate	$ 600 "	$ 878,400	"
Total Maintenance, Homes & Grounds		$ 16,791,600	per year
Total Revenues (on-site)		**$ 130,708,400**	per year
Less Sales Included in Consumption Expenditures			
Retail Sales to Makaiwa Hills Residents	90% of retail sales	$ (64,800,000)	per year
Maintenance, Homes & Grounds		$ (16,791,600)	"
Revenues in Addition to Consumption Expenditures		**$ 49,116,800**	**per year**
Profit	10% of revenues	$ 13,070,840	"
Employment (on-site)			
Retail	2.5 per 1,000 sq. ft.	600	jobs
Maintenance, Homes & Grounds	18.2 jobs/$1 million	306	"
Home Office	4% of workforce	194	"
Total Employment		**1,100**	**jobs**
Payroll			
Retail	$ 23,000 per job	$ 13,800,000	per year
Maintenance, Homes & Grounds	$ 23,000 "	$ 7,038,000	"
Home Office	$ 65,000 "	$ 12,610,000	"
Total Payroll		**$ 33,448,000**	**per year**
Less Payroll Included with Household Income			
Retail	10% or retail payroll	$ (1,380,000)	per year
Home Office	above	$ (12,610,000)	"
Payroll in Addition to Household Income		$ 19,458,000	per year

Table 4. Impacts on City Revenues and Expenditures

(Values in 2006 dollars)

Item	Source or Multiplier	Amount or Annual Average	Units
4.a. TAX & EXPENDITURE BASE			
Development Activity			
Duration	Table 2, Section 2.a	12	years
Multi-family Homes	Table 1, Section 1.b	2,506	homes
Single-family Homes	"	1,594	"
Commercial Space	Table 1, Section 1.c	240,000	sq. ft.
Final Sales			
Annual	Table 2, Section 2.f	$ 247,870,705	per year
Cumulative		$ 2,974,448,460	
Population (on site at full development)	Table 3, Section 3.b	11,596	people
Operations at Full Development			
Population (on-site)			
Residents, Kama'aina	Table 3, Section 3.b	10,786	people
Residents, Retirees New to O'ahu	"	680	"
Part-time Residents	"	130	"
Total Population		11,596	people
Employment	Table 3, Section 3.c	1,100	jobs
Homes Qualifying for Property-tax Exemption			
Owner-occupied Homes, Kama'aina	Table 3, Section 3.b	2,965	homes
Owner-occupied Homes, Retirees New to O'ahu	"	349	"
Taxable Values, Homes			
Rented Homes	Table 3, Section 3.b	$ 378,220,000	
Owner-occupied Homes, Kama'aina	"	$ 1,686,660,000	
Less Standard Exemption	$ 80,000 per home	$ (237,200,000)	
Owner-occupied Homes, Retirees New to O'ahu	Table 3, Section 3.b	$ 265,500,000	
Less Senior Exemption	$ 120,000 per home	$ (41,880,000)	
Vacation & Second Homes	Table 3, Section 3.b	$ 122,600,000	
Total Taxable Value, Homes		$ 2,173,900,000	
Taxable Values, Commercial Property	Table 2, Section 2.e	$ 96,000,000	
Sales Revenues			
Consumption Expenditures	Table 3, Section 3.b	$ 174,796,725	per year
Additional On-site Sales	Table 3, Section 3.c	$ 49,116,800	"
Total Sales		$ 223,913,525	per year

Table 4. Impacts on City Revenues and Expenditures

(Values in 2006 dollars)
(continued)

Item	Source or Multiplier	Amount or Annual Average	Units
4.b. DEVELOPMENT ACTIVITY			
Revenues (cumulative)			
Highway Impact Fees			
Multi-family Homes	$ 1,245 per home	$ 3,119,970	
Single-family Homes	$ 1,836 per home	$ 2,926,584	
Commercial Space	$ 4,053 per 1000 sq. ft.	$ 972,720	
Total Highway Impact Fees		$ 7,019,274	
City Share of Highway Impact Fees	28%	$ 1,965,397	
Excise-tax Surcharge (Mass Transit)	0.5% of final sales	$ 14,872,242	
Other Fees [1]		n.e.	
Total Revenues		**$ 16,837,639**	
Average Annual Revenues		**$ 1,403,137**	**per year**
Expenditures (cumulative)			
Infrastructure and Facilities			
Highway Fund	above	$ (1,965,397)	
Mass Transit Fund	"	$ (14,872,242)	
Other Infrastructure [1]			
Interior Roads		$ -	
Water Source Development		$ -	
Interior Water Distribution		$ -	
Drainage Systems		$ -	
Sewer Connections		$ -	
Collector Sewers & Trunks		$ -	
Wastewater Treatment Plant		$ -	
Parks			
Land, Graded and Landscaped [1]		$ -	
Improvements	$ 1,200 per person	$ (13,915,200)	
Fire Station	City	$ -	
Police Substation	"	$ -	
Services		$ -	
Total Expenditures		**$ (30,752,839)**	
Average Annual Expenditures		**$ (2,562,737)**	**per year**
Net Revenues (cumulative)		**$ (13,915,200)**	
Annual Debt Service at Full Development (4.5%, 20-year bond; 3% inflation)	6.6% of net revenues	**$ (918,403)**	per year

[1] Most infrastructure will be built by the developer, or the Project's fair-share will be financed via connect charges and user fees.

Table 4. Impacts on City Revenues and Expenditures
(Values in 2006 dollars)
(continued)

Item	Source or Multiplier	Amount or Annual Average	Units
4.c. OPERATIONS AT FULL DEVELOPMENT			
Revenues (annual)			
Property Taxes			
Homes	$ 3.75 per $1,000	$ 8,152,125	per year
Commercial Property	$ 11.37 per $1,000	$ 1,091,520	"
Less Current Taxes	City	$ (26,900)	"
Total Property Taxes		$ 9,216,745	per year
Excise-tax Surcharge (Mass Transit)	0.5% of final sales	$ 1,119,568	"
Other Revenues			
Residents, Kama'aina	$ 520 per person	$ 5,608,720	"
Residents, Retirees New to O'ahu	$ 520 "	$ 353,600	"
Part-time Residents	$ 400 "	$ 52,000	"
Economic Activity	$ 460 per job	$ 506,000	"
Total Revenues		**$ 16,856,633**	**per year**
Expenditures (annual)			
Mass Transit Fund	above	$ (1,119,568)	per year
Services			
Residents, Kama'aina	$ 810 per person	$ (8,736,660)	"
Residents, Retirees New to O'ahu	$ 760 "	$ (516,800)	"
Part-time Residents	$ 760 "	$ (98,800)	"
Economic Activity	$ 780 per job	$ (858,000)	"
Debt Service	Section 4.b	$ (918,403)	"
Total Expenditures		**$ (12,248,231)**	**per year**
Net Revenues (annual)		**$ 4,608,402**	**per year**

Table 5. Impacts on State Revenues and Expenditures
(Values in 2006 dollars)

Item	Source or Multiplier	Amount or Annual Average	Units
5.a. TAX & EXPENDITURE BASE			
Development Activities			
Duration	Table 2, Section 2.a	12	years
Multi-family Homes	Table 1, Section 1.b	2,506	homes
Single-family Homes	"	1,594	"
Commercial Space	Table 1, Section 1.c	240,000	sq. ft.
Final Sales			
Annual Average	Table 2, Section 2.f	$ 247,870,705	per year
Cumulative		$ 2,974,448,460	
Intermediate Sales			
Annual Average	Table 2, Section 2.f	$ 189,269,475	per year
Cumulative		$ 2,271,233,700	
Home Sales (for Conveyance Tax)			
Sales to Owner-occupants, at Prices:			
Below $600,000	Table 3, Section 3.a	$ 651,060,000	
$600,000 to $1 million	"	$ 1,165,900,000	
Over $1 million	"	$ 135,200,000	
Sales to Other Buyers, at Prices:			
Below $600,000	"	$ 123,320,000	
$600,000 to $1 million	"	$ 354,100,000	
Over $1 million	"	$ 23,400,000	
Commercial Property Sales, adjusted for lots sold without improvements	Table 2, Section 2.e 60%	$ 57,600,000	
Profits			
Annual Average	Table 2, Section 2.g	$ 50,086,468	per year
Cumulative		$ 601,037,616	
Payroll			
Annual Average	Table 2, Section 2.l	$ 70,283,100	per year
Cumulative		$ 843,397,200	
Population (on site at full development)	Table 3, Section 3.b	11,596	people
Students	"	1,380	students
Operations at Full Development			
Population (on-site)			
Residents, Kama'aina	Table 3, Section 3.b	10,786	people
Residents, Retirees New to O'ahu	"	680	"
Part-time Residents	"	130	"
Total Population		11,596	people
Students	Table 3, Section 3.b	1,380	students
Sales Revenues			
Consumption Expenditures	Table 3, Section 3.b	$ 174,796,725	per year
On-site Sales other than Consumption	Table 3, Section 3.c	$ 49,116,800	"
Total Sales		$ 223,913,525	per year
Profits (on-site activities)	Table 3, Section 3.c	$ 13,070,840	"
Employment	"	1,100	jobs
Household Income	Table 3, Section 3.b	$ 358,580,000	per year
Payroll in Addition to Household Income	Table 3, Section 3.c	$ 19,458,000	"

Table 5. Impacts on State Revenues and Expenditures

(Values in 2006 dollars)
(continued)

Item	Source or Multiplier	Amount or Annual Average	Units
5.b. DEVELOPMENT ACTIVITIES			
Revenues (cumulative)			
Highway Impact Fees			
Multi-family Homes	$ 1,245 per home	$ 3,119,970	
Single-family Homes	$ 1,836 per home	$ 2,926,584	
Commercial Space	$ 4,053 per 1000 sq. ft.	$ 972,720	
Total Highway Impact Fees		$ 7,019,274	
State Share of Highway Impact Fees	72%	$ 5,053,877	
School Impact Fees			
Multi-family Homes	$ 1,662 per home	$ 4,164,972	
Single-family Homes	$ 4,236 per home	$ 6,752,184	
Total School Impact Fees		$ 10,917,156	
Conveyance Tax			
Owner-occupied Homes at Prices:			
Below $600,000	0.10% of sales	$ 651,060	
$600,000 to $1 million	0.20% "	$ 2,331,800	
Over $1 million	0.30% "	$ 405,600	
Sales to Other Buyers, at Prices:			
Below $600,000	0.15% "	$ 184,980	
$600,000 to $1 million	0.25% "	$ 885,250	
Over $1 million	0.35% "	$ 81,900	
Commercial Property	0.30% "	$ 172,800	
Total Conveyance Tax		$ 4,713,390	
Excise Tax, State Share			
Final Sales	4.0% of sales	$ 118,977,938	
Intermediate Sales	0.5% "	$ 11,356,169	
Total Excise Tax		$ 130,334,107	
Corporate Income Taxes	1.0% of profits	$ 6,010,376	
Personal Income Taxes	4.4% of income	$ 37,109,477	
Total State Tax Revenues		**$ 194,138,383**	
Average Annual Revenues		**$ 16,178,199**	**per year**
Expenditures (cumulative)			
Highway Fund	above	$ (5,053,877)	
Schools (K to 12)	$ 40,000 per student	$ (55,200,000)	
Services		$ -	
Total Expenditures		**$ (60,253,877)**	
Average Annual Expenditures		**$ (5,021,156)**	**per year**
Net Revenues (cumulative)		**$ 133,884,506**	
Annual Average		**$ 11,157,042**	**per year**

Table 5. Impacts on State Revenues and Expenditures

(Values in 2006 dollars)
(continued)

Item	Source or Multiplier	Amount or Annual Average	Units
5.c. OPERATIONS AT FULL DEVELOPMENT			
Revenues (annual)			
Excise Tax, State Share	4.0% of sales	$ 8,956,541	per year
Corporate Income Tax	1.0% of profit	$ 130,708	"
Personal Income Tax			
On Household Income or Residents	4.80% income	$ 17,211,840	"
On Payroll of Non-residents	4.25% "	$ 826,965	"
Other Revenues			
Residents, Kama'aina	$ 2,220 per person	$ 23,944,920	"
Residents, Retirees New to O'ahu	$ 2,220 "	$ 1,509,600	"
Part-time Residents	$ 1,030 "	$ 133,900	"
Economic Activity	$ 650 per job	$ 715,000	"
Total Revenues		**$ 53,429,474**	per year
Expenditures (annual)			
Education	$ 7,000 per student	$ (9,660,000)	per year
Other Services			
Residents, Kama'aina	$ 2,070 per person	$ (22,327,020)	"
Residents, Retirees New to O'ahu	$ 1,730 "	$ (1,176,400)	"
Part-time Residents	$ 1,130 "	$ (146,900)	"
Economic Activity	$ 1,080 per job	$ (1,188,000)	"
Total Expenditures		**$ (34,498,320)**	per year
Net Revenues (annual)		**$ 18,931,154**	**per year**

Table 6. Pulbic School Staff Attributable to Makaiwa Hills

Item	On-site Schools			Off-site Schools			TOTAL
	Elementary	Middle	Subtotal	Elementary	High	Subtotal	
a. Students							
From Makaiwa Hills	550	298	848	195	337	532	1,380
From Other Communities	-	302	302	355	2,463		
Total	550	600	1,150	550	2,800		
b. Public School Staff							
Teachers	35	39	74	35	161	196	270
Administrators [1]	3	4	7	3	10	13	20
Librarians	1	1	2	1	2	3	5
Counselors	2	3	5	2	9	11	16
Other [2]	21	29	50	21	89	110	160
Total	62	76	138	62	271	333	471
c. Public School Staff Attributable to Makaiwa Hills							
Teachers	35.0	19.4	54.4	12.4	19.4	31.8	86.2
Administrators [1]	3.0	2.0	5.0	1.1	1.2	2.3	7.3
Librarians	1.0	0.5	1.5	0.4	0.2	0.6	2.1
Counselors	2.0	1.5	3.5	0.7	1.1	1.8	5.3
Other [2]	21.0	14.4	35.4	7.4	10.7	18.2	53.6
Total	62.0	37.7	99.7	22.0	32.6	54.6	154.3

[1] Includes principals, vice-principals, student activity coordinators, student services coordinators, registrars, and athletic directors.

[2] Includes nurses, secretaries, clerks, cafeteria workers, maintenance workers, janitors, gardeners, security workers, etc.

Sources:

DOE for the size of new elementary and middle schools, and for the estimated number of students who will come from Makaiwa Hills.

DAHI for all other estimates.

Appendix G
Archaeological Data Recovery, Preservation Plan, and Inventory Survey Addendum

Data Recovery Plan for the Makaīwa Hills Project Honouliuli Ahupua‘a, ‘Ewa District, O‘ahu TMK: [1] 9-1-015:005 por. and 017; 9-2-003:002 por., 005 por., and 084 por.

Prepared for

Group 70 International

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Section 1 Management Summary

Reference	Data Recovery Plan for the Makaīwa Hills Project, Honouliuli Ahupua‘a, ‘Ewa District O‘ahu (O'Leary et al. 2006)
Date	June 2007
Project Number (s)	Cultural Surveys Hawai‘i (CSH) Project Code: HONOU 2
Investigation Permit Number	CSH carries out archaeological studies under Permit 0605.
Project Location	Makaīwa, Honouliuli, ‘Ewa, O‘ahu. TMK: [1] 9-1-015:005 por. and 017; 9-2-003:002 por., 005 por., and 084 por.
Land Jurisdiction	The project area is privately owned by Makaīwa Hills LLC.
Agencies	State Historic Preservation Division / Department of Land and Natural Resources (SHPD/DLNR)
Project Description	The proposed Makaīwa Hills project is a residential development, with supporting commercial uses, infrastructure and open space. Although specific details regarding the development within the project area are not available at this time, extensive disturbance is anticipated.
Project Acreage	The sites described lie in a 1,780.705-acre project area.
Historic Preservation Regulatory Context	This document has been prepared to meet all of the requirements set forth in Hawaii Administrative Rules (HAR) 13-278-3 governing preparation of a Data Recovery Plan.
Fieldwork Effort	As part of the preparation of this data recovery plan, sites under discussion were re-located, photographed, and recorded with high precision GPS equipment.
Historic Properties Addressed	50-80-12-4312 C-shape enclosure 50-80-12-4313 Terrace 50-80-12-4317 Circular enclosure, platform 50-80-12-4318 Circular enclosure 50-80-12-4319 Rock shelter with interior terrace 50-80-12-4321 Rock shelter with interior terrace 50-80-12-4322 Rock shelter with interior *ahu* 50-80-12-4324 Mound; *ahu* 50-80-12-4325 C-shape enclosure, *ahu* 50-80-12-4326 Enclosure 50-80-12-4328 Rock shelter complex (3) 50-80-12-4331 L-shape enclosure 50-80-12-4332 Circular enclosure 50-80-12-4334 Circular enclosure 50-80-12-4336 Enclosure 50-80-12-4337 Circular enclosure 50-80-12-4338 Rock shelter complex 50-80-12-6870 Terrace, springs, and a rock shelter 50-80-12-6871 Paved Area

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Section 2 Introduction

2.1 Project Background and Regulatory Context

The project area addressed by this study is located on the southern slopes of the Wai‘anae Mountains above the ‘Ewa Plain in southwestern O‘ahu and includes TMK: [1] 9-1-015:005 por. and 017; 9-2-003:002 por., 005 por., and 084 por. (Figure 1, Figure 2, and Figure 3).

At the request of Group 70 International this data recovery plan was prepared to address mitigation efforts for nineteen sites. Seventeen of these sites were recommended for data recovery in *An Archaeological Inventory Survey for the Makaīwa Hills Project Site, Honouliuli, ‘Ewa, O‘ahu* (Hammatt et al. 1991) that was reviewed and accepted by the State Historic Preservation Division (SHPD) (Hibbard to Hammatt letter of June 13, 1991; see Appendix A). The SHPD acceptance letter specifies data recovery at these seventeen sites and requires approval of a Data Recovery Plan. Two of the sites (50-80-12-6870 and –6871) addressed in the present plan were described in an *Archaeological Inventory Survey Addendum for the Makaīwa Hills Project, Honouliuli Ahupua‘a, ‘Ewa District, O‘ahu* (O’Leary and Hammatt 2006).

In general this present plan follows HAR 13-278-3 governing preparation of Data Recovery Plans. The seventeen sites for data recovery are listed below (Table 1) and are presented in detail in Section 4 of this plan.

Cultural Surveys Hawai‘i (CSH) personnel carried out fieldwork in 2006 successfully relocating the seventeen historic properties scheduled for data recovery in the *Archaeological Inventory Survey for the Makaīwa Hills Project Site, Honouliuli, ‘Ewa, O‘ahu* (Hammatt et al. 1991) study. This data recovery will examine the project area utilizing a settlement-pattern approach to determine how artifacts, deposits, and features are part overall cultural landscape. Radiocarbon dating will be undertaken to determine how early, and for how long, the project area was inhabited by Native Hawaiians. Non-destructive Energy-Dispersive X-ray Fluorescence (EDXRF) will be undertaken to capitalize on the opportunity to examine stone tool procurement, production, and distribution.

2.2 Project Description

The proposed Makaīwa Hills project is a residential development with supporting commercial uses, infrastructure and open space. Although specific details regarding the development within the project area are not available at this time, extensive disturbance is anticipated.

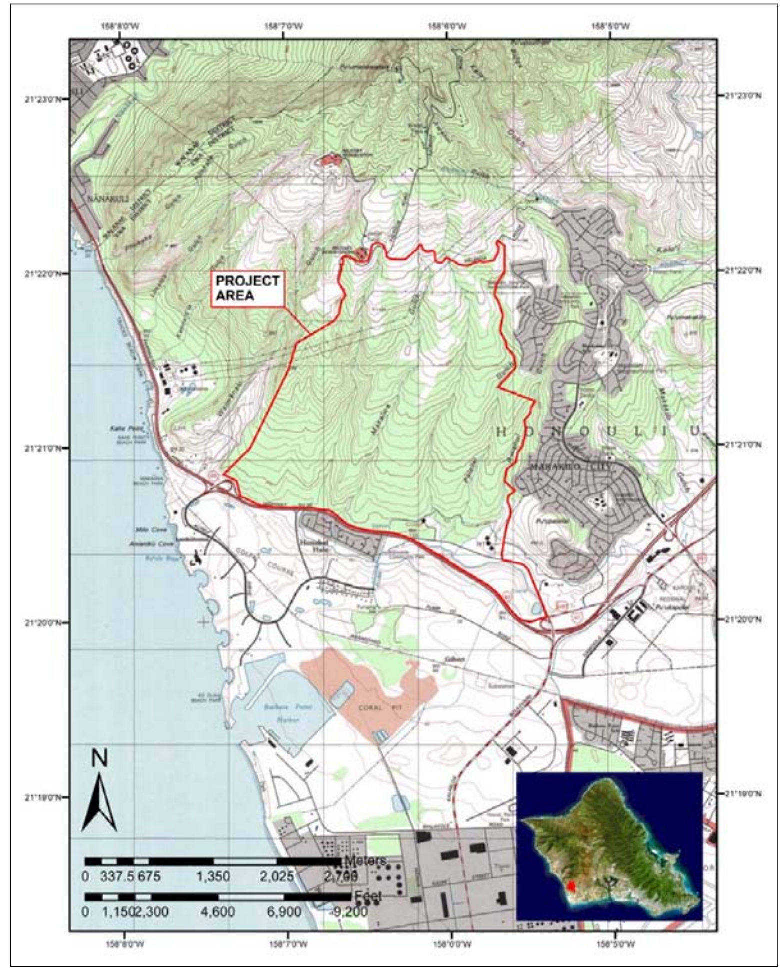

Figure 1. A portion of the 1998 ‘Ewa USGS 7.5-minute topographic quadrangle showing the current project area

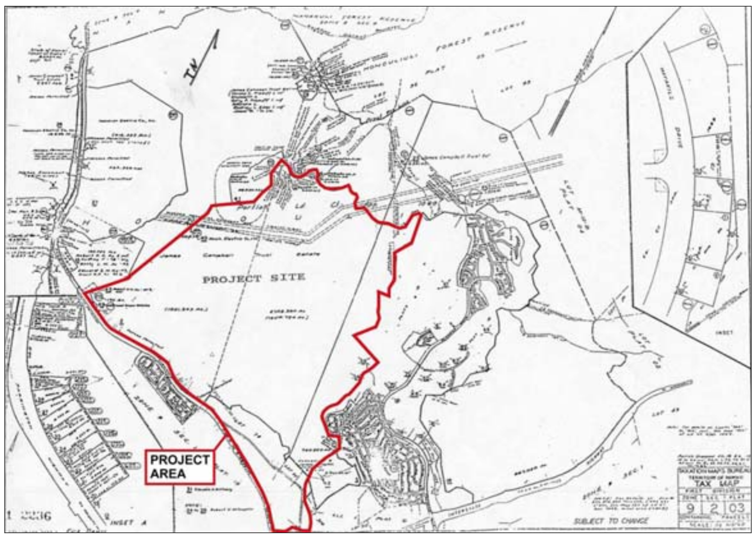

Figure 2 Tax Map Key (TMK) [1] 9-2-03 showing the Makaīwa Hills project area

Figure 3. Portion of the Oahu, Hawaii EarthData High-Resolution Orthoimagery – vol001 showing the location of the Makaīwa Hills Project Area

Table 1. Historic Properties for Data Recovery within the Makaīwa Hills Project Area. Proposed treatments include M = Map, L = GPS locate, P = Photograph, E = Excavate.

SIHP # 50-80-12-	Site Form	Site Function	Proposed Treatment
-4312	C Shape enclosure	Temporary habitation	M, L, P, E
-4313	Terrace/	Agricultural	M, L, P, E
-4317	Circular enclosure; platform	Recurrent habitation	M, L, P, E
-4318	Circular enclosure	Temporary habitation-shelter	M, L, P, E
-4319	Rockshelter w/interior terrace	Permanent habitation	M, L, P, E
-4321	Rockshelter w/interior terrace	Habitation	M, L, P, E
-4322	Rockshelter w/interior *ahu*	Quarry	M, L, P, E
-4324	Mound; *ahu*	Agricultural	M, L, P, E
-4325	C-shape enclosure; *ahu*	Temporary Habitation	M, L, P, E
-4326	Enclosure	Temporary habitation	M, L, P, E
-4328	Rockshelter complex (3)/	Permanent habitation	M, L, P, E
-4331	L-shape enclosure	Temporary habitation	M, L, P, E
-4332	Circular enclosure	Temporary habitation	M, L, P, E
-4334	Circular enclosure	Temporary habitation	M, L, P, E
-4336	Rectangular enclosure	Recurrent habitation	M, L, P, E
-4337	Circular enclosure	Temporary habitation	M, L, P, E
-4338	Rockshelter complex	Permanent habitation	M, L, P, E
-6870	Terrace, springs, and a rock shelter	Animal Husbandry	M, L, P, E
-6871	Paved Area	Indeterminate	M, L, P, E

2.3 Environmental Summary

2.3.1 Built Environment

Presently, the majority of the project area is being used for cattle grazing. An active water trough and cattle pen are situated just south of Pālehua Road and an extensive wire fence, which includes stone wall sections crosscuts the slope at approximately the 600 ft. contour, retaining the majority of the cattle within this northern enclosure.

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

TMK [1] 9-1-015:11 & 23 are small exclusions zones within the project area because they are government property where there are already large water tanks located on them.

2.3.2 Natural Environment

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

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

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

-Stony steep land (rsy) (ridges - majority of project area)

-Lualualei extremely stony clay (LPE) (lower gulches)

-Helemano silty clay (HLMG) (ridge crests)

-Honouliuli clay (HxA, HxB) (lowlands to southeast)

-Mahana-Badland complex (MBL) (heavily eroded *mauka* lands)

-Lualualei stony clay (LvB) (low lands to southeast)

-Ewa silty clay loam (EaB) (lowlands to southeast)

-Molokai silty clay loam (MuC) (lowlands to southeast)

-Ewa stony silty clay (EwC) (lowlands to southeast)

-Rock land (rRK) (steep land above Waimanalo Gulch)

-Mahana silty clay loam (MC) (higher soil covered ridges)

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

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

Vegetation type and density varies according to the topographical environment and erosional effects within the project area. The vegetation adjacent to the deeply eroded stream channels during the winter months (within the flood zones) is extremely thick and lush with tall grasses predominating, often reaching a height of 2 m. The upper valley slopes are characterized by clusters of trees and low shrubs and grasses surrounded by pockets of denuded ground surface.

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

a) Lowland zone - open grassland on the leeward side;

b) Lower Forest - beginning about 1000 feet and richer in species than the rainforest; *kukui*, *'ōhia 'ai*, *koa*, *kalia*, sandalwood, *'ōhia lehua*, *hau*, *kī*, '*ape*, *pia*, banana, ginger, birdnest fern and *honohono*, as well as grasses and cyperaceous plants;

c) Specifically leeward lower forest – '*ohe*, *wiliwili*, *maile*, *halapepe* and '*alani*, with almost no undergrowth.

Historical accounts presented by Frierson (1972:5-6) describe these lower forest species as extending to 500 feet, with the presence of sandalwood observed down to as low as 300 feet. The lower forest then is hypothesized to have covered at least the upper one-third of the project area. The higher site density may correlate to the lower fringes of this forest. Viewing the heavily eroded and fairly open landscape today one is impressed by the dramatic effects of herbivore grazing in the last 150 years in terms of vegetation changes and erosion. This was always a rain shadow slope and we may more accurately envisage a parkland community rather than a thick forest.

Section 3 Cultural and Historical Documentation

3.1 Prehistory and Early History

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

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

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

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

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

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

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

Other early historical accounts of the general region typically refer to the more populated areas of the ‘Ewa District, where missions and schools were established and subsistence resources were perceived to be greater. However, the presence of archaeological sites along the barren coral plains and coast of southwest Honouliuli Ahupua‘a, as well as those identified within the present study area along the slopes of the Wai‘anae Range, indicate that prehistoric and early historic populations also adapted to these less inviting areas, despite the environmental hardships.

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

1) "early", c. 1790:

Prickly pear cactus, *Opuntia tuna*

Haole koa, *Leucaena glauca*

Guava, *Psidium guajava*

2) 1835-1840

Burmuda [sic] grass, *Cynodon dactylon*

Wire grass, *Eleusine indica*

3) Lantana, *Lantana camara*

The *kiawe* tree was also introduced during this period, either in 1828 or 1837 (Frierson 1972: 11).

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

3.2 Mid to late 19th Century

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

Samuel Kamaukau relates the following about Kekau‘onohi as a child:

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

Kekau'onohi was one of Liholiho's (Kamehameha II's) wives, and after his death, she lived with her half-brother, Luanu‘u Kahala‘i‘a, who was governor of Kaua‘i (in Hammatt and Shideler 1990: 20). Subsequently, Kekau‘ōnohi ran away with Queen Ka‘ahumanu's stepson, Keli‘i-ahonui, and then became the wife of Chief Levi Ha‘alelea. Upon her death on June 2, 1851, all her property was passed on to her husband and his heirs. When Levi Ha‘alelea died the property went to his surviving wife, who in turn leased it to James Dowsett and John Meek in 1871 for stock running and grazing.

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

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

Ewa Plantation Co. grew quickly and continued in full operation up into modern times. As a means to generate soil deposition on the coral plain and increase arable land in the lowlands, the Ewa Plantation Co. installed ditches running from the lower slopes of the mountain range to the lowlands and then plowed the slopes vertically just before the rainy season to induce erosion (Frierson 1972:17). Two ditches, which were likely used for this procedure, are still present along the southern boundary of the project area.

3.3 Modern Land Use

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

Section 4 Previous Archaeological Research

The coral plains of ‘Ewa have been the focus of more than 50 archaeological studies over the last two decades, largely as the result of required compliance with county, state, and federal legislation. The Kalaeloa (Barber’s Point) area is one of the most studied places in Polynesia (Figure 4). Those studies will not be reviewed in detail in this data recovery plan. This plan will focus on the few studies that comprise the small amount of research that has been conducted along the southern slopes of the Wai‘anae Range.

The earliest attempt to record archaeological remains in Honouliuli Ahupua‘a was made by Thomas Thrum (1906) (Table 2). He reports the existence of a *heiau* located on Pu‘u Kapolei, approximately 1 mile (1.6 km) southeast of the current project area. Pu‘u Kapolei Heiau is described as “Ewa-size and class unknown. Its walls thrown down for fencing” (Thrum 1906:46).

In his surface survey of 1930, archaeologist J. Gilbert McAllister recorded the specific locations of important sites, and the general locations of less important sites (at least at Honouliuli). Archaeological investigations by McAllister along the southern slopes of the Wai‘anae Range identified a number of sites that are of interest.

McAllister documents Pu‘u Kapolei Heiau as Site 138 and notes:

> The stones from the heiau supplied the rock crusher which was located on the side of this elevation, which is about 100 feet away on the sea side. There was formerly a large rock shelter on the sea side where Kamapuaa (the pig-god) is said to have lived with his grandmother (Kamaunuaniho). (McAllister 1933:108)

McAllister's Site 136 is located near Mauna Kapu, northwest of the current project area, and is described as a small platform on the ridge dividing the ‘Ewa and Wai‘anae districts. The 4 to 6 square foot platform was constructed of coral and basalt stones, and was believed to be an altar (McAllister 1933:107). It is noted to have been destroyed by the time of Sterling and Summers’ work in the late 1950’s (Sterling and Summers 1978:32).

McAllister’s Site 137 is at Pu‘u Ku‘ua, a prominent landmark 1.8 miles (2.9 km) north of the current project area. Pu‘u Ku‘ua Heiau is described by McAllister as:

> (Destroyed) The heiau was located on the ridge overlooking Nanakuli as well as Honouliuli at the approximate height of 1800 feet. Most of the stones of the heiau were used for a cattle pen located on the sea side of the site. The portion of the heiau which has not been cleared for pineapple has been planted in ironwoods. (McAllister 1933:32)

The presence of Pu‘u Ku‘ua Heiau, provides some archaeological evidence of the Pu‘u Ku‘ua settlement described in the Hawaiian Newspaper “*Ka Loea Kalai‘āina*”.

None of these sites are in the immediate vicinity of the current project area. However, the presence of extant or former archaeological remains demonstrates Hawaiian use of these *mauka* lands.

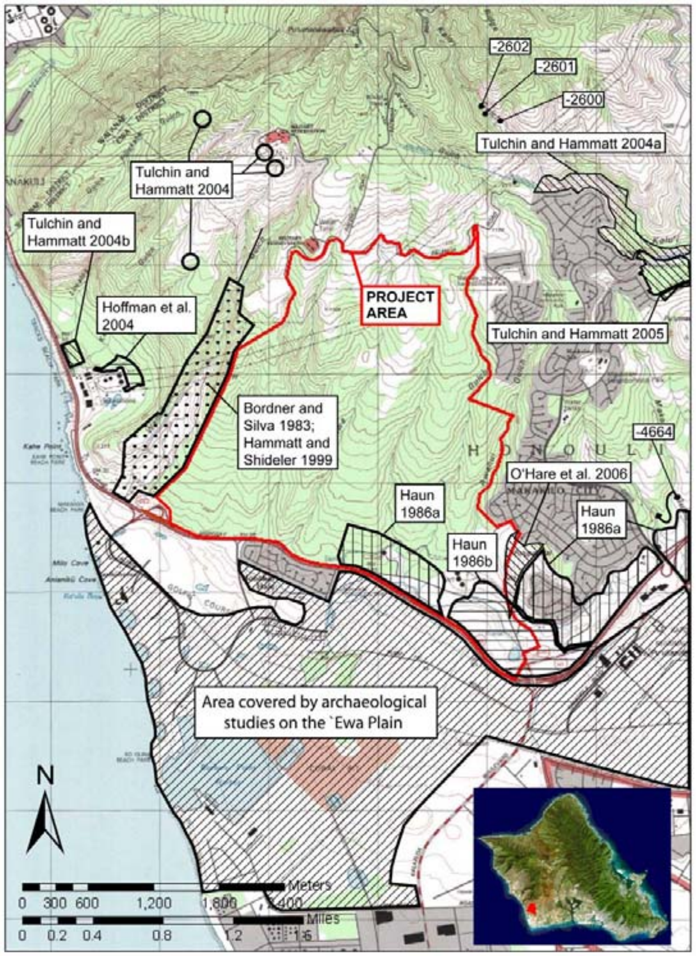

Figure 4. A portion of the 1998 ‘Ewa USGS 7.5-minute topographic quadrangle showing the current project area and previous archaeology completed in the vicinity

Table 2. Previous Archaeological Investigations in the Uplands of Honouliuli Ahupua‘a

Reference	**Type of Investigation**	**General Location**	**Findings**
Bordner 1977a	Archaeological Reconnaissance	Proposed Makaīwa Gulch Landfill Site	No archaeological sites identified
Bordner 1977b	Archaeological Reconnaissance	Proposed Kalo‘i Gulch Landfill Site	3 sites (-2600, -2601, -2602), low stacked boulder walls
Bordner and Silva 1983	Archaeological Reconnaissance and Historical Documentation:	Proposed Waimānalo Gulch Landfill Site	No archaeological sites identified
Sinoto 1988	Archaeological Reconnaissance	Makakilo Golf Course	low stacked boulder wall (-1975)
Bath 1989	Petroglyph Documentation	Waimānalo Gulch	3 petroglyphs (-4110)
Hammatt et al. 1991	Archaeological Inventory Survey	Makaīwa Hills Project Site	34 sites, including prehistoric habitation and agricultural features, rock shelters, petroglyphs, *ahu*, and various sugar cane cultivation infrastructure
Hammatt 1992	Archaeological Inventory Survey	KAIM Radio Tower, Pālehua	No archaeological sites identified
Nakamura et al. 1993	Archaeological Inventory Survey	Makakilo D and D-1 Development Parcels	cement irrigation flume (-4664)
Borthwick 1997	Archaeological Assessment	Satellite Multi-Ranging Station, Pālehua	No archaeological sites identified
Dega et al. 1998	Archaeological Inventory Survey	UH West O‘ahu	Two historic site complexes, (50-80-08-5593 historic irrigation system and 50-80-09-2268 Waiahole Ditch System)
Hammatt and Shideler 1999	Archaeological Inventory Survey and Assessment	Waimānalo Gulch Sanitary Landfill Project Site	Battery Arizona Complex and modern “shrine” site
Hoffman et al 2004	Archaeological Assessment	30-acres next to the Kahe Power Plant	No historic properties
Tulchin and Hammatt 2004	Archaeological Field Inspection	North of Waimānalo Gulch	Three prehistoric archaeological features

Reference	Type of Investigation	General Location	Findings
Tulchin and Hammatt 2004a	Archaeological Inventory Survey	86-acres in Kalo‘i Gulch	4 historic era sites: concrete and iron structures (-6680), boulder clearing mounds (-6681), small terrace (-6682), and a portion of the Waiāhole Ditch (-2268)
Tulchin and Hammatt 2004b	Archaeological Inventory Survey	24-acres next to the Kahe Power Plant	4 sites (-6647 to -6650): predominantly historic ranching era related ruins
Tulchin and Hammat 2005	Archaeological Inventory Survey	71-acres north of Pu‘umakakilo	3 sites: prehistoric agricultural alignment and mound (-6666), plantation-era boulders walls and ditch (-6667), and a prehistoric agricultural terrace (-6668)

Recent archaeological investigations in the southern Wai‘anae Range have generally been focused on deep gulch areas for potential landfill locations, lower slopes for residential development, and mountain peaks for antennae or satellite tracking infrastructure (Table 2).

Relatively few archaeological sites have been located by archaeological studies made in the vicinity of the current project area (Figure 4). Kalo‘i Gulch, which borders the northern portion of the current project area, was also surveyed as a potential landfill location (Bordner 1977b). The archaeological reconnaissance survey included lands within Kalo‘i Gulch and its smaller tributaries from the *makai* end of the gulch up to the 1,400 ft elevation. It was noted that lands at the base of the gulch, *makai* of an historic quarry, were extensively modified by bulldozing. In the *mauka* portions of the project area, three sites, possibly prehistoric, were identified (Figure 4). The three historic properties (50-80-12-2600, -2601, -2602) consisted of low stacked basalt boulder walls located along the north side of the Kalo‘i Stream channel.

During the initial archaeological survey of the lower portions of Waimānalo Gulch (the future site of the Waimānalo Gulch Sanitary Landfill), up to the 430-foot elevation, no archaeological sites were identified (Bordner and Silva 1983). In 1989, three petroglyph units (historic property 50-80-12-4110) were located within the previously surveyed parcel (Bath 1989). Historic property 50-80-12-4110 is located in the southwest corner of Waimānalo Gulch, at approximately 80 ft. elevation.

Further archaeological study within Waimānalo Gulch was conducted for the expansion of the sanitary landfill (Hammatt and Shideler 1999). No archaeological sites were located with the project area, however two sites, the Battery Arizona bunker complex and a modern “shrine” site, were observed along the northern ridge which separates Waimānalo Gulch from the HECO Kahe

Power Plant property. The stones of the “shrine” site were understood to have been previously relocated from the central portion of Waimānalo Gulch circa 1988.

Makaīwa Gulch, the next major gulch east of Waimānalo Gulch was also surveyed as a potential landfill location (Bordner 1977a). The reconnaissance survey included lands within Makaīwa Gulch from Farrington Highway, *mauka* to the approximate 1000 ft (305 m) elevation. No significant archaeological sites were identified.

Archaeological studies relevant for the current project area are two reports by Alan Haun of the archaeological firm Paul H. Rosendahl, Inc. (PHRI). The first is a letter report entitled *Preliminary Archaeological Reconnaissance Survey for Environmental Assessment (EA) ‘Ewa Town Center/ Secondary Urban Center, Land of Honouliuli, ‘Ewa, Island of Oahu (TMK: 9-1-15: Por. 4, 5, 17; 9-1-16:1, Por. 4, 6, 9, 16, 18, 24, 30: 9-2-19: Por. 1)* (Haun 1986a). This study covered a petition area of approximately 1,400 acres, and extends into the *makai* portion of the current project area (Figure 4). The second is *Preliminary Archaeological Reconnaissance Survey for Environmental Assessment (EA) ‘Ewa Town Center/ Secondary Urban Center, Land of Honouliuli, ‘Ewa, Island of Oahu* (*TMK: 9-1-15: Por., 5, 17; 9-1-16:Por. 9)* (Haun 1986b). This study covered a petition area of approximately 200 acres and overlaps the southeast corner of the current project area (Figure 4).

The Haun studies note the extensive modification for sugarcane cultivation and concludes that only two sites had been previously reported in the vicinity: the OR&L alignment (SIHP 50-80-12-9714) well to the south of the current project area and the *heiau* and large rock shelter recorded by McAllister (1933) on Pu‘uokapolei (SIHP 50-80-12-138). Pu‘uokapolei was outside of the Haun study area and was not checked by him during his field survey. Haun identified two sites within the current project area: an irrigation ditch (a portion of the same SIHP 50-80-12-4341 identified during the 200-acre survey), and a rock wall that paralleled the irrigation ditch. This wall was later designated Site 50-80-12-4314. Both of these historic properties were later addressed by Hammatt et al. (1991) and found to be non-significant.

In 1990 Cultural Surveys Hawaii was requested by William E. Wanket Inc., Land Use Consultant for the Estate of James Campbell, to undertake an archaeological inventory survey for the approximately 1,780.705-acre proposed Makaīwa Hills development project (TMK 9-1-15: 5, 11, 17; 9-1-16: Portion 9; 9-2-03: Portion 2) located in the *ahupua‘a* of Honouliuli, ‘Ewa, Island of O‘ahu. The archaeological inventory survey (Hammatt et al. April 1991) was reviewed and approved by the State Historic Preservation Division (see Appendix A below).

The survey and limited testing were conducted between September 24 and late October, 1990. During the fieldwork, 34 historic properties were located, including habitation structures (permanent and temporary), agricultural features (terrace and mounds), rock shelters, a possible rock shelter quarry, petroglyphs, *ahu*(s) and various other structures associated with sugarcane cultivation attributable to the ‘Ewa Plantation Company.

Eighteen of the 34 recorded historic properties were considered "likely to yield information important to prehistory and history". Of these 18 historic properties, four were also evaluated as an excellent example of a site type. Thus, it was recommended that all of the 17 historic properties that were considered significant be subjected to a program of subsurface testing followed by intensive excavation of selected sites to address scientific/informational significance preceding developmental impact and removal of sites. It was additionally recommended that the four sites evaluated as excellent site types be considered for preservation pending results of subsurface testing. SIHP # 50-80-12-2893 had been the subject of previous research and as a result had already been recommended for preservation.

Of the 34 historic properties, sixteen, including structures associated with the Ewa Plantation Company, historic cattle walls and various other amorphous and disturbed mounds and *ahu*(s), were considered to be no longer significant and were not recommended for further work. Detailed data recovery and preservation plans were called for to be prepared and submitted to the State Historic Preservation Office (DLNR) for review and approval.

Surface collection took place in only a handful or historic properties. Only two 50 cm square test units were excavated and no radiocarbon samples were submitted for dating. Detailed descriptions and the fieldwork that was previously conducted at the 17 historic properties scheduled for data recovery are provided below in Section 4.

Archaeological inventory survey of the Makakilo D and D-1 Development Parcels included lands on the southern and western slopes of Pu'u Makakilo, adjacent to the golf course property. A single historic property, a cement irrigation flume (SIHP # 50-80-12-4664), was located in the southern portion of the project area near the H-1 Freeway (Nakamura et al. 1993).

Tulchin and Hammatt (2004a) conducted an inventory survey of the approximately 86-acre proposed Pālehua Community Association (PCA) Common Areas on the northwestern side of Makakilo. The elevation of that project area (approximately 400-1100 ft) makes it comparable to the present project area. Historic sites located during the inventory survey included: a complex of concrete and iron structures associated with industrial rock quarry operations (SIHP # 50-80-12-6680); three boulder mounds believed to be related to land clearing or ditch construction by the O'ahu Sugar Co. (SIHP # 50-80-12-6681); a small terrace believed to function as an historic water diversion feature (SIHP # 50-80-12-6682); and a remnant portion of the Waiāhole Ditch (SIHP # 50-80-09-2268). No prehistoric historic properties were identified.

A parcel of land adjacent to the Kahe Power Plant was the subject of an archaeological inventory survey (Tulchin and Hammat 2004b). Four historic properties were identified. The first (SIHP # 50-80-12-6647), consists of a ranch-related stacked limestone slab wall, an agricultural terrace, and a possible fishing shrine. The second (SIHP # 50-80-12-6648) includes three cement, brick and dressed basalt boulder ruins related to an historic structure. The third (SIHP # 50-80-12-6649) is an historic water diversion wall. The fourth (SIHP # 50-80-12-6650) comprises a collection of predominantly limestone boulder and cobble agricultural mounds and platforms.

An additional 30-acres adjacent to the Kahe Power Plant were the subject of an archaeological assessment (Hoffman et al. 2004). No historic properties were discovered.

Tulchin and Hammatt (2004) undertook a field inspection of four locations to the north of Waimanalo Gulch. Three small stone features were identified: an *ahu*, a stone terrace, and a small C-shape. An archaeological inventory survey was recommended should any construction activities be proposed for those parcels of land.

Tulchin and Hammat (2005) conducted an additional inventory of a 71-acre parcel adjoining the PCA which had been previously surveyed. Three historic properties were identified. SIHP # 50-80-12-6666 is a prehistoric agricultural alignment and mound. SIHP # 50-80-12-6667

consists of plantation-era stacked basalt boulder walls and a ditch. SIHP # 50-80-12-6668 is made up of two features: a single alignment of upright basalt boulders and a small, low terrace. Both features were thought to be prehistoric agricultural features.

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Section 5 Properties for Data Recovery

Descriptions of the 17 historic properties recommended for data recovery are given below. The descriptions are taken from the original archaeological inventory survey (Hammatt et al. 1991), but have been modified based upon CSH field personnel's observations during the initial reconnaissance for the relocation of the historic properties. The locations of the 17 historic properties are indicated in Figure 5.

5.1 SIHP #: 50-80-12-4312

Site Type: Enclosure

Function: Temporary habitation

Probable Age: Pre-Contact

Condition: Fair

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

Description: This structure is open to the west and walled on three sides with the east side of the enclosure utilizing the slope (Figure 6). The walls are constructed of stacked small to medium boulders standing 40 cm. (1.3 ft.) high, 1-3 courses, and average 40 cm. (1.3 ft.) wide (1 boulder). This site is located on the east side of the most western unnamed gulch in the project area east of Waimānalo Gulch.

CSH personnel were unable to relocate this historic property during the initial reconnaissance for the preparation of this data recovery plan. Further efforts will be made to find it during the data recovery fieldwork.

5.2 SIHP #: 50-80-12-4313

Site Type: L-Shaped Terrace Wall

Function: Agricultural

Probable Age: Pre-Contact

Condition: Fair

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

Description: This site consists of an L-shaped terrace wall constructed of stacked boulders and cobbles utilizing some large outcrop boulders (Figure 7). The terrace wall has exterior heights that range from 60 cm. (1.9 ft.) to 1 m. (3.2 ft.) high, 3 courses, and 75 cm. (2.4 ft.) wide. This terrace wall retains an area approximately 14.3 m. (46.9 ft.) by 9.5 m. (31.1 ft.) of level soil (presently covered by dense grass). This site is located on the west side of Makaīwa Gulch at an approximate elevation of 1020 ft. (310.9 m.). A deep erosional channel drops roughly 3 m. (9.8 ft.) immediately below the terrace edge at the center of the gulch.

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

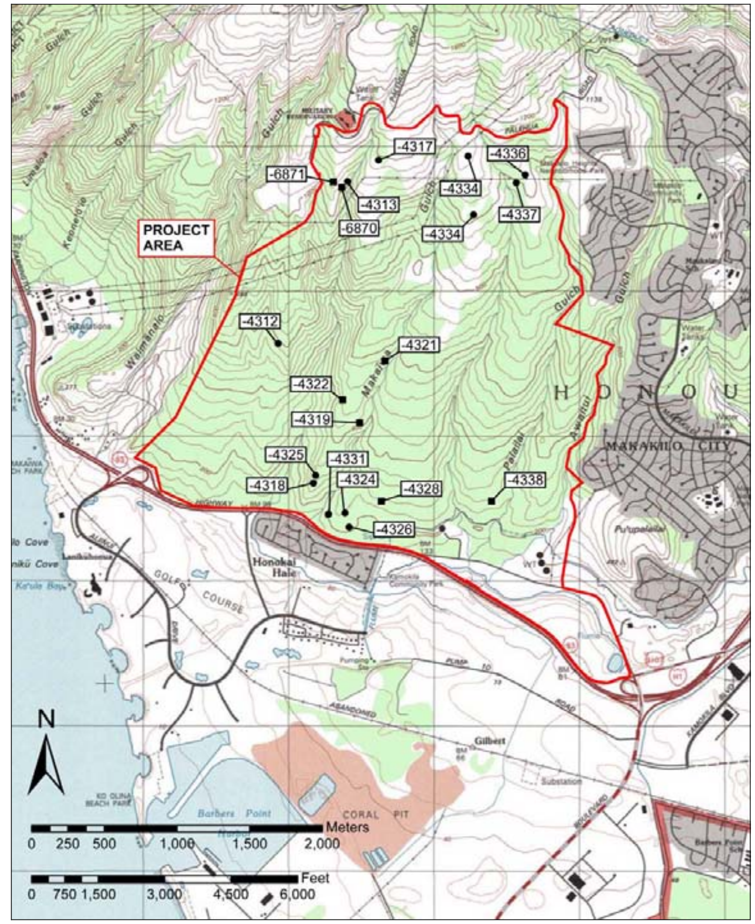

Figure 5. A portion of the 1998 'Ewa USGS 7.5-minute topographic quadrangle showing the project area and the locations of the historic properties within it that are slated for data recovery (circles and squares) and preservation (squares); all SIHP #s are be proceeded with 50-80-12

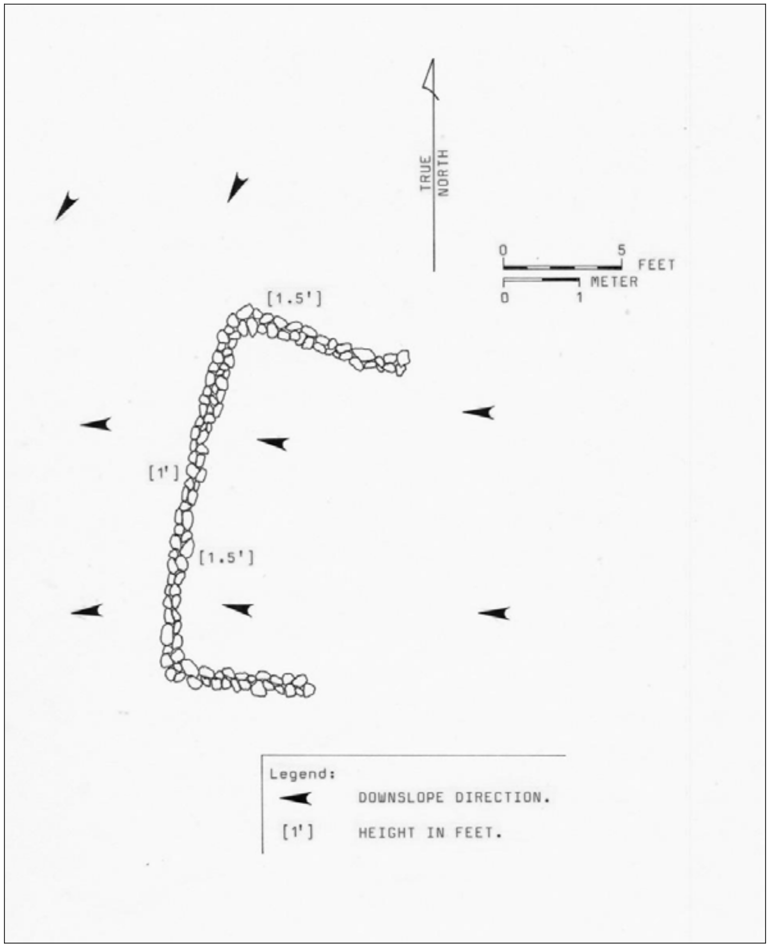

Figure 6. SIHP # 50-80-12-4312; Plan View

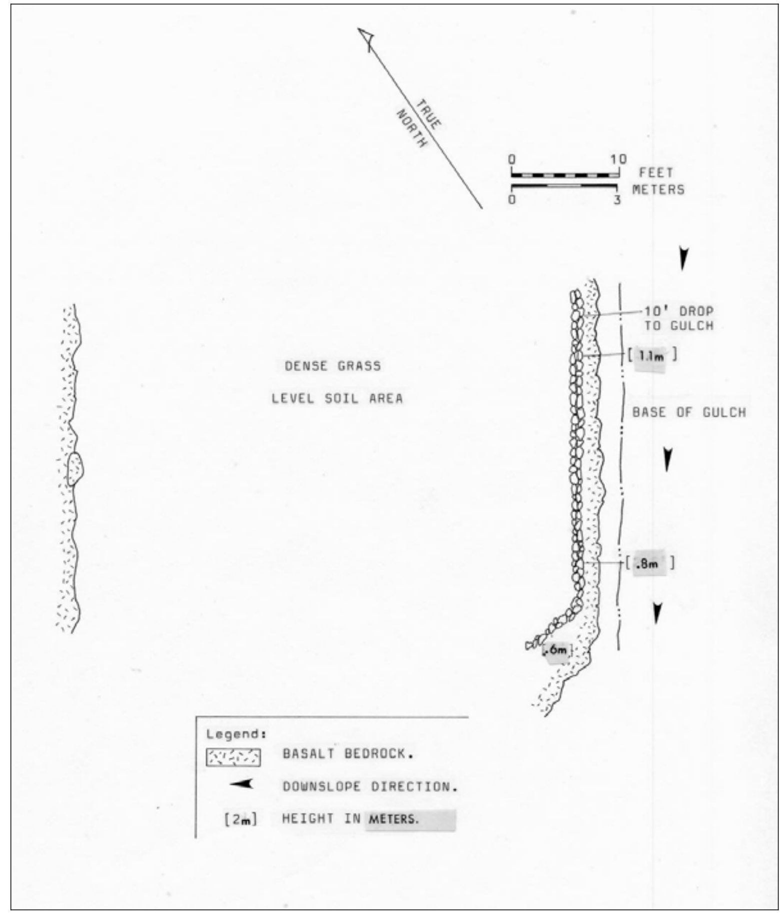

Figure 7. SIHP # 50-80-12-4313; Plan View

5.3 SIHP #: 50-80-12-4317

Site Type: Circular Enclosure and Platform

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

Probable Age: Pre-Contact

Condition: Fair

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

Description: This site consists of a roughly "U" shaped enclosure open to the northeast with an attached platform (Figure 8). The enclosure is roughly rectangular in shape and is constructed of small boulders and cobbles with mounded walls discontinuous in sections. These walls average 50 cm. (1.6 ft.) high and 1 m. (3.2 ft.) wide.

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

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

Testing Results

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

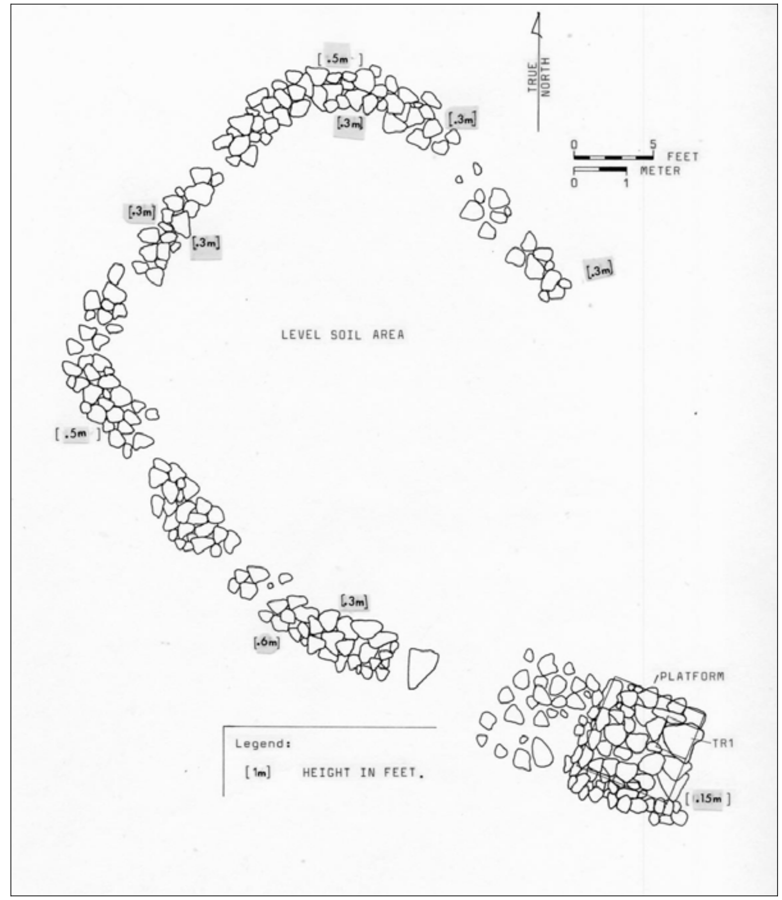

Figure 8. SIHP # 50-80-12-4317; Plan View

5.4 SIHP #: 59-80-12-4318

Site Type: Circular Enclosure

Function: Temporary Habitation

Probable Age: Pre-Contact

Condition: Fair

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

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

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

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

5.5 SIHP #: 50-80-12-4319

Site Type: Rock Shelter with Interior Terrace

Function: Permanent Habitation

Probable Age: Pre-Contact

Condition: Excellent

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

Description: This rock shelter measures 10.3 m. (33.7 ft.) wide and 5.4 m. (17.7 ft.) deep (Figure 10). Ceiling heights range from 45 cm. (1.4 ft.) to 1.6 m. (5.2 ft.) high. A stone-faced terrace constructed of 3-5 courses of cobbles and boulder slabs, measures 5.4 m. (17.7 ft.) long and 60 cm. (1.9 ft.) high above the shelter floor. The terrace abuts the rear of the cave and retains a soil area measuring 5.4 m. (17.7 ft.) by 2.7 m (8.8 ft.) approximately 1 m. (3.2 ft.) below the rock shelter ceiling. The main entrance to the rock shelter is 2.5 m. (8.2 ft.) high.

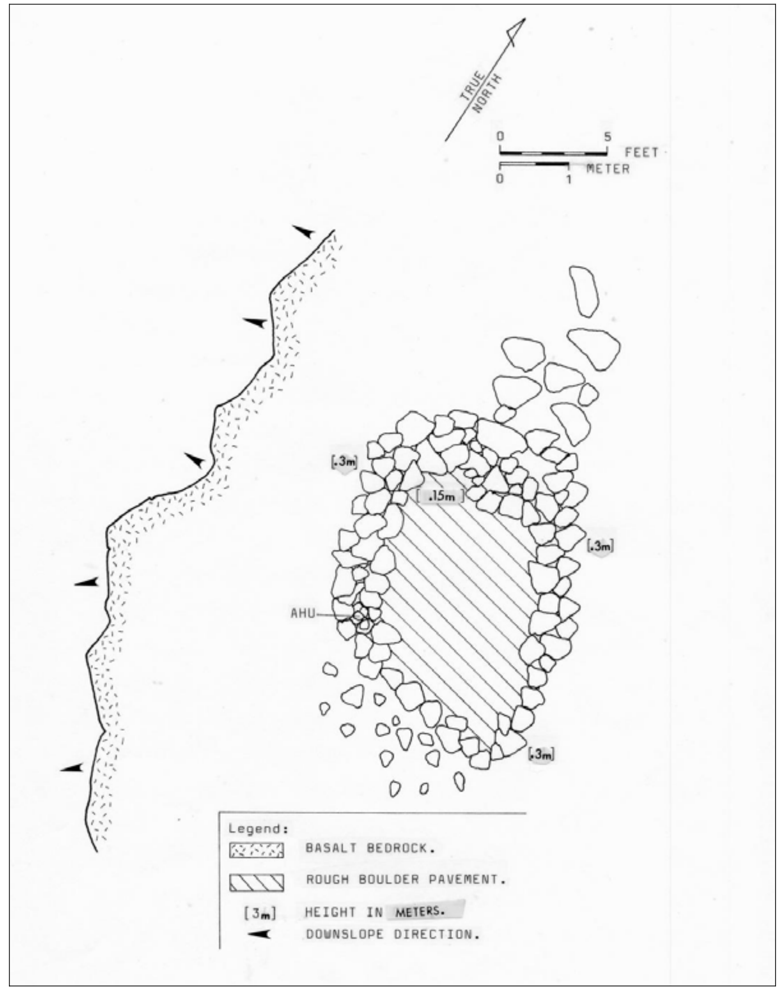

Figure 9. SIHP # 50-80-12-4318; Plan View

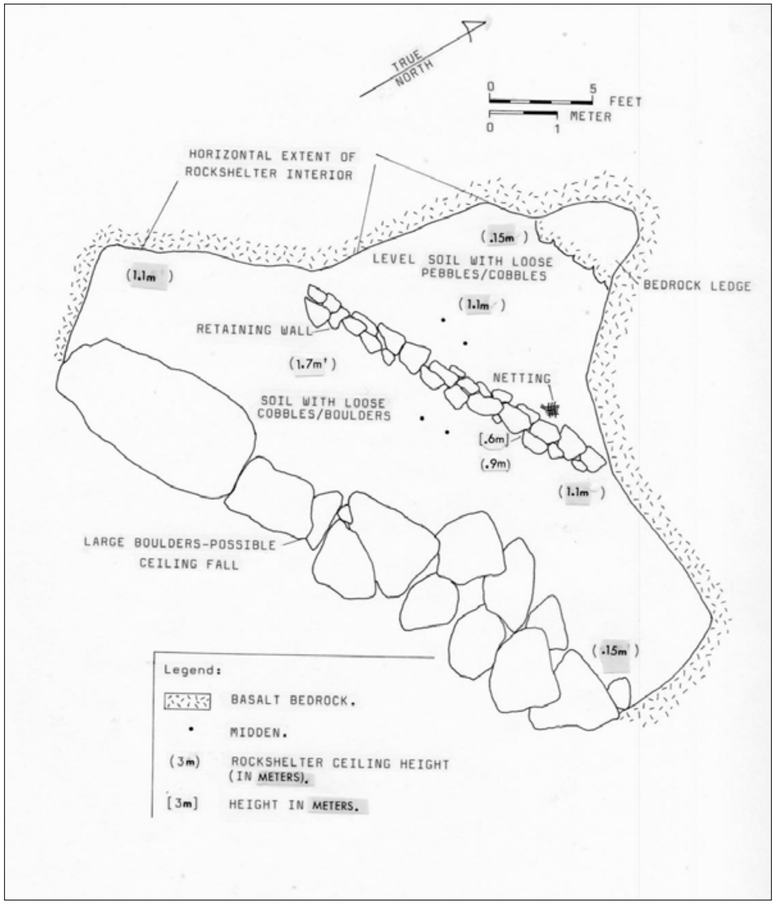

Figure 10. SIHP # 50-80-12-4319; Plan View

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

This site is located on the western lower ridge of an unnamed gulch east of Makaīwa Gulch at an approximate elevation of 400 ft. (121.9 m.). The excavation potential for this historic property is excellent.

5.6 SIHP #: 50-80-12-4321

Site Type: Rock Shelter/Interior Terrace

Function: Recurrent/Permanent Habitation

Probable Age: Pre-Contact

Condition: Good/Excellent

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

Description: The rock shelter measures 10 m. (32.8 ft.) wide by 5.7 m. (18.6 ft.) deep (Figure 11). The ceiling heights range from 60 cm. (1.9 ft.) to 1.2 m. (3.9 ft.) high. A stone-faced terrace measuring 4.2 m. (13.7 ft.) long retains a soil area of 2.5 m. (8.2 ft.) by 3.0 m. (9.8 ft.) which abuts the rear of the cave. The terrace face is constructed of angular and rounded small boulders and stands 30 cm. (9 in.) high, 2-3 courses, above the shelter floor. The entrance has an average height of 1.3 m. (4.2 ft.).

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

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

The excavation potential for this historic property is excellent.

TMK: [1] 9-1-015:005 por. and 017; 9-2-003:002 por., 005 por., and 084 por.

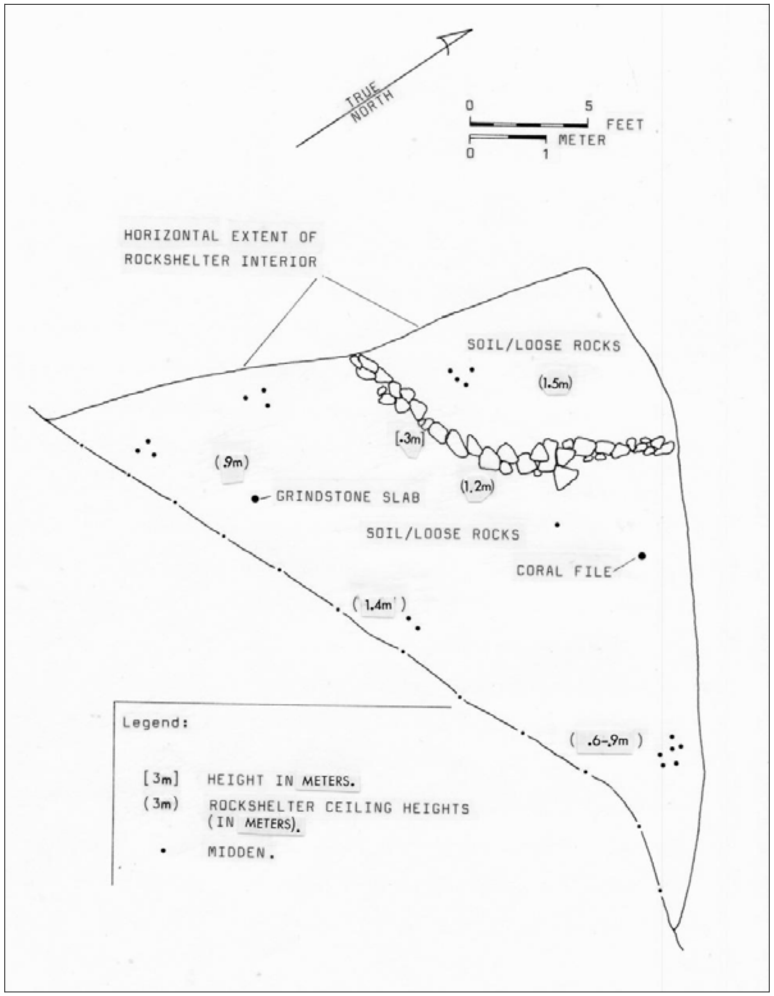

Figure 11. SIHP # 50-80-12-4321; Plan View

5.7 SIHP #: 50-80-12-4322

Site Type: Rock Shelter with Interior *Ahu*

Function: Quarry

Probable Age: Pre-Contact

Condition: Fair

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

Description: This rock shelter (Figure 12) measures 4.2 m. (13.7 ft.) wide and 6 m. (19.6 ft.) deep, with an average ceiling height of 1 m. (3.2 ft). The interior floor slopes moderately to steeply towards the opening of the shelter and is comprised for the most part of piles of broken outcrop that have fallen or were deliberately removed from the ceiling above. Within the rear portion of the cliff overhang several percussion scars are present in the ceiling; an underlying accumulation of what appears to be primary flakes characteristic of quarrying activities lies beneath. Towards the opening of the rock shelter a roughly rectangular depression, roughly 50 cm. (1.6 ft.) deep with three vertical faces, is present. It was originally suspected that this excavation was conducted in recent times by an avocational archaeologist or a modern-day rock-miner. However, after inspecting the site area further, a fine-grain basalt dike was identified along the ceiling of the shelter and was also visible at the base of the excavated trench. Many flaking scars are observable on the dike portion of the bedrock at the base of the trench and small and large primary flakes were also seen within the profile of the trench and the surrounding ground surface.

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

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

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

Excavation potential at this site is excellent for gathering data about Native Hawaiian stone tool procurement, processing, and production. The site has potential for yielding information on adz quarrying and sourcing studies. No samples were collected but the cave is available for future studies and sampling for petrographic characterization

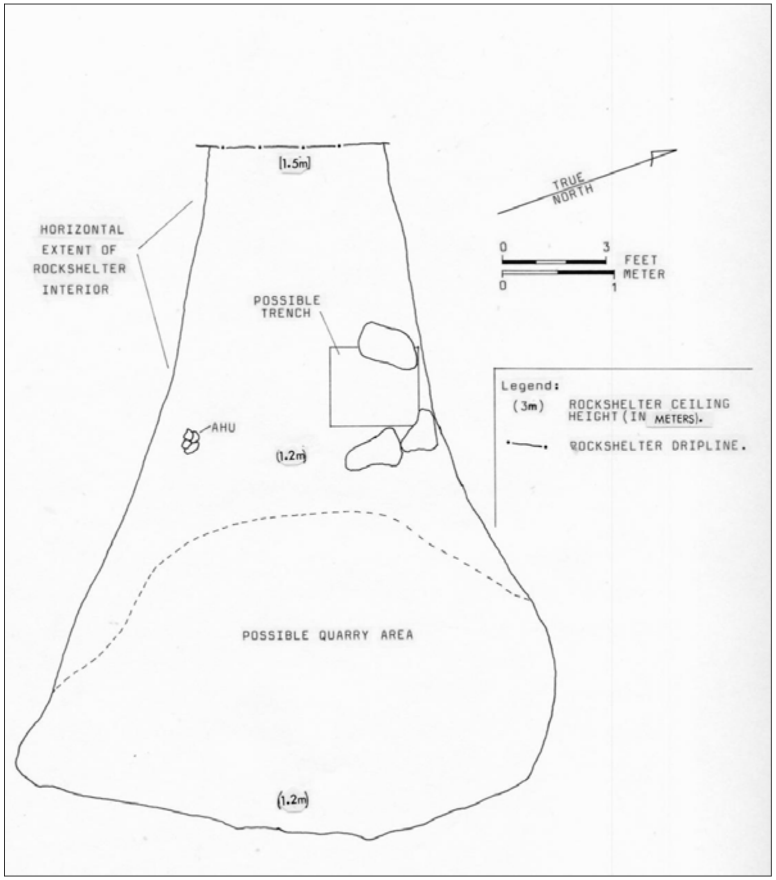

Figure 12. SIHP # 50-80-12-4322; Plan View

5.8 SIHP #: 50-80-12-4324

Site Type: Mound-*Ahu*

Function: Agricultural

Probable Age: Pre-Contact

Condition: Fair

Dimensions: 1.5 m. (4.9 ft.) diameter

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

Excavation potential for this site is poor.

5.9 SIHP #: 50-80-12-4325

Site Type: C-Shape

Function: Temporary Habitation

Probable Age: Prehistoric

Condition: Fair

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

Description: This historic property (Figure 13) is constructed of stacked small boulders and cobbles. The walls stand 30 cm. (9 in.) high, 1-2 courses, and 45 cm. (1.4 ft.) wide. The enclosure is open to the east and lies on fairly level terrain covered with grass. An *ahu* of five stacked cobbles is located 14.6 m. and 215E TN from this site. This particular *ahu* in combination with two others located *mauka* and *makai* (SIHP # 50-80-12- 4318) may represent a series of markers delineating a trail running north/south along this ridgeline. This site is located on the eastern ridgeline of Makaīwa Gulch at approximately the 320 ft (97.5 m.) elevation. The site encloses a small area of loose soil and scattered rocks covered with grass; no midden or artifacts were observed. Excavation potential for this site is poor.

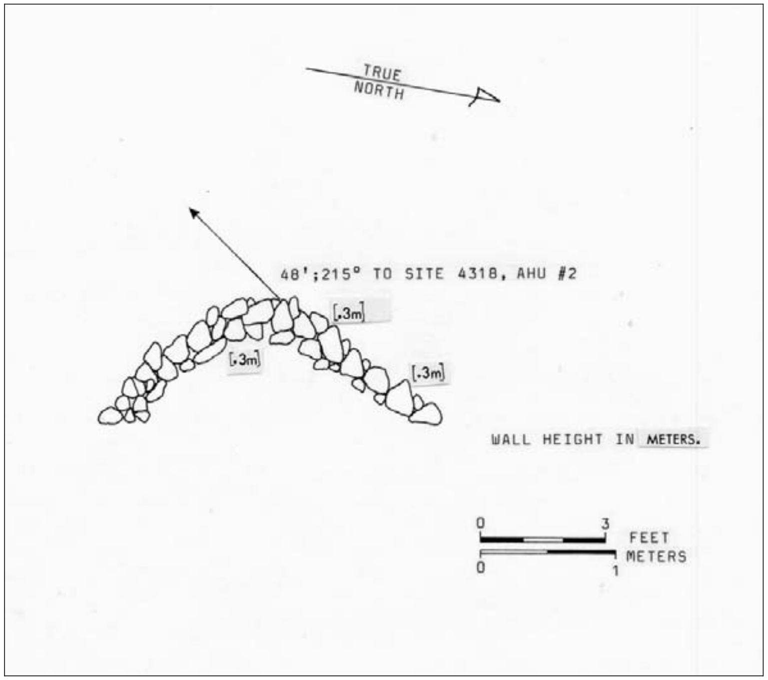

Figure 13. SIHP # 50-80-12-4325; Plan View

5.10 SIHP #: 50-80-12-4326

Site Type: Wall Section

Function: Temporary Habitation

Probable Age: Pre-Contact

Condition: Fair

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

Description: This short wall section is constructed of stacked small boulders and stands 60-91 cm. (1.9-2.9 ft.) high, 3-5 courses, and 60 cm. (1.9 ft.) wide (Figure 14). It is constructed on the south tip of an outcrop knoll within the presently burned zone of the project area. Between the wall and the south edge of the outcrop knoll a natural or constructed boulder alignment is present and in conjunction with the wall encloses a roughly 1.5 m. (4.9 ft.) by 3 m. (9.8 ft.) shallow soil surface. The outcrop knoll on which the site is situated rises a maximum height of 5 m. (16.5 ft.) above the surrounding terrain and forms a natural enclosure around level soil immediately below the site to the west. This site is located on level terrain on the east side of an unnamed gulch east of Makaīwa Gulch at approximately the 200 ft. (60.9 m.) elevation. This structure may have served as a windbreak or shelter.

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

5.11 SIHP #: 50-80-12-4328

Site Type: Rock Shelter Complex (3 features)

Function: Permanent Habitation

Probable Age: Pre-Contact

Condition: Good

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

Description: This site consists of 3 rock shelters located on a 2-tiered outcrop bluff. The three individual rock shelters were designated as one site and each was given individual feature designations: A, B and C. Features A and B (Figure 15) are located on the upper tier of the bluff directly above Feature C (Figure 16).

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

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

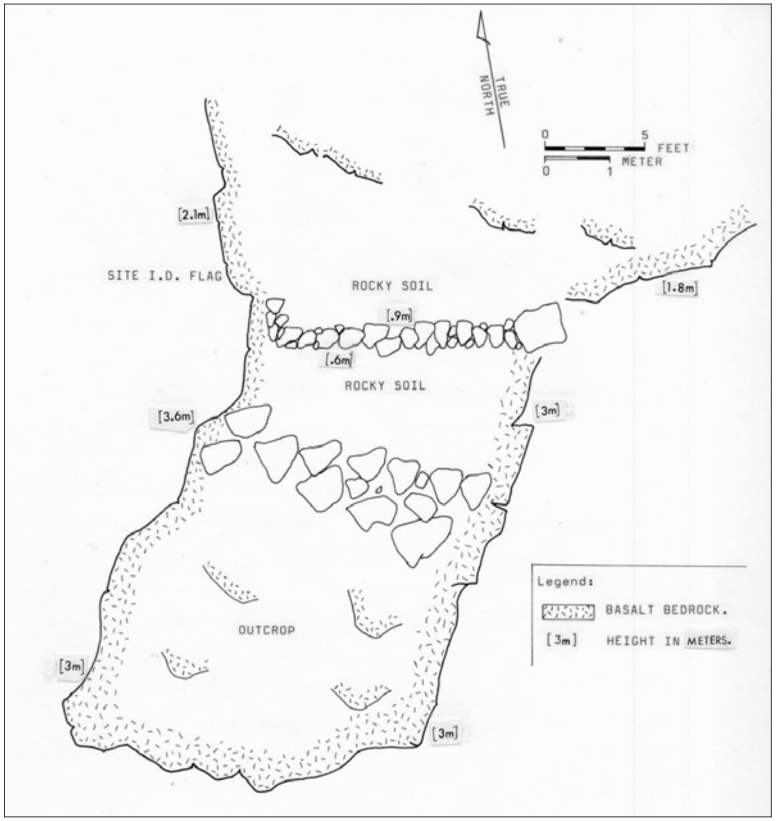

Figure 14. SIHP # 50-80-12-4326; Plan View

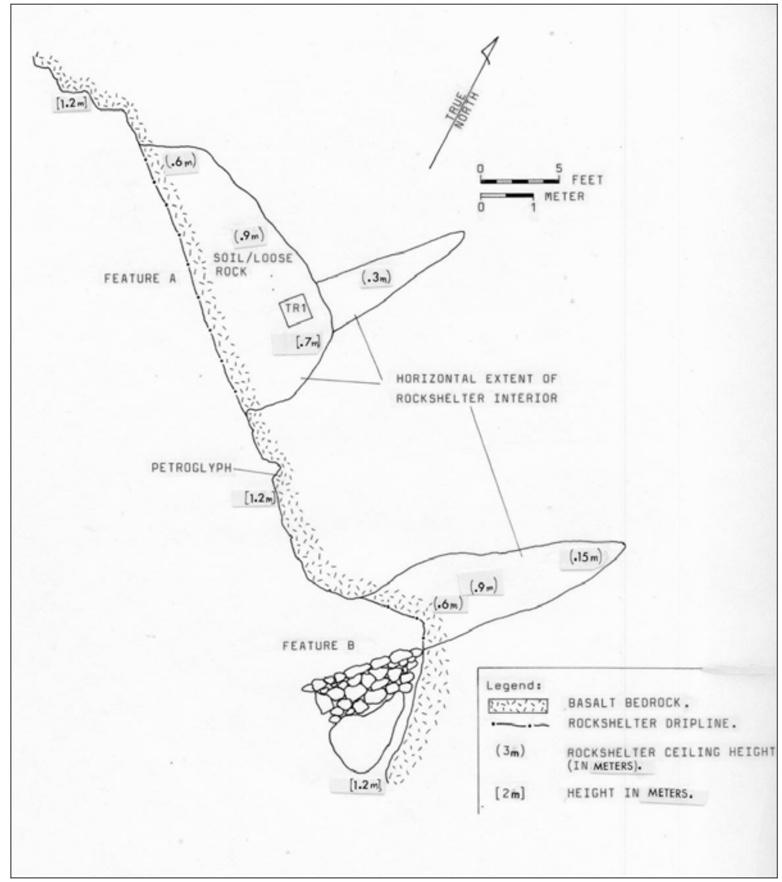

Figure 15. SIHP # 50-80-12-4328, Features A and B; Plan View

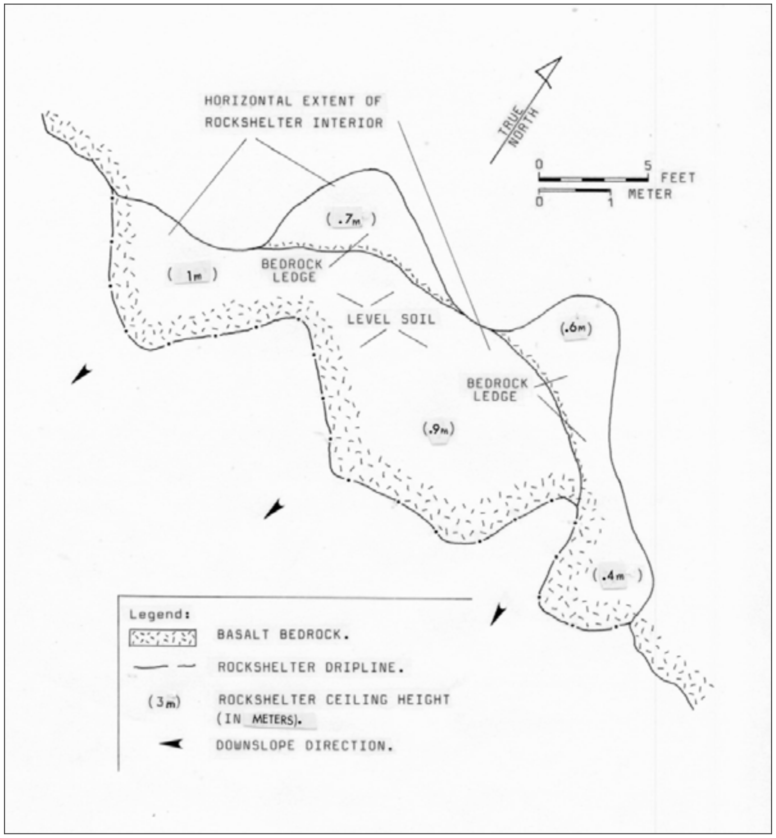

Figure 16. SIHP # 50-80-12-4328, Feature C; Plan View

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

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

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

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

Testing Results

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

5.12 SIHP #: 50-80-12-4331

Site Type: L-Shaped Enclosure

Function: Poss. Agricultural

Probable Age: Pre-Contact

Condition: Fair

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

Description: This site consists of an L-shaped enclosure constructed of small boulders and cobbles (Figure 17). The north and east sides utilize the natural bedrock outcrop to form an enclosure. The low constructed walls stand only 15 cm. (5 in.) to 30 cm. (10 in.) high and are an average of 30 cm. (10 in.) thick. The interior consists of level soil with some loose cobbles. This site is situated on the east side of an outcrop bluff located on the east side of an unnamed gulch (east of Makaīwa Gulch) within the burned portion of the project area. It lies at an approximate

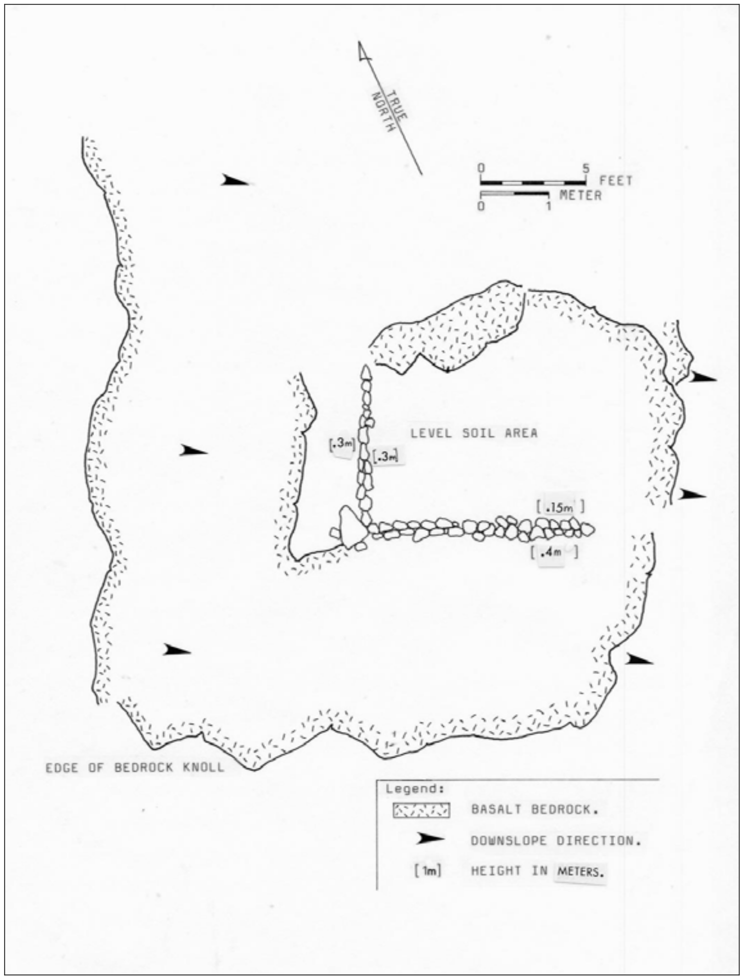

Figure 17. SIHP # 50-80-12-4331; Plan View

elevation of 220 ft. (67 m.). No midden or artifacts were observed. Excavation potential for this site is poor.

5.13 SIHP: # 50-80-12-4332

Site Type: Circular Enclosure

Function: Temporary Habitation

Probable Age: Pre-Contact

Condition: Fair

Dimensions: 4.5 m. (14.7 ft.) N/S by 4.8 m. (15.7 ft.) E/W

Description: This historic property consists of a circular enclosure constructed of piled and stacked boulders and cobbles, forming a possible entrance on the west end (Figure 18). The walls range in height from 15 cm. (5 in.) to 30 cm. (10 in.) high and 60 cm. (2 in.) to 1.2 m. (4 in.) wide. The interior consists of loose rocks and compact soil. No midden or artifacts were observed.

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

5.14 SIHP #: 50-80-12-4334

Site Type: Circular Enclosure

Function: Temporary Habitation

Probable Age: Prehistoric

Condition: Fair

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

Description: This structure is constructed of loosely stacked boulders with its north side abutting a sloping ridge (Figure 19). The walls stand 30 cm. (10 in.) to 60 cm. (1.9 ft.) high and range from 60 cm. (1.9 ft.) to 1.8 m. (5.9 ft.) wide. The south wall represents the widest construction while the northwest wall is most formally stacked. A possible entrance located in the west wall measures 1 m. (3.2 ft.) wide. The site encloses a slightly sloped interior consisting of a shallow soil deposit with no visible midden or artifacts. Excavation potential for this historic property is good.

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

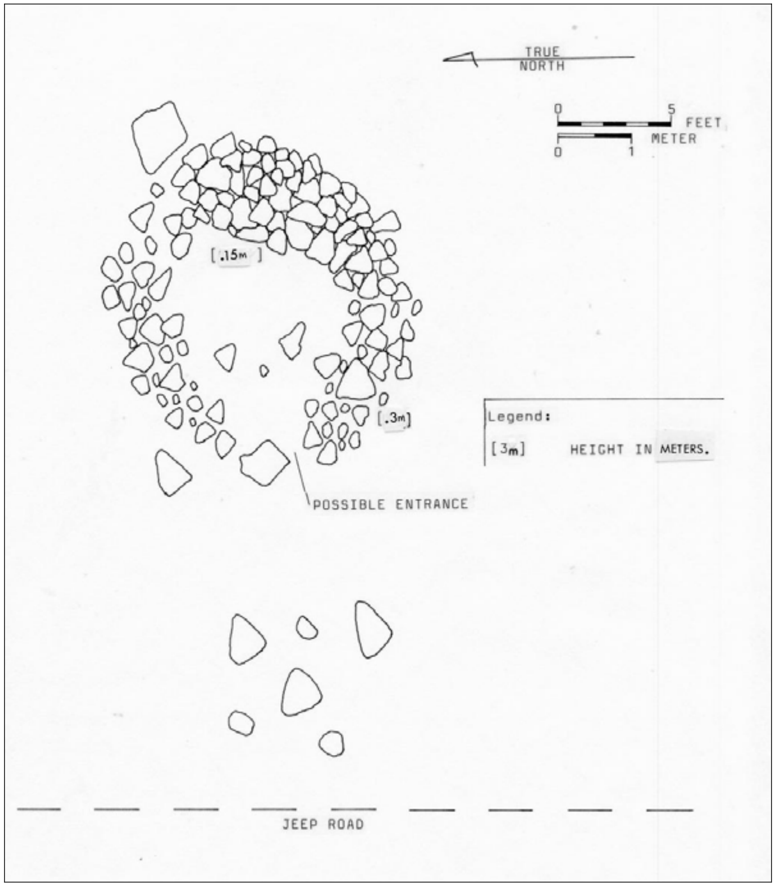

Figure 18. SIHP # 50-80-12-4332; Plan View

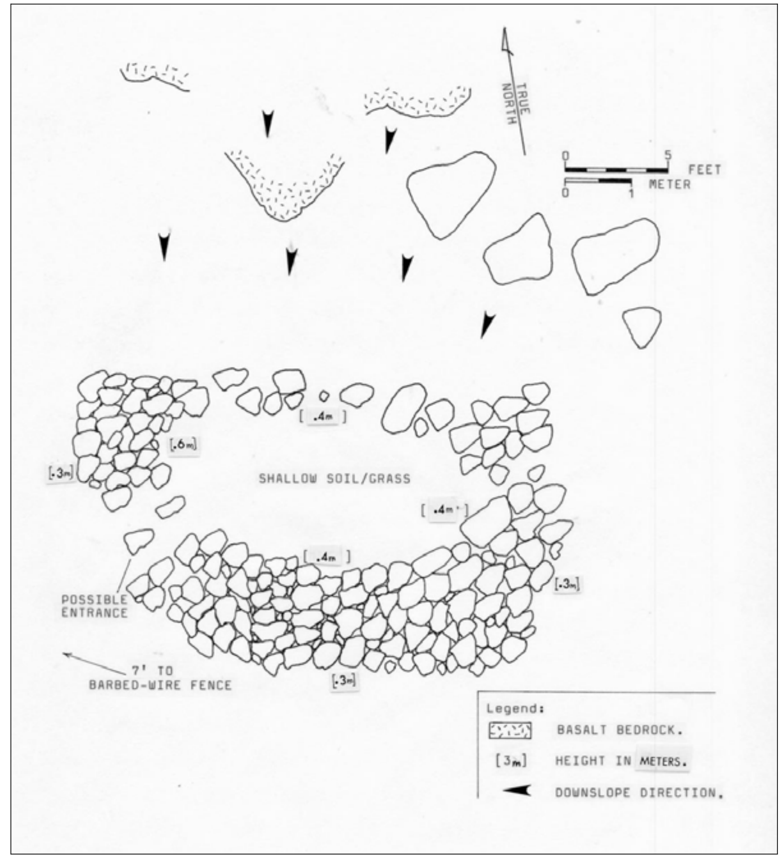

Figure 19. SIHP # 50-80-12-4334; Plan View

5.15 SIHP #: 50-80-12-4336

Site Type: Triangular Enclosure

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

Probable Age: Pre-Contact

Condition: Fair to good

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

Description: This historic property is constructed of wall alignments that form a triangular enclosure that opens to the west (Figure 20). The north wall of this structure exhibits the most substantial construction of the historic property and is oriented east/west. This wall consists of stacked boulders and cobbles and measures 0.8 m. (2.6 ft.) wide by 0.3 m. (10 in.) high. The two other walls on the southeast and southwest sides of the structure are less substantially constructed, often consisting of a single-course, single-boulder alignment. These walls range from 0.3 to 0.5 m. (1-1.6 ft.) high and 0.5 to 0.8 m. (1.6-2.6 ft.) wide. The interior of this enclosure is covered in grass and contains two boulders.

The soil depth was probed and found to be 10 cm. or less in thickness.

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

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

5.16 SIHP #: 50-80-12-4337

Site Type: Rectangular Enclosure

Function: Permanent Habitation

Probable Age: Pre-Contact

Condition: Fair

Dimensions: 8 m. (26.2 ft.) diameter

Description: Site 50-80-12-4337 (Figure 21) consists of a roughly rectangular enclosure with partially tumbled walls measuring 1.5 m. (4.9 ft.) wide and between 0.3 m. (10 in.) and 0.6 m. (1.9 ft.) high. These walls are of a stacked boulder and cobble construction and display extensive lichen growth. There appears to be an entrance to this structure in the NW wall.

Another entrance, although possibly the result of cattle disturbance, was observed in the NE wall. The interior of this structure is relatively level, containing grass and soil. The southeast and southwest walls of this enclosure are built on the edge of a moderate slope of the terrain. A substantial amount of tumble is present along the slope.

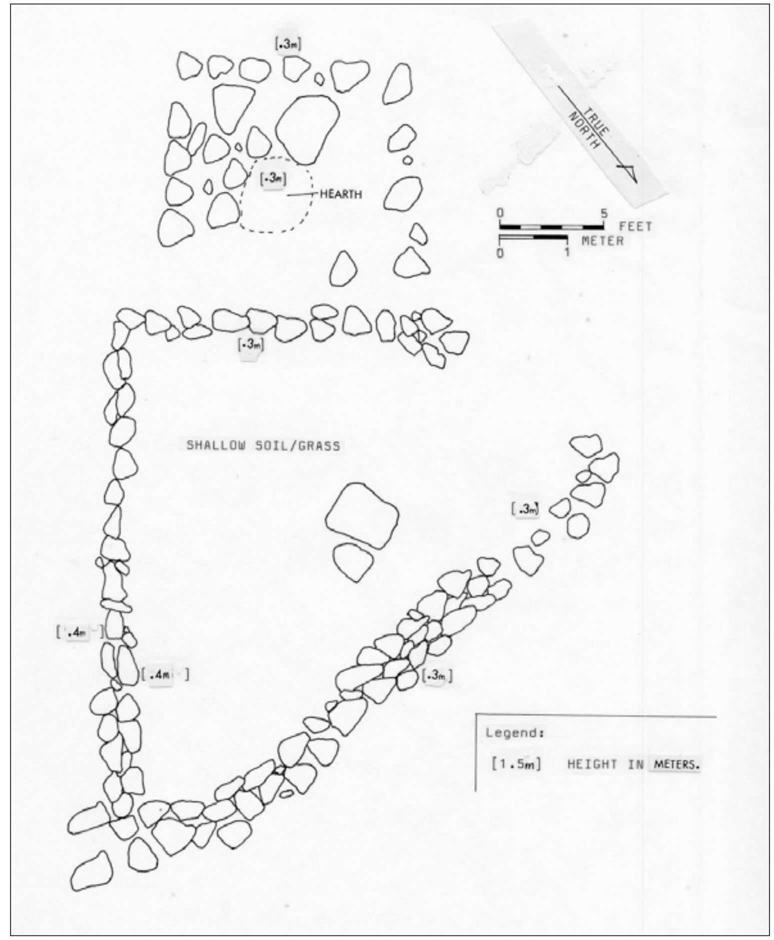

Figure 20. SIHP # 50-80-12-4336; Plan View

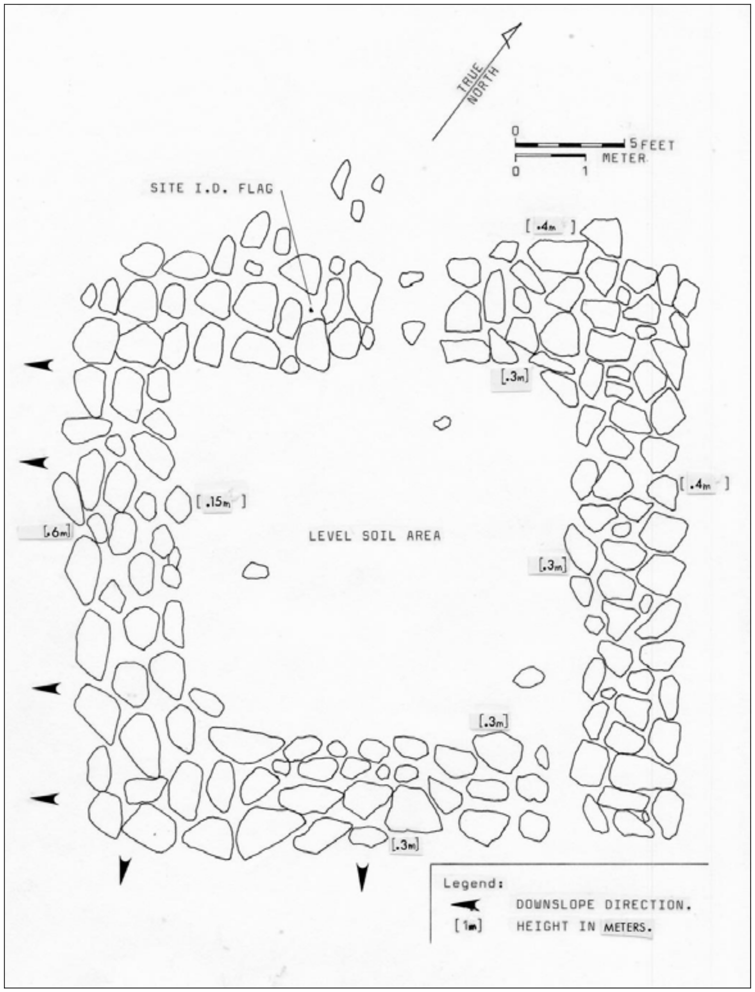

Figure 21. SIHP # 50-80-12-4337; Plan View

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

The excavation potential of this historic property is good.

5.17 SIHP #: 50-80-12-4338

Site Type: Rock Shelter Complex (3 features)

Function: Permanent Habitation

Probable Age: Pre-Contact

Condition: Good

Dimensions: See below

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

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

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

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

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

5.18 SIHP # 50-80-12-6870

FORMAL TYPE: Terrace, springs, and a rock shelter

FUNCTION: Animal Husbandry

AGE: Historic (Post-Contact)

 # OF FEATURES: 5 (A-E)

DIMENSIONS: 42 m northeast/southwest by 8 m northwest/southeast

LOCATION: *Mauka*/north corner of the project area

CONDITION: Excellent

DESCRIPTION:

SIHP # 50-80-12-6870 is located halfway up the west side of an unnamed gulch at the southern end of the Waianae Mountains. The gulch eventually joins Makaīwa Gulch farther down the slope of the Makaīwa Hills. The sides of the gulch are steeply sloped and the area is dominated by invasive grasses and burnt *koa haole* trees. SIHP # 50-80-12-6870 is located approximately 50 m down the gulch from SIHP # 50-80-12-4313. SIHP # 50-80-12-6871 is located along the ridge top directly to the west of SIHP # 50-80-12-6870.

SIHP # 50-80-12-6870 is comprised of five features (Figure 22): Feature A is a terrace; Features B, C, and D are freshwater springs; and Feature E is a small rock shelter. The presence of the naturally occurring springs in the dry leeward portion of O‘ahu is the likely reason why the terrace was constructed. The historic property measures 42 meters in a northeast/southwest direction and 8 meters in a northwest/southeast direction.

Feature A is a historic single-tiered terrace that extends for approximately 40 m (Figure 10). The level earthen filled terrace is created by a faced retaining wall down slope of the three springs. The terrace face, which incorporates bedrock outcrops extends for 32 m and has a maximum height of 1.4 meters. The terrace encompasses approximately 200 m^2 between the terrace face and a large basalt outcrop.

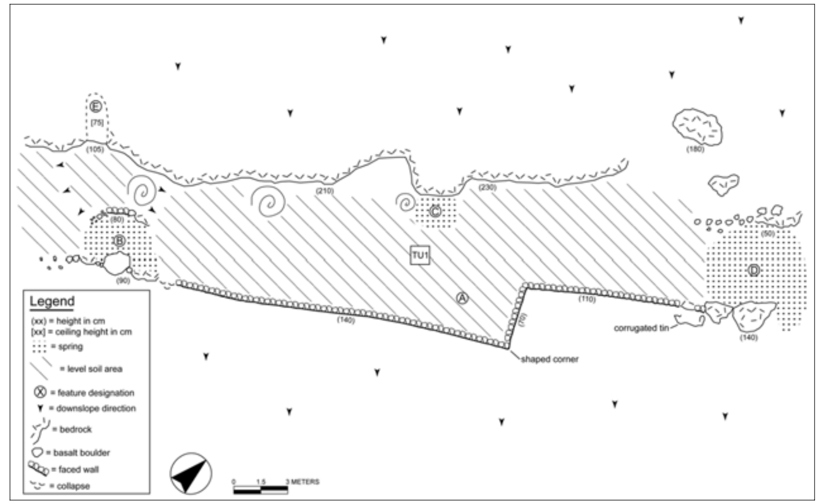

Figure 22. Plan view map of SIHP # 50-80-12-6870 showing features A through E

The wall is constructed from tightly fitting and occasionally interlocked basalt boulders that are stacked between 3 and 7 courses high. The boulders range in size from 10x10x5 cm to 80x60x20 cm. Many of the rocks are tabular in shape and have been placed in a horizontal position. The edges of some of the rocks exhibit evidence of intentional flaking to modify their shape for a more precise fit in the terrace wall. The best example of this is the outward "shaped corner" (Figure 22) where all five courses of stones are closely aligned.

The wall has suffered a small amount of collapse due to sediment that has pushed some of the upper most rocks in the terrace wall off the top and down onto the downward slope. A rusted piece of corrugated sheet metal is located just down slope of the northeast end of the terrace wall.

All three of the springs in SIHP # 50-80-12-6870 can be characterized as slow freshwater seeps that only produce enough water to create a little mud and cause the immediately adjacent tufts of invasive grasses to turn green. Cattle have heavily disturbed the sediments at all three springs.

Feature B is the southwest most spring in SIHP # 50-80-12-6870. It is 4 m by 3 m (Figure 10) and is situated just east of a slightly raised portion of the terrace in front of the small rockshelter (Feature E) that is part of SIHP # 50-80-12-6870 (Figure 22).

Feature C is the smallest of the three springs, measuring 2.5 m by 1.5 m (Figure 10). It is centrally located within SIHP # 50-80-12-6870 at the base of the large bedrock outcrop (Figure 22).

Feature D, located at the northeastern end of SIHP # 50-80-12-6870 is the largest of the three springs. It is 5.5 m by 5.0 m (Figure 10). This spring has undergone the most cattle disturbance because the cows have to walk through it access the other two springs if they come from the *mauka* end of the historic property.

Feature E is a small natural rockshelter located in the southwest corner of SIHP # 50-80-12-6870 (Figure 22) immediately to the west of a raised portion of the terrace (Feature A). The rock shelter is 1.3 m wide at the opening, 2.5 meters deep, and has an interior height of 75 cm. There was no evidence of cultural material on the soil surface of the floor of the rockshelter.

SIHP # 50-80-12-6870 is comprised of four naturally occurring features – three springs and a rock shelter – and a historically constructed retaining wall that forms a large level terrace. The historic property is in excellent condition and retains a high degree of integrity. The site has likely served as a water source for animals and people for a long time. The terrace was likely constructed during the ranching period to allow easier access for cattle. The site is significant under criterion D, information content, of the HAR 13-284-6.

A single 1 m by 1 m test unit was excavated in the soil surface of Feature A adjacent to Feature C (Figure 22). The location for the test unit was chosen because the presence of water might have served as a reason for Native Hawaiians to frequent the area. The location was also chosen to examine the stratigraphy of the sediments retained by the terrace wall.

Two layers of sediment were present in the test unit. The upper-most was clay silt that has undergone substantial soil formation processes. The lower stratigraphic layer was silty clay with lesser soil formation. This layer likely has a higher clay percentage due the filtering of the

smaller particles down through the sediment column. This lower layer ended on natural, highly decomposed, bedrock. Complete details of the stratigraphy are presented below.

Stratum I: 0-22 cmbs	A Horizon; 10 YR 3/3, dark brown; clay-silt; strong, course blocky structure, slightly hard dry consistency; plastic; no cementation; clear smooth lower boundary. No cultural materials were found in this stratum.
Stratum II: 22-37 cmbs	B Horizon; 10YR 4/4, dark yellowish brown; silty clay; moderate medium crumb structure, weakly coherent dry consistency; slightly plastic; no cementation. Small amounts of pig bone and tooth fragments were found in this layer. This layer terminates on extremely corroded bedrock.

Twenty-one pieces of highly weathered pig long bone shaft fragments (15.1g) were discovered near the bottom of the sediment. Two fragments (2.1g) of pig tooth were also found. The absence of any signs of human modification to the bones combined with the lack of any other evidence of human activity suggests that the presence of the bones is most likely the result of natural causes.

5.19 SIHP # 50-80-12-6871

FORMAL TYPE: Paved Area

FUNCTION: Indeterminate

AGE: Pre-Contact

 # OF FEATURES: 1

DIMENSIONS: 42 m northeast/southwest by 8 m northwest/southeast

LOCATION: *Mauka*/north corner of the project area

CONDITION: Poor

DESCRIPTION:

SIHP # 50-80-12-6871 is located in the *mauka*/west corner of the Makaīwa Hills project area. It is the western-most historic property in the project area. SIHP # 50-80-12-6871 rests atop a ridge between two gulches. It is situated where the slope shifts from very gradual to a steeper grade. The location of the site affords commanding views of the western half of the 'Ewa Plain including Barber's Point, Deep Draft Harbor, Ko'olina, Kapolei, and Pu'u Pālailai.

SIHP #s 50-80-12-4313 and 50-80-12-6870 are located in the gulch immediately to the east of ridge that SIHP # 50-80-12-6871 sits on. An abandoned military reservation is located to the west of the historic property.

SIHP # 50-80-12-6871 is comprised of basalt boulders and large cobbles that have been placed to form a rough pavement on the ridge top (Figure 23). The presence of rocks in this area differs from the rest of the ridge where there are no clusters of stones. The pavement extends along the ridge top for approximately 45.0 m in a 21°/201° direction and 6.0 m in a 135°/315° direction.

The rocks that make up the historic property vary in size from variously shaped 10x10x10 cm cobbles to large flat tabular stones, some of which are 100x70x20 cm. Except for the stones that have been disturbed by the bulldozing, most of the stones are relatively level with the ground's surface resulting in a paved effect.

SIHP # 50-80-12-6871 has been heavily disturbed by bulldozer activity (Figure 23). Both the east and west sides of the pavement have been completely removed by bulldozing, resulting in the inability to tell how wide the historic property originally was. The two bulldozed cuts converge at the *makai* end of the historic property, so it is also not possible to determine total length. Only 6.6 m of the original edge of the historic property can be observed along the northern/*mauka* portion of the site. There is no evidence of erosion within the historic property itself, but a large section of erosion has occurred in the bulldozed road cut to the east of the historic property (Figure 23).

Cultural consultants and CSH personnel identified one of the stones in the historic property as a stone image. It is located along the eastern edge of the historic property. It measures 75x60x40 cm. It has a water worn *puka* and several other water worn channels in the upward facing surface (Figure 24). It is possible that this is one of the stones discussed in the legend of Two Old Women who Turned to Stone *(Ka Loea Kālai'āina*).

The Hawaiian language newspaper *Ka Loea Kālai'āina* relates that near Pu'uokapolei, on the plain of Pukaua, on the *mauka* side of the road, there was a large rock. The legend is as follows:

> There were two supernatural old women or rather peculiar women with strange powers and Pu'ukaua belonged to them. While they were down fishing at Kualaka'i [near Barbers Point] in the evening, they caught these things, '*a'ama* crabs, *pipipi* shellfish, and whatever they could get with their hands. As they were returning to the plain from the shore and thinking of getting home while it was yet dark, they failed for they met a one-eyed person [bad omen]. It became light as they came near to the plain, so that passing people were distinguishable. They were still below the road and became frightened lest they be seen by men. They began to run - running, leaping, falling, sprawling, rising up and running on, without a thought of the *'a'ama* crabs and seaweeds that dropped on the way, so long as they would reach the upper side of the road. They did not go far for by then it was broad daylight. One woman said to the other, "Let us hide lest people see us," and so they hid. Their bodies turned into stone and that is one of the famous things on this plain to this day, the stone body. This is the end of these strange women. When one visits the plain, it will do no harm to glance on the upper side of the road and see them standing on the plain. (*Ka Loea Kālai'āina,* January 13, 1900)

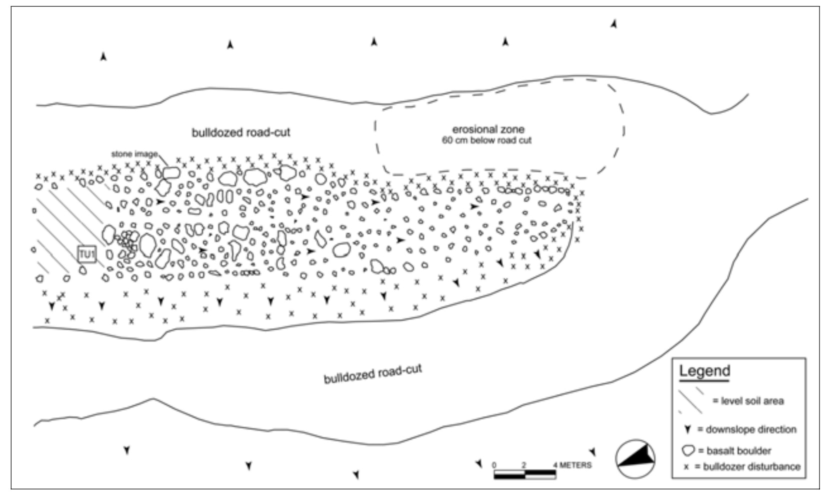

Figure 23. Plan view map of SIHP # 50-80-12-6871

Figure 24. Photograph of the stone image (75x60x40 cm) that is incorporated into SIHP # 50-80-12-6871

SIHP # 50-80-12-6871 is a paved area located on a promontory of a ridge at the southern end of the Wai‘anae Mountains. The historic property is comprised of primarily large tabular basalt boulders that form an elongated paved area. The construction technique and absence of any historic artifacts suggest that the site was constructed prehistorically. This site is unique in nature and CSH is unaware of any other site like it on O‘ahu.

The site’s proximity to the spring in the gulch to the east and it’s prominent location on the ridge suggest many possible functions for the site. It could have served as a trail marker, a resting place for people traveling from the coast to *mauka* villages, possibly even a religious function. Tom “Pohaku” Stone confirmed that the historic property was not an *hōlua* slide. The historic property also contains a stone image that is spoken about in the oral traditions of this portion of Honouliuli Ahupua‘a.

Based upon the site’s location, uniqueness, reference in oral traditions, and proximity to other historic properties on the landscape, SIHP # 50-80-12-6871 is significant under criteria D (information content) and E (importance to Native Hawaiians).

A single 1 m by 1 m test unit was excavated in the level soil surface at the *mauka* end of SIHP # 50-80-12-6871 (Figure 23). Two layers of fine-grained clay-silt characterized the sediments in the excavation. They differed in that the upper layer had undergone soil formation processes, and the lower layer had not. Complete details of the stratigraphy are presented below.

Stratum I: 0-18 cmbs	A Horizon; 10 YR 4/3, brown; clay-silt; moderate medium blocky structure, weakely coherent dry consistency; plastic; no cementation; clear smooth lower boundary. No cultural materials were found in this stratum. Numerous small basalt cobbles were contained in this layer.
Stratum II: 22-37 cmbs	B Horizon; 10YR 4/3, brown; clay-silt; structureless, loose dry consistency; slightly plastic; no cementation. No cultural material was discovered in this stratum. This layer terminates on extremely corroded bed rock

Section 6 Research Objectives

6.1 Theoretical Orientation

The hills at the southern end of the Wai‘anae Mountains have been the subject of very few archaeological investigations when compared to the ‘Ewa Plain. As shown in Section 3, there are no studies comparable to the inventory survey (Hammatt et al. 1991) completed for the current project area. While other studies have found small alignments and mounds (Tulchin and Hammatt 2004; Tulchin and Hammatt 2005), there have been no other large rock shelters discovered on the southern slopes of the Wai‘anae Range. In addition, no radiocarbon dates have been retrieved from any of the other studies to help provide a temporal framework upon which to build.

The relative lack of basic archaeological information necessitates that this data recovery plan adopt a more traditional “settlement-pattern approach” (Kirch 1985:19). Under this approach, artifacts, deposits, and features are studied as components of an overall cultural landscape. The principal questions asked by this paradigmatic framework are: what people were doing on the landscape and when they were doing it? The dearth of previous archaeological investigations in the area and the somewhat superficial treatment of the project area by the prior archaeological inventory survey have not sufficiently answered these two questions.

The minimal amount of excavation of the historic properties within the project area has left many questions regarding what activities took place in the historic properties as well as the land use pattern for the project area as a whole. The lack of any radiocarbon dates from within the project area leaves the question of when the prehistoric sites were in use completely unresolved.

A solid understanding of the two basic questions raised above is necessary before more in-depth investigations can take place. This data recovery plan and associated fieldwork will primarily address these questions. Methods, which will be discussed in complete detail below, typically undertaken in a settlement-pattern approach, include, but are not limited to: surface survey, feature recording, surface collection, controlled excavation, radiocarbon dating, and cataloging faunal and artifactual remains.

The presence of SIHP # 50-80-12-4322, a small cave that served as a basalt quarry, provides a unique opportunity to make strides towards answering more complex archaeological questions. There are two main research goals stemming from SIHP # 50-80-12-4322: First, is to examine pre-contact Native Hawaiian stone tool procurement and production, and the second is to explore stone tool distribution and trade using Energy-Dispersive X-ray Fluorescence (EDXRF).

6.2 EDXRF Analysis to Address Stone Tool Trade

This research design has been developed in consultation with Dr. Peter Mills of the University of Hawai‘i at Hilo. Dr. Mills is involved in a long-term research project in association with Dr. Ken Hon (Dept. of Geology) using non-destructive EDXRF to analyze basalt and volcanic glass artifacts. This information can be used to help study stone tool exchange patterns, and is being facilitated through a Major Research Instrumentation Grant from the National Science

Foundation (UH04978) for $143,977.00 which was recently awarded to Mills (PI) and Hon (Co-PI).

Drs. Mills and Hon are building upon an already substantial body of literature that has demonstrated the usefulness of sourcing type analysis in the Pacific (Sinton and Sinoto 1997; Walter and Sheppard 1996, 2001; Weisler 1998). Weisler and Kirch (1996: 1381) utilized EDXRF techniques on basalt adze and adze flakes to demonstrate that stone materials were moving from one island to another within Samoa and from Samoa to Mangaia, more than 1600 km (1000 miles) away in the Southern Cook Islands.

Lithic sourcing studies have also been conducted throughout the Hawaiian Islands (Best 1984; Cleghorn et al. 1985; Weisler 1990). Building upon this earlier research Dr. Mills and Dr. Hon are using an EDXRF spectrometer to establish geochemical "fingerprints" of stone tools that pre-contact Hawaiians quarried from various sites, and track the extent to which that material was traded throughout the islands. In order to determine how far any particular piece of stone has been transported it is of course necessary to determine the source of the rock that a tool is made from. The data collected from SIHP # 50-80-12-4322 will add another location to a an already growing database of quarry sites.

There is a continuing debate in Hawaii regarding the extent of self-sufficiency that Hawaiians maintained in their various island districts (*ahupua‘a*). Some archaeologists argue that *ahupua‘a* were virtually closed economic systems, and that Hawaiians rarely engaged in long-distance trade between districts or islands; others feel that long-distance trade in some valued commodities was common. The EDXRF analyzer allows archaeologists to conduct rapid and non-destructive analyses of stone artifacts to determine the extent and distance over which stone tools were traded from the quarries. Attempts will be made to match tools and chipping debris found in domestic sites, with geochemical data collected at known prehistoric quarry areas. Samples that do not match known quarry sites may lead to the discovery of currently unknown quarry sites, or possibly to the identification of stone tools derived from other islands or even possibly other archipelagoes, such as Tahiti and the Marquesas. By examining the extent to which stone tools in various districts were derived from non-local sources, archaeologists will be able to quantify pre-contact commodity exchange through time and space, and possibly identify some tools that were carried over thousands of miles of open ocean on prehistoric voyages.

Dr. Mills and Dr. Hon are overseeing the purchase, installation and calibration of an EDXRF spectrometer with the assistance of a laboratory technician who will prepare standard samples to help calibrate the data with other laboratories in California, Oregon, Washington, Otago and Aukland (that are working on similar projects in other regions). They have initiated a three-year multi-scalar research project that will process thousands of stone samples obtained from sites within the Hawaiian Islands. It is hoped that this EDXRF system, which is especially designed for rapid and non-destructive analyses, will generate a quantum change in the level of sampling of pre-contact Hawaiian stone tools. In terms of the research, this project is important for the contributions it will make towards better understanding pre-contact trade in Hawaii and pre-contact open-ocean voyaging between islands and archipelagoes.

6.3 Research Questions

6.3.1 General Research Questions

The following research questions are intended to guide the data recovery investigation:

1. What do the cultural features and structural remains observed tell us about the traditional Hawaiian land use within the project area? How does this activity relate to our understanding of traditional Hawaiian land use in Honouliuli?
2. What were each of the types of historic properties used for? Were the rockshelters permanent or only temporary habitation sites for people working in the nearby quarry cave? Were the *mauka* enclosures constructed for agriculture, habitation, animal husbandry practices, or some other function?
3. What can we learn about Native Hawaiian stone tool procurement, production, and use through the examination of cultural remains from SIHP # 50-80-12-4322? Where do the various stages of lithic reduction for tool making take place?
4. When were the historic properties used by Native Hawaiians? When were the historic properties first used or constructed? How do the dates of settlement and land use compare with those of the ‘Ewa Plain?
5. Can stratigraphically and temporally distinct periods of human land use within the project area be distinguished? Or is there primarily one “surface” which corresponds to prehistoric and/or historic land use?

6.3.2 Specific Research Hypothesis

1. SIHP # 50-80-12-4322 provided sufficient stone tool material such that the inhabitants of other historic properties would not have imported lithic material from other locations.

6.4 Data Requirements

The project area contains historic properties that could be described as traditional archaeological remains: rockshelters, enclosures, and other constructed features. As previously discussed, these historic properties have not had the most basic archaeological questions answered about them. The combination of traditional historic properties and substantial knowledge gaps about those properties results in the need for relatively straightforward data requirements to answer the research questions.

High precision GPS will provide information about the exact location of each historic property in the project area. Written descriptions, photographs and detailed tape and compass maps provide details regarding the possible function of each of the historic properties. Cultural remains recovered from controlled hand excavations will provide further and more conclusive information about the function of each historic property and the types of activities that were occurring. Analyses of midden remains and wood charcoal will shed light on what natural resources were being utilized. Where charcoal or other carbon samples are available from

discrete, chronologically informative stratigraphic contexts, radiocarbon dating will be used to help determine the deposit’s age.

The examination of lithic debitage from SIHP # 50-80-12-4322 will illuminate Native Hawaiian procurement and production strategies. Samples of basalt from the roof of the cave (SIHP # 50-80-12-4322), the floor of the cave, and the other historic properties in the project area will be subjected to EDXRF. This will provide the ability to determine if lithic materials are being imported from outside sources. This will inform about Native Hawaiian use of the landscape and further details about lithic processing. The collection of the EDXRF data from the quarry itself will contribute to the database currently being assembled by Dr. Mills and Dr. Hon. These data might also possibly prove to be the point of origin for other lithic materials found across O‘ahu and the Hawaiian archipelago.

Section 7 Methods

The following methods will be used to conduct data recovery excavations, analyze excavated materials, and report on historic property mitigation through data recovery in 1,780.705-acre parcel. CSH field personnel will continue to attempt to relocate SIHP #s 50-80-4312 and 50-80-12-4338 during fieldwork.

7.1 Field Methods

7.1.1 Mapping

1. All sites designated for testing or excavation will be mapped to scale, if not previously done so. As most of the features have scale maps, the existing drawings will be used for additional notation and location of excavation units. Mapping, as necessary, will precede the testing and excavation.
2. A high precision GPS unit (Trimble Pro XR backpack GPS unit with a TSCI Datalogger) will be used to record the location of each historic property within the project area and each test unit within each historic property where applicable. Data collected using the Trimble GPS unit will be processed using ESRI's Arc Surveyor 5.0 and ArcGIS 9.1. Any GPS data collected will be available for inclusion in the SHPD database.
3. Boundaries of all sites tested will be mapped with the GPS unit.
4. Photographs with a scale ruler will be taken of all historic properties.

7.1.2 Excavation Methods

Excavation methods are outlined as follows:

1. A minimum of 9 square meters, in the form of nine 1 m x 1 m test units, will be designated for test excavations in the six *mauka* historic properties (SIHP #s 50-80-12-4313, -4317, -4332, -4334, -4336, and –4337). Each of these historic properties designated for data recovery will have at least one test unit placed within it. The location of the remaining three test units will be determined after initial testing of the six historic properties to optimize recovery of data.
2. The four main rockshelter sites (SIHP #s 50-80-12-4319, -4321, -4322, and –4328) will be the subject of a total of twelve 1 m x 1 m test units. Two test units will be excavated in each of the historic properties. The location of the remaining four test units will be determined after initial testing of the six historic properties to optimize recovery of data.
3. The smaller *ahu* and mound type historic properties (SIHP #s 50-80-12-4318, -4324, -4325, -4326, and -4331) will have one 1 m x 1 m test unit placed in each of them. Additional units may be excavated if cultural remains are discovered.
4. Sites 50-80-12-6870 and –6871, that are to be preserved, will be subject to a total of 3 1 m x 1 m test units. One test unit will be excavated in each of the historic properties. The location of the remaining test unit will be determined after initial testing. The primary purpose of the testing at these sites will be the recovery of chronological data.

5. Addition test units will be excavated if SIHP #s 50-80-12-4312 and –4338 are relocated. Additional test units may also be excavated depending on findings in the field.
6. Excavated sediments will be screened through 1/8-inch mesh screen;
7. All artifacts and shell and bone midden will be recovered from the screens;
8. In-situ charcoal samples and charcoal samples from the screening of sediments will be collected for radiocarbon dating and wood species identification, as appropriate;
9. A minimum of one stratigraphic profile from each unit from each feature will be recorded by scale drawing. One profile from each excavated feature will show stratigraphic relationship of structural elements to the sediment layers;
10. The recording of the stratigraphic profile will be completed using USDA soil description observations/terminology. Sediment descriptions will include Munsell color, texture, consistence, structure, plasticity, cementation, origin of sediments, descriptions of any inclusions such as cultural material and/or roots and rootlets, lower boundary distinctiveness and topography, and other general observations.
11. All trenches will be excavated to culturally sterile sediments or bedrock;
12. Cultural strata will be excavated in 10 cm (centimeter) levels, where applicable; and,
13. Features within excavation trenches will be treated as discrete excavation units.

7.2 Laboratory Methods

This phase of work will involve the following specific procedures:

1. Identification and cataloguing of artifactual material including both historic as well as prehistoric forms will be completed. Spatial and functional analyses will be performed on the assemblages of each feature and cluster of features to examine the type and extent of activities taking place in each feature and cluster and to assess the relative validity of the models. Artifacts will be measured with representative samples drawn and/or photographed to scale;
2. Identification, weighing, and analysis to genus and species of a representative midden sample, consisting of a minimum of one quadrant of each excavation unit will be completed. If the volume of midden recovered is small, as anticipated, 100% of the midden will be identified, weighed, and analyzed to genus and species. Data will be tabulated by depth and stratigraphic unit;
3. Calculation of total weight of midden by excavation unit, by depth by stratigraphic unit of each feature;
4. Charcoal samples containing pieces suitable for wood identification will be submitted for species analysis first. Selection of charcoal samples for dating will be selected in part based on the wood species findings;
5. Historic era artifacts will be identified by type and age;

6. Select faunal remains will be analyzed by Cultural Surveys Hawai‘i personnel using, if appropriate, the comparative faunal collection located at the Bernice P. Bishop Museum in Honolulu, which has a large collection of mammal, reptile, amphibian, and fish specimens. Technical help at the Bishop Museum will be provided by Ms. Carla H. Kishinami, Collection Manager of Vertebrate Zoology, and by Dr. Kenneth R. Longenecker, Assistant Zoologist, who has developed a physical and digital reference collection of fish skeletons; and,
7. Select samples of basalt collected from the 17 historic properties will be submitted for EDXRF analysis related to sourcing of raw material. Dr. Peter Mills has offered the following comments regarding sample selection and preparation:

   "Clean flakes that are around 2 cm in diameter are best, but we can run much larger flakes and adzes as well. Smaller flakes can also be run with somewhat less precision and a great deal more work (we have to use a "collimator" on the spectrometer, and run the samples using a different method). Polished adze flakes and finished adzes have the greatest potential for identifying non-local resources because many initial adze blank production flakes would logically be from local sources only." (Dr. Mills, personal communication)
8. Samples will be collected from the ceiling of SIHP # 50-80-12-4322 and submitted for EDXRF analysis.

7.3 Reporting

In compliance with HAR 13-278-4 (a) the final report will contain the following:

1. A management summary that presents concise information, with the lay reader in mind, to include:
   - (A) The sites studied; and
   - (B) General findings relevant to research objectives;
2. An introduction, including the reasons for the project and the location of the study area. This shall include:
   - (A) A portion of the relevant United States Geological Survey standard 1:24,000 topographic map showing the ahupua‘a, the parcel, and the sites studied; and
   - (B) Text, which specifies the island, district, ahupua‘a, and the tax map key (TMK) of the parcel.
3. A research objectives section which identifies the research objectives, test implications, and relevant information to address the research objectives;
4. An archaeological field methods section which identifies:
   - (A) Number of personnel, with the names and qualifications of the principal investigator and field director;
   - (B) When the work was done; and

   - (C) Methods planned in the Data Recovery Plan and any deviations, to include sampling strategies and specifics on techniques used.
5. Archaeological fieldwork findings;
6. Laboratory findings;
7. Historical and oral historical findings, if covered in the data recovery plan and if not reported elsewhere;
8. Research conclusions;
9. References; and

1. Location of depository (archive) for collections, photographs and written site records and maps (May be presented in an appendix.)

(b) In the archaeological fieldwork findings section of the report, each site studied shall be individually described, to include:

1. State site number and any previous numbers;

2. Reference to a previous study, if the site has been recorded before;

3. The site's formal type (e.g. C-shaped enclosure, platform, enclosure, wall, paving, etc.). If it has several major features, then each of these should be noted (e.g. 3 C-shaped enclosures, 1 platform, 4 stone cairns);

4. A description of the site, to include any of the following, if not recorded in previous studies:
   - (A) Size, horizontal extent;
   - (B) The major feature(s)'s shape, area, with representative architectural heights and widths, etc. (in metrics).
   - (C) The presence or absence of surface remains (artifacts, midden, debris, etc.), and if present, the general nature of these remains and their density and distribution;
   - (D) The presence or absence of any subsurface deposits, and if so, an assessment of the general depth and nature of these deposits.
   - (E) Representative photographs, or line drawings, or both;
   - (F) Drafted plan maps, which shall include major features, a bar scale, north arrow, and indicate method used (e.g. tape and compass or instrument mapping.); and
   - (G) The integrity of the site;

5. Findings to be presented under each site's description, to include:
   - (A) Location of the excavations on a plan map of the site;
   - (B) Description of stratigraphic layers, with U.S.D.A. standard soil descriptions (using Munsell colors);

(C) Line-drawings depicting the entire length of the profiles, to scale, of all test excavations through surface architecture or of all test excavations with cultural layers;

(D) Representative stratigraphic profiles, to scale, of test excavations not through surface architecture or where no cultural layers are visible in the excavation sidewalls;

(E) Descriptions of features, including provenience within layers;

(F) Listing of artifacts, including provenience within layers;

(G) Listing of debris and other remains, by layer; and

(H) Listing of carbon samples, by provenience;

6. An assessment of site function, with reasonable and adequate supportive arguments; and

7. An assessment of site age.

(c) The results and analysis section of the report shall include:

1. An overall presentation of artifacts, to include:

(A) A master list with provenience, material and type;

(B) Measurements of each artifact, as appropriate, which can be in table form and can be presented under the next item;

(C) Analysis of artifact assemblage by artifact types, materials and provenience, as appropriate; and

(D) Illustrations (line drawings or photographs, or both) of a representative sample of artifacts.

2. An overall presentation of faunal and botanical remains, to include:

(A) A master list, presenting the species identified and non-quantitative remarks on abundance

3. An overall presentation of chronology to include absolute and relative dating, to include:

(A) A master list, by site and by provenience within site, which includes laboratory numbers for each date;

(B) Methods of collection and lab treatment;

(C) For radiocarbon dates, C12/C13 ratios shall be obtained; and

(D) Methods of sample selection.

4. An overall presentation of lithic sourcing, if appropriate, to include:

(A) A master list, by site and by provenience within site;

(B) Methods of sample selection; and

(C) Methods and techniques of source analysis.

5. Osteological analyses, if human skeletal remains are to be analyzed, the analysis shall conform to chapters 13-283 and 13-300.

A draft report will be submitted to the client, and subsequently, to the DLNR Historic Preservation Division for review and approval.

Section 8 Disposition of Collections

Upon conclusion of the project all materials collected will temporarily remain curated at Cultural Surveys Hawai‘i, Kailua Office, until a permanent facility can be decided upon based on consultation with the landowner and SHPD/DLNR.

Section 9 References Cited

Bath, Joyce
1989 *Waimanalo Gulch Petroglyphs*, SHPD, DLNR, State of Hawaii, Honolulu, HI.

Best, S.
1984 *Lakeba: The Prehistory of a Fijian Island.* Ph.D. dissertation, Anthropology, University of Aukland. University Microfilms, Ann Arbor.

Bordner, Richard M.
1977a Archaeological Reconnaissance of the Proposed Makaiwa Gulch Landfill Site, ‘Ewa, O‘ahu, Archaeological Research Center Hawai‘i, Inc.

1977b Archaeological Reconnaissance of the Proposed Kaloì Gulch Landfill Site, ‘Ewa, O‘ahu Island, Archaeological Research Center Hawai‘i, Inc.

Bordner, Richard M. and Carol Silva
1983 Archaeological Reconnaissance and Historical Documentation: Waimanalo Gulch, Oahu, TMK:9-2-03:2,40,13 (por).

Borthwick, Douglas
1997 Archaeological Assessment for the proposed Ministry of Transportation Satellite Multi-Ranging Station (MTSAT-MRS) project site, Palehua, Honouliuli, Ewa, Oahu Island, Hawaii (TMK 9-2-3: por 2), Cultural Surveys Hawai‘i, Kailua, HI.

Cleghorn, P.L., T. S. Dye, M. Weisler, J. Sinton
1985 A preliminary petrographic study of Hawaiian stone adze quarries. *Journal of the Polynesian Society*, 94:235-251.

Dega, Michael F., Randy Ogg, Michael T. Carson, and Leina‘ala Benson
1998 An Archaeological Inventory Survey of the University of Hawai‘i West O‘ahu Campus, District of ‘Ewa, Island of O‘ahu, Hawai‘i (TMK 9-2-02:01, 9-2-02:03, 9-2-02:05), Scientific Consultant Services, Honolulu, HI.

Frierson, Barbara
1972 *A Study of Land Use and Vegetation Change: Honouliuli, 1790-1925*, Manuscript prepared for Graduate Seminar in Geography (750), University of Hawaii, Honolulu.

Hammatt, Hallett H.
1992 Archaeological Inventory Survey of Proposed K-A-I-M Radio Tower, Palikea, Honouliuli, ‘Ewa, O‘ahu (TMK 9-2-005:013 Portion), Cultural Surveys Hawai‘i, Kailua, HI.

Hammatt, Hallett H., Jennifer J. Robins, Mark Stride and Matthew J. McDermott
1991 An Archaeological Inventory Survey for the Makaiwa Hills Project Site, Honouliuli, ‘Ewa, O‘ahu (April 1991) Cultural Surveys Hawai‘i Kailua, HI.

Hammatt, Hallett H. and David W. Shideler
1999 An Archaeological Inventory Survey and Assessment for the Waimanalo Gulch Sanitary Landfill Project Site, Honouliuli, ‘Ewa, O‘ahu, Draft, Cultural Surveys Hawaii, Kailua, HI.

1990 Archaeological Inventory Survey of the West Loch Bluffs Project Site, Honouliuli, ‘Ewa, O‘ahu, Cultural Surveys Hawaii, Kailua, HI.

Handy, E.S. Craighill and Elizabeth G. Handy
1972 Native Planters in Old Hawaii: Their Life, Lore, and Environment, Bishop Museum Bulletin 233, Honolulu.

Haun, Alan E.
1986a Preliminary Archaeological Reconnaissance Survey for Environmental Assessment (EA) Ewa Town Center/Secondary Urban Center Land of Honouliuli, ‘Ewa, Island of O‘ahu, (TMK 9-1-15 and 9-1-16). Paul H. Rosendahl, Ph.D., Inc., Hilo, Hawai‘i.

1986b Preliminary Archaeological Reconnaissance Survey for Environmental Assessment (EA) Ewa Town Center/Secondary Urban Center Land of Honouliuli, Ewa, Island of Oahu, (TMK 9-1-15:Por. 5, 17: 9-1-16:Por. 9). Paul H. Rosendahl, Ph.D., Inc., Hilo, Hawai‘i.

Haun, Alan E. and Marion Kelly
1984 Research Design for an Archaeological Survey of Naval Communication Area Radio Transmission Facility, Lualualei; and Naval Air Station, Barbers Point, Oahu, Hawaii, Dept. of Anthropology, Bishop Museum, Honolulu.

Hoffman, Tracy, Todd Tulchin, Hallett H. Hammatt
2004 Archaeological Assessment of an Approximately 30-Acre Parcel Adjacent to the Kahe Power Plant, Honouliuli Ahupua‘a, ‘Ewa District, Island Of O‘ahu (TMK: 9-2-03:27), Cultural Surveys Hawai‘i, Kailua, HI.

‘Ī‘ī, John Papa
1959 *Fragments of Hawaiian History*, Revised, Bishop Museum Press, Honolulu, HI.

Kirch, Patrick V.
1985 *Feathered Gods and Fishhooks.* Honolulu: University of Hawai‘i Press.

McAllister, J. Gilbert
1933 *Archaeology of Oahu*. Bulletin 104. Bishop Museum: Honolulu.

Nakamura, Barry S., Jeffery Pantaleo, and Aki Sinoto
1993 Archaeological Inventory Survey of Proposed Development Parcels D and D-1 Makakilo, Honouliuli, ‘Ewa, O‘ahu Island (TMK 9-2-3:18 por.; 75 por.; 81 por.), Aki Sinoto Consulting, Honolulu, HI.

Native Register
1847-53 Native Register of Kuleana Claims to Quiet Land Titles in the Hawaii Islands, State of Hawaii Archives, Honolulu, HI.

O’Leary, Owen and Hallett H. Hammatt
2006 Archaeological Inventory Survey Addendum for the Maka‘iwa Hills Project, Honouliuli Ahupua‘a, ‘Ewa District, O‘ahu

Sinoto, Aki
1988 Surface Survey of the Proposed Makakilo Golf Course, ‘Ewa, O‘ahu, Bishop Museum, Honolulu, HI.

Sinton, J. M., Sinoto, Y. H.
1997 A geochemical database for Polynesian adze studies. In M. I. Weisler (Ed.), *Prehistoric Long-distance Interaction in Oceania: An Interdisciplinary approach*, pp. 194-204. New Zealand Archaeological Association Monograph 21.

Sterling, Elspeth P. and Catherine C. Summers (comp.)
1978 *Sites of O`ahu*, Dept. of Anthropology, B.P. Bishop Museum, Honolulu.

Thrum, Thomas G.
1906 "Heiaus and Heiau Sites Throughout the Hawaiian Islands, in Thos. G. Thrum, compiler, *Hawaiian Almanac and Annual* for 1907, pp. 38-47, Honolulu, HI.

Tulchin, Jon and Hallett H. Hammatt
2004 Archaeological Field Inspection for the Proposed HECO Meteorological Observation Stations, Honouliuli Ahupua‘a, ‘Ewa District, Island of O‘ahu (TMK: 9-2-03), Cultural Surveys Hawai‘i, Kailua, HI.

Tulchin, Todd and Hallett H. Hammatt
2005 Archaeological Inventory Survey Of the Approximately 71-AcreProposed Pālehua East B Project,Makakilo, Honouliuli Ahupua`a, ‘Ewa District, Island of O‘ahu (TMK: 9-2-03: 76 and 78), Cultural Surveys Hawai‘i, Kailua, HI.

2004a Archaeological Inventory Survey Of the Approximately 86-Acre Proposed Pālehua Community Association (PCA) Common Areas Parcels, Makakilo, Honouliuli Ahupua‘a, ‘Ewa District, Island of O‘ahu (TMK: 9-2-03: 78 por. and 79) Cultural Surveys Hawai‘i, Kailua, HI.

2004b Archaeological Inventory Survey of an Approximately 24-Acre Parcel Adjacent to the Kahe Power Plant, Honouliuli Ahupua‘a, ‘Ewa District, Island of O`ahu (TMK: 9-2-03:27), Cultural Surveys Hawai‘i, Kailua, HI.

Walter, R. K., P. J. Sheppard
1996 The Ngati Tiare adze cache: further evidence of prehistoric contact between West Polynesia and the Southern Cook Islands. *Archaeology in Oceania*, 31:33-39

2001 Adze Sourcing on Mangaia (Southern Cook Islands). In M. D. Jones and P. J. Sheppard (Eds.), *Australian Connections and New Directions: Proceedings of the 7th Australian Archaeometry Conference*. Research in Anthropology and Liguistics, Auckland, New Zealand.

Weisler, M. I.
1990 A Technological Petrographic, and Geochemical Analysis of the Kapohaku Adze Quarry, Lanai, Hawaiian Islands. *New Zealand Journal of Archaeology*, 12:29-50.

1993 Provenance studies of Polynesian basalt adze material: A review and suggestions for improving regional data bases. *Asian Perspective*, 32:61-83

1998 Hard Evidence for Prehistoric Interaction in Polynesia. *Current Anthropology*, 39,521-532.

Weisler, M. I., Patrick V. Kirch
1996 Interisland and interarchipelago transfer of stone tools in prehistoric Polynesia. *Proceedings of the National Academy of Sciences*, 93:1381-1385.

Appendix A SHPD Acceptance Letter for the Archaeological Inventory Survey

JOHN WAIHEE
GOVERNOR OF HAWAII

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STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
STATE HISTORIC PRESERVATION DIVISION
33 SOUTH KING STREET, 6TH FLOOR
HONOLULU, HAWAII 96813

June 13, 1991

Dr. Hallett H. Hammatt
Cultural Surveys of Hawaii
49 South Kalaheo Avenue
Kailua, HI 96734

Dear Dr. Hammatt:

SUBJECT: Review of second revised draft of An archaeological inventory survey for the Makaiwa Hills Project Site
Honouliuli, 'Ewa, O'ahu
TMK: 9-1-15: 5, 11, 17; 9-1-16: por. 9; 9-2-3: por. 2

Thank you for the copy of this report which we have reviewed and found to be a substantial improvement. The greatly expanded Land Use section was informative and interesting and convincingly establishes a context for the Makaiwa Hills project in the overall settlement pattern of Honouliuli, enabling better context for evaluating the significance of the sites found in the project area.

The description of survey methods makes it clear that the parcel was adequately surveyed, and we believe that all historic sites have been found. A total of 34 sites were recorded.

We concur with the significance assessments and appreciate the information on the distribution of dry caves that has changed our assessment of the significance of sites -4319, -4321, and -4338. We agree that 16 sites are "no longer significant" because sufficient information has been collected. We also agree that the 18 remaining sites are significant -- 14 (50-80-12-4312, -4313, -4317, -4318, -4322, -4324, -4325, -4326, -4328, -4331, -4332, -4334, -4336, and -4337) for their information content; 3 (50-80-12-4319, -4321, and -4338) because they are excellent examples of a particular site type and because of their information content; and 1 site (50-80-12-2893) because it is an excellent example of a site type, it has significant information content, and it has cultural significance to an ethnic group of the State. Thus, we agree that 18 significant historic sites remain in the project area.

We agree with the mitigation recommendations for the 18 significant sites -- preservation of site 2893; preservation with some data collection for 4 sites (4319, 4321, 4322, and 4328); and data recovery for the remaining 13 sites. As you have discussed on the telephone with Tom Dye, site 2893 has already been the subject of a detailed preservation plan, so that your report need not be concerned with other than the remnant portion that is included in your survey area.

Dr. Hallatt H. Hammatt
June 13, 1991
Page Two

Please note that Figures 9 and 11 still give measurements in feet, instead of meters. Also, site 50-80-12-4317 is still labeled a Circular Enclosure and described as a rectangular "U" shape. We would appreciate it if these inconsistencies could be corrected, with replacement pages submitted. With the understanding that these corrections will be shortly submitted, we find this document to be an acceptable archaeological inventory survey report.

When we receive a City & County permit for review, we will recommend that the project will have "no adverse effect" to significant historic sites, with the agreed upon mitigation commitment noted above. We will also then recommend a condition that would require approval of a detailed data recovery plan (scope of work) and of a detailed preservation plan by our office and the City & County and would require verification of the successful execution of the plans by our office and the City & County. Such a condition is a common procedure to ensure that the mitigation agreement is acceptably carried out.

Sincerely,

DON HIBBARD, Administrator
State Historic Preservation Division

cc: William E. Wanket, Department of General Planning,
City and County of Honolulu

Preservation Plan for SIHP #s 50-80-12-4319, -4321, -4322, -4328 & -4338, -6870 & -6871 at the Makaīwa Hills Project, Honouliuli Ahupua'a, 'Ewa District, O'ahu TMK: [1] 9-1-015:005 por. and 017; 9-2-003:002 por., 005 por., and 084 por.

Prepared for
Group 70 International

Prepared by
Owen L. O'Leary
David W. Shideler, M.A.
and
Hallett H. Hammatt, Ph.D.

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

June 2007

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Management Summary

Title	Preservation Plan for SIHP #s 50-80-12-4319, -4321, -4322, -4328, -4338, -6870 & -6871 at the Makaīwa Hills Project Honouliuli Ahupua‘a, ‘Ewa District, O‘ahu TMK: [1] 9-1-015:005 por. and 017; 9-2-003:002 por., 005 por., and 084 por.
Date	June 2007
Project Number	Cultural Surveys Hawai‘i (CSH) Job Code: HONOU 1
Agency	State Historic Preservation Division / Department of Land and Natural Resources (SHPD/DLNR)
Investigation Permit Number	Fieldwork was performed under CSH’s annual archaeological research permit, No. 0605, issued by SHPD/DLNR, per Hawai‘i Administrative Rules (HAR) Chapter 13-13-282.
Project Location	The project area is located in Makaīwa, Honouliuli, ‘Ewa, O‘ahu. The property is bounded by Farrington Highway to the south and Palehua Road to the north. Waimānalo Gulch is on the west and the residential community of Makakilo is on the east.
Project Land Jurisdiction	The project area is privately owned by Makaīwa Hills LLC.
Project Funding	The proposed project is privately funded.
Project Acreage	1,780.705-acres
Project Description	The proposed Makaīwa Hills project is a residential development with supporting commercial uses, infrastructure and open space. Although specific details regarding the development within the project area are not available at this time, extensive disturbance is anticipated.
Background to the Plan	Hammatt et al. (1991) conducted an archaeological inventory survey of the entire 1,780.705-acre project area. The report concluded that 18 historic properties within the project area were eligible for inclusion on the Hawai‘i Register of Historic Places. Five of these were recommended for permanent preservation. The State Historic Preservation Division accepted the above recommendations from the inventory survey. An Addendum to the Inventory Survey (O’Leary and Hammatt November 2006) identified two additional sites (50-80-12-6870 and –6871) that were both recommended for preservation and they are included in the present plan. The present Preservation Plan has been prepared to address preservation plan measures for these seven sites.

Historic Preservation Regulatory Context	At the request of Group 70 International, this preservation plan is prepared in accordance with the Hawai‘i Administrative Rules (HAR) 13-277-3. This document was prepared to support the proposed project’s historic preservation review under Hawai‘i Revised Statutes (HRS) Chapter 6E-42 and HAR Chapter 13-284.
Historic Properties Addressed	Preservation by avoidance and protection is recommended for State Inventory of Historic Properties: 50-80-12-4319 Rockshelter with interior terrace 50-80-12-4321 Rockshelter with interior terrace 50-80-12-4322 Rockshelter with interior *ahu* 50-80-12-4328 Rockshelter complex (3) and petroglyph 50-80-12-4338 Rockshelter complex (3) 50-80-12-6870 Terrace, springs, and a rock shelter 50-80-12-6871 Paved Area

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Section 1 Introduction

1.1 Project Background

At the request of Group 70 International this preservation plan has been prepared to address mitigation efforts for seven historic properties recommended for preservation (Table 1). Five of these historic properties were described in *An Archaeological Inventory Survey for the Makaiwa Hills Project Site, Honouliuli, ‘Ewa, O‘ahu* TMK: [1] 9-1-015:005 por. and 017; 9-2-003:002 por., 005 por., and 084 por. (Hammatt et al. 1991) that was reviewed and accepted by the State Historic Preservation Division (SHPD) (Hibbard to Hammatt letter of June 13, 1991; see Appendix A below) and two of these sites (50-80-12-6870 and –6871) were described in an *Archaeological Inventory Survey Addendum for the Makaīwa Hills Project, Honouliuli Ahupua‘a, ‘Ewa District, O‘ahu* (O’Leary and Hammatt 2006).

Makaīwa Hills LLC owns the 1,780.705-acre project area located in Makaīwa, Honouliuli, ‘Ewa, O‘ahu that contains the five historic properties. The parcel is bounded by Farrington Highway to the south and Palehua Road to the north. Waimanalo Gulch is on the west and the residential community of Makakilo is on the east (Figure 1, Figure 2, and Figure 3).

Table 1. Historic Properties for Preservation with Limited Data Recovery

SIHP # 50-80-12-	Site Form	Site Function	Proposed Treatment
4319	Rockshelter w/interior terrace	Permanent Habitation	Avoidance and Protection
4321	Rockshelter w/interior terrace	Permanent Habitation	Avoidance and Protection
4322	Rockshelter w/interior *ahu* and basalt quarry	Quarry	Avoidance and Protection
4328	Rockshelter complex (3) w/ petroglyph	Permanent Habitation	Avoidance and Protection
4338	Rockshelter complex (3)	Permanent Habitation	Avoidance and Protection
6870	Terrace, springs, and a rock shelter	Animal Husbandry	Avoidance and Protection
6871	Paved Area	Indeterminate	Avoidance and Protection

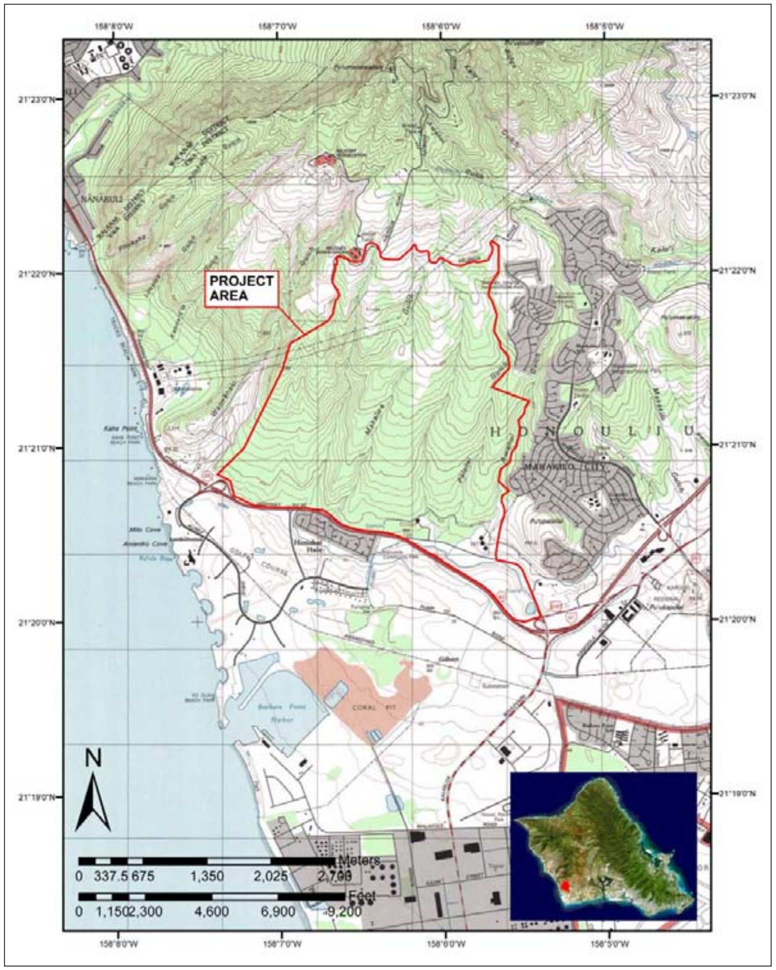

Figure 1. A portion of the 1998 ‘Ewa USGS 7.5-minute topographic quadrangle showing the current project area

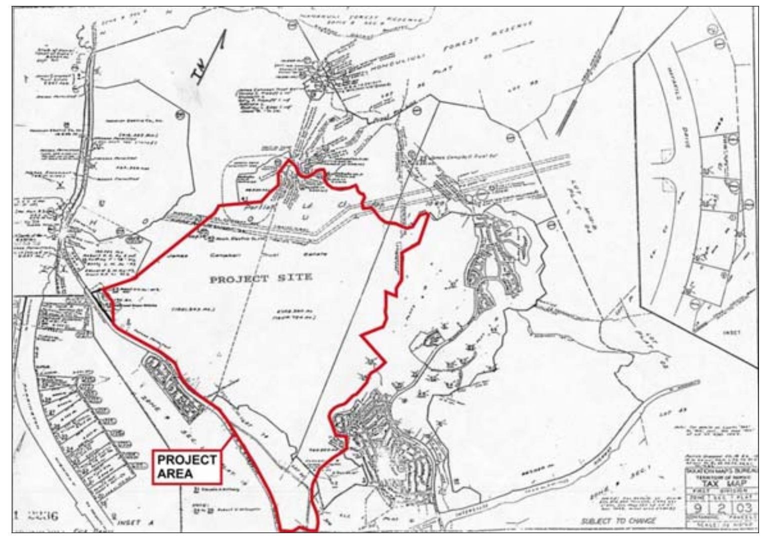

Figure 2. Tax Map Key (TMK): 9-2-03 showing Makaiwa Hills project area

Figure 3. Portion of the Oahu, Hawaii EarthData High-Resolution Orthoimagery – vol001 showing the location of the Makaīwa Hills Project Area

The proposed Makaīwa Hills project is a residential development with supporting commercial uses, infrastructure and open space. Although specific details regarding the development within the project area are not available at this time, extensive disturbance is anticipated.

This preservation plan is prepared in accordance with the Hawai‘i Administrative Rules (HAR) 13-277-3. This document was prepared to support the proposed project’s historic preservation review under Hawai‘i Revised Statutes (HRS) Chapter 6E-42 and HAR Chapter 13-284.

1.2 Scope of Work

The Scope of Work for the approximately 1,780.705-acre parcel comprising the southern end of the Waianae Mountains in Honouliuli Ahupua‘a, ‘Ewa District, island of O‘ahu is to develop, in the public's interest, proper preservation measures that include forms of preservation such as conservation, restoration, interpretation, and use. This plan specifies elements of protection buffers, short-term and long-term preservation protection measures, consultation processes and preservation treatment expressed by those consulted, and interpretive requirements. The plan lists preservation sites and depicts them on a map of sufficient scale.

1.3 Environmental Setting

1.3.1 Natural Environment

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

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

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

-Stony steep land (rsy) (ridges - majority of project area)

-Lualualei extremely stony clay (LPE) (lower gulches)

-Helemano silty clay (HLMG) (ridge crests)

-Honouliuli clay (HxA, HxB) (lowlands to southeast)

-Mahana-Badland complex (MBL) (heavily eroded *mauka* lands)

-Lualualei stony clay (LvB) (low lands to southeast)

-Ewa silty clay loam (EaB) (lowlands to southeast)

-Molokai silty clay loam (MuC) (lowlands to southeast)

-Ewa stony silty clay (EwC) (lowlands to southeast)

-Rock land (rRK) (steep land above Waimanalo Gulch)

-Mahana silty clay loam (MC) (higher soil covered ridges)

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

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

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

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

a) Lowland zone - open grassland on the leeward side

b) Lower Forest - beginning about 1000 feet and richer in species than the rainforest; *kukui*, *‘ōhia ‘ai*, *koa*, *kalia*, sandalwood, *‘ōhia lehua*, *hau*, *kī*, ‘*ape*, *pia*, banana, ginger, birdnest fern and *honohono*, as well as grasses and cyperaceous plants.

c) Specifically leeward lower forest – ‘*ohe*, *wiliwili*, *maile*, *halapepe* and *alani*, with almost no undergrowth.

Historical accounts presented by Frierson (1972:5-6) describe these lower forest species as extending to 500 feet, with the presence of sandalwood observed down to as low as 300 feet. The lower forest then is hypothesized to have covered at least the upper one-third of the project area. The higher site density may correlate to the lower fringes of this forest. Viewing the heavily eroded and fairly open landscape today one is impressed by the dramatic effects of herbivore grazing in the last 150 years in terms of vegetation changes and erosion. This was always a rain shadow slope and we may more accurately envisage a parkland community rather than a thick forest.

1.3.2 Built Environment

Presently, the majority of the project area is being used for cattle grazing. An active water trough and cattle pen are situated just south of Pālehua Road and an extensive wire fence, which includes stone wall sections, crosscuts the slope at approximately the 600 ft. contour, retaining the majority of the cattle within this northern enclosure.

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

TMK [1] 9-1-015:11 & 23 are small exclusions zones within the project area because they are government property where there are already large water tanks located on them.

1.4 Introduction to the Preservation Plan

This long-term preservation plan addresses concerns related to five historic properties described and recommended for preservation within *An Archaeological Inventory Survey for the Makaiwa Hills Project Site, Honouliuli, ‘Ewa, O‘ahu* (TMK: [1] 9-1-015:005 and 017; 9-1-016: 009; 9-2-003:002) (Hammatt et al. 1991). The archaeological inventory survey of 1,780.705-acres was reviewed and accepted by the State Historic Preservation Division (SHPD) (Hibbard to Hammatt letter of June 13, 1991; see Appendix A below). Additionally two sites (50-80-12-6870 and –6871) treated in the present plan were described in an *Archaeological Inventory Survey Addendum for the Makaīwa Hills Project, Honouliuli Ahupua‘a, ‘Ewa District, O‘ahu* (O’Leary and Hammatt 2006).

This preservation plan addresses the seven historic properties that were recommended for preservation by the aforementioned archaeological inventory survey and addendum studies. The locations of these sites can be seen in Figure 4 and are summarized in Table 2. They include: SIHP #s 50-80-12-4319, a rockshelter; -4321, a rockshelter; -4322, a rockshelter w/interior *ahu*

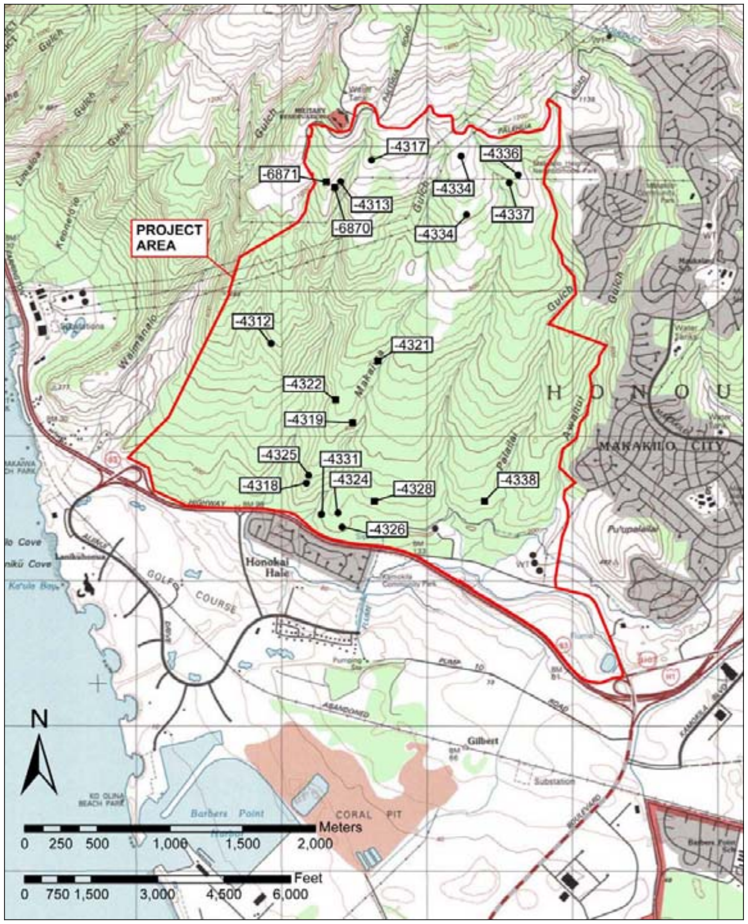

Figure 4. A portion of the 1998 ʻEwa USGS 7.5-minute topographic quadrangle showing the project area and the locations of the historic properties within it that are slated for data recovery (circles and squares) and preservation (squares); all SIHP #s are be proceeded with 50-80-12

Table 2. Historic Properties Recommended for Historic Preservation

SIHP # 50-80-12-	Site Type	Recommendation	Significance Assessment *	Size	No. of Features	Period**
-4319	Rockshelter w/interior terrace	Preserve by constructing an encompassing fence	C, D	10.3 m x 5.4 m	1	P
-4321	Rockshelter w/interior terrace	Preserve by constructing an encompassing fence	C, D	10.0 m x 5.7 m	1	P
-4322	Rockshelter w/interior *ahu* and basalt quarry	Preserve by constructing an encompassing fence	D	6.0 m x 4.2 m	1	P
-4328	Rockshelter complex (3) w/ petroglyph	Preserve by constructing an encompassing fence	D	13.4 m x 13.1 m	3	P
-4338	Rockshelter complex (3)	Preserve by constructing an encompassing fence	C, D	27.5 m x 5.5 m	3	P
-6870	A terrace, 3 springs, and a rockshelter complex	Preserve by constructing an encompassing fence	D& E	6 m x 40 m	5	H
-6871	A paved area	Preserve by constructing an encompassing fence	D & E	6 m x 45 m	1	P

* Significance assessments as dictated in the HAR 13-284-6 are “C” is an excellent example of a site type/work of a master; “D” has yielded or may be likely to yield information important in prehistory or history

** H= Historic (Post 1778) P = Pre-contact and basalt quarry; -4328, a rockshelter complex (3) with a petroglyph; -4338 a rockshelter complex (3); -6870 a terrace, springs, and rock shelter complex and -6871 a paved area.

This present plan specifies preservation procedures for seven historic properties within the 1,780.705-acre parcel. As further archaeological investigation followed by substantial development is to occur within the parcel, this preservation plan first outlines interim protection measures for the seven historic properties during the projected archaeological data recovery phase of investigation. These interim protection measures will continue in place during subsequent construction activities within the parcel.

The present plan also outlines long-term preservation measures for the seven historic properties. These measures may be amended or supplemented – following approval by the State Historic Preservation Division – based on findings during the data recovery investigations

Section 2 Descriptions of Sites to be Preserved

The descriptions of the seven sites recommended for preservation are presented below and the locations of them within the project area can be seen in Figure 4. The descriptions of the first five sites (-4319, -4321, -4322, -42328 and –4338) are taken from the original archaeological inventory survey (Hammatt et al. 1991), but have been modified based upon CSH field personnel’s observations during the initial reconnaissance for the relocation of the historic properties. The descriptions of the last two sites (-6870 and -6871) are adapted from the O’Leary and Hammatt (2006) Addendum study.

2.1 SIHP #: 50-80-12-4319

Site Type: Rock Shelter with Interior Terrace

Function: Permanent Habitation

Probable Age: Pre-contact

Condition: Excellent

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

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

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

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

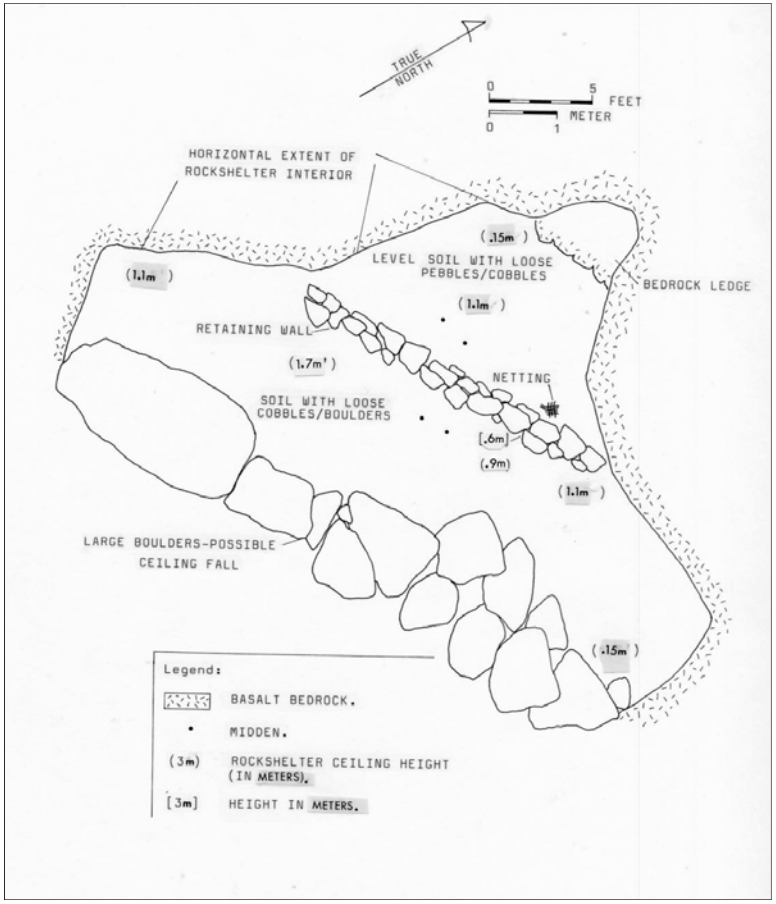

Figure 5. SIHP # 50-80-12-4319; Plan View

2.2 SIHP #: 50-80-12-4321

Site Type: Rock Shelter/Interior Terrace

Function: Recurrent/Permanent Habitation

Probable Age: Pre-contact

Condition: Good/Excellent

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

Description: The rock shelter measures 10 m. (32.8 ft.) wide by 5.7 m. (18.6 ft.) deep (Figure 6). The ceiling heights range from 60 cm. (1.9 ft.) to 1.2 m. (3.9 ft.) high. A stone-faced terrace measuring 4.2 m. (13.7 ft.) long retains a soil area of 2.5 m. (8.2 ft.) by 3.0 m. (9.8 ft.) that abuts the rear of the cave. The terrace face is constructed of angular and rounded small boulders and stands 30 cm. (9 in.) high, 2-3 courses, above the shelter floor. The entrance has an average height of 1.3 m. (4.2 ft.).

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

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

The excavation potential for this historic property is excellent.

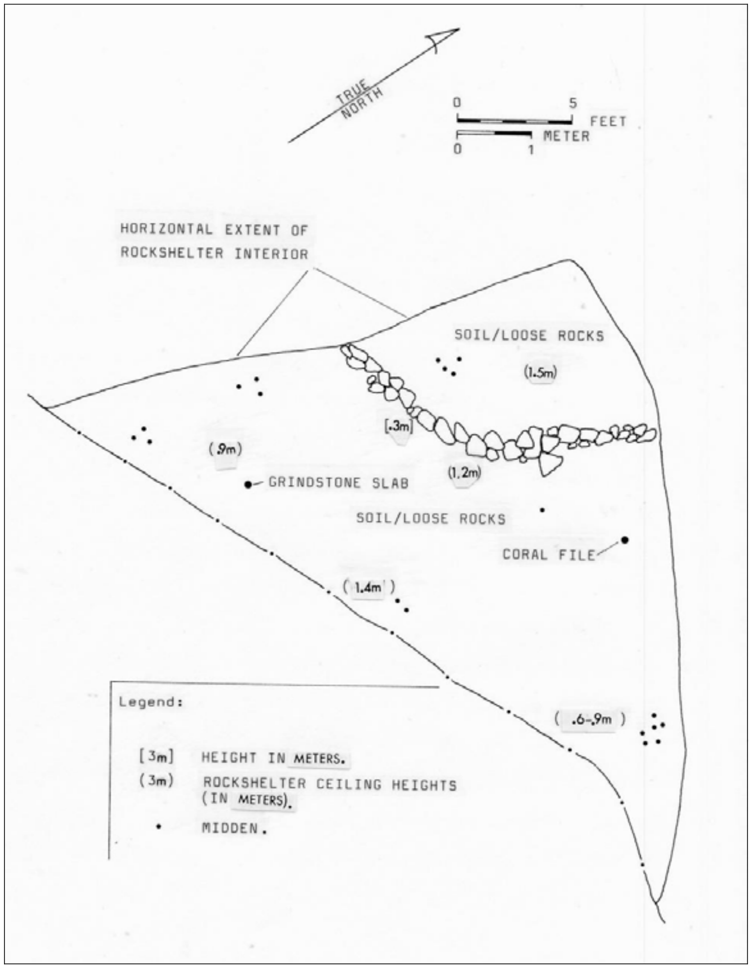

Figure 6. SIHP # 50-80-12-4321; Plan View

2.3 SIHP #: 50-80-12-4322

Site Type: Rock Shelter with Interior *Ahu*

Function: Quarry

Probable Age: Pre-contact

Condition: Fair

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

Description: This rock shelter (Figure 7) measures 4.2 m. (13.7 ft.) wide and 6 m. (19.6 ft.) deep, with an average ceiling height of 1 m. (3.2 ft). The interior floor slopes moderately to steeply towards the opening of the shelter and is comprised for the most part of piles of broken outcrop that have fallen or were deliberately removed from the ceiling above. Within the rear portion of the cliff overhang several percussion scars are present in the ceiling; an underlying accumulation of what appears to be primary flakes characteristic of quarrying activities lies beneath. Towards the opening of the rock shelter a roughly rectangular depression, roughly 50 cm. (1.6 ft.) deep with three vertical faces, is present. It was originally suspected that this excavation was conducted in recent times by an avocational archaeologist or a modern-day rock-miner. However, after inspecting the site area further, a fine-grain basalt dike was identified along the ceiling of the shelter and was also visible at the base of the excavated trench. Many flaking scars are observable on the dike portion of the bedrock at the base of the trench and small and large primary flakes were also seen within the profile of the trench and the surrounding ground surface.

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

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

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

Excavation potential at this site is excellent for gathering data about Native Hawaiian stone tool procurement, processing, and production. No organic materials were observed and the probability of their occurring ─ considering lack of evidence of habitation use ─ is low.

However, the site has potential for yielding information on adz quarrying and sourcing studies. No samples were collected but the cave is available for future studies and sampling for petrographic characterization

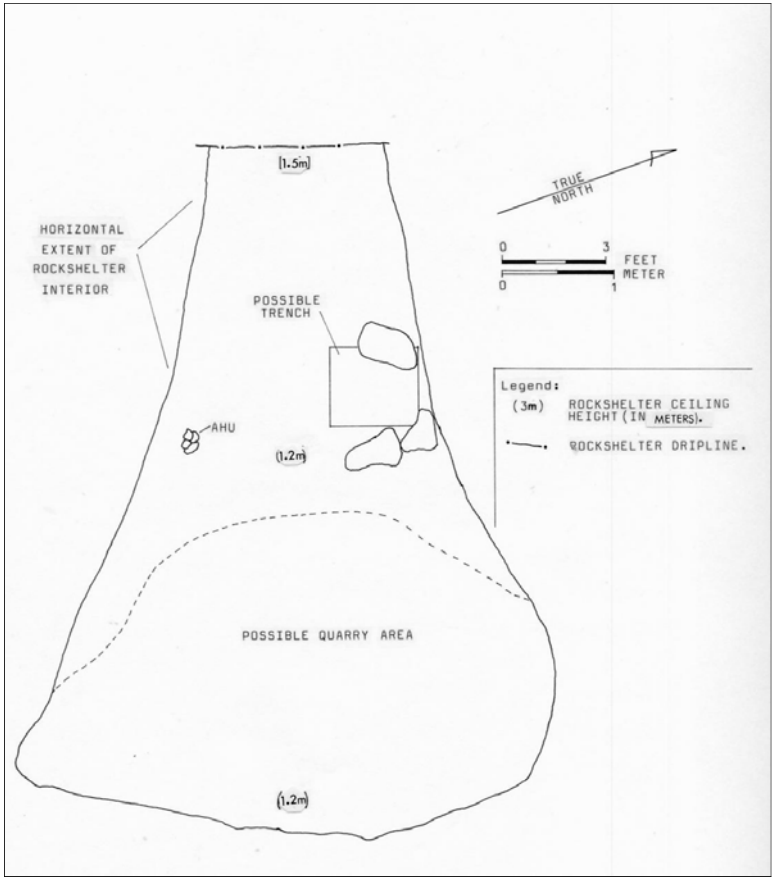

Figure 7. SIHP # 50-80-12-4322; Plan View

2.4 SIHP #: 50-80-12-4328

Site Type: Rock Shelter Complex (3 features)

Function: Permanent Habitation

Probable Age: Pre-contact

Condition: Good

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

Description: This historic property consists of 3 rock shelters located on a 2-tiered outcrop bluff. The three individual rock shelters were designated as one historic property and each was given individual feature designations: A, B and C. Features A and B (Figure 8) are located on the upper tier of the bluff directly above Feature C (Figure 9).

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

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

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

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

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

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

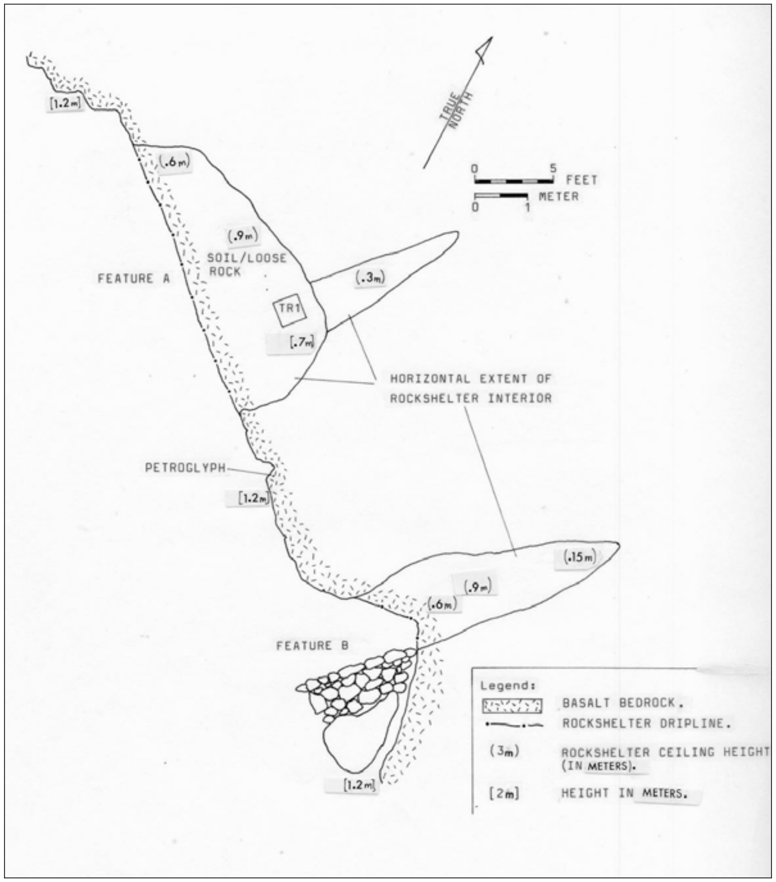

Figure 8. SIHP # 50-80-12-4328, Features A and B; Plan View

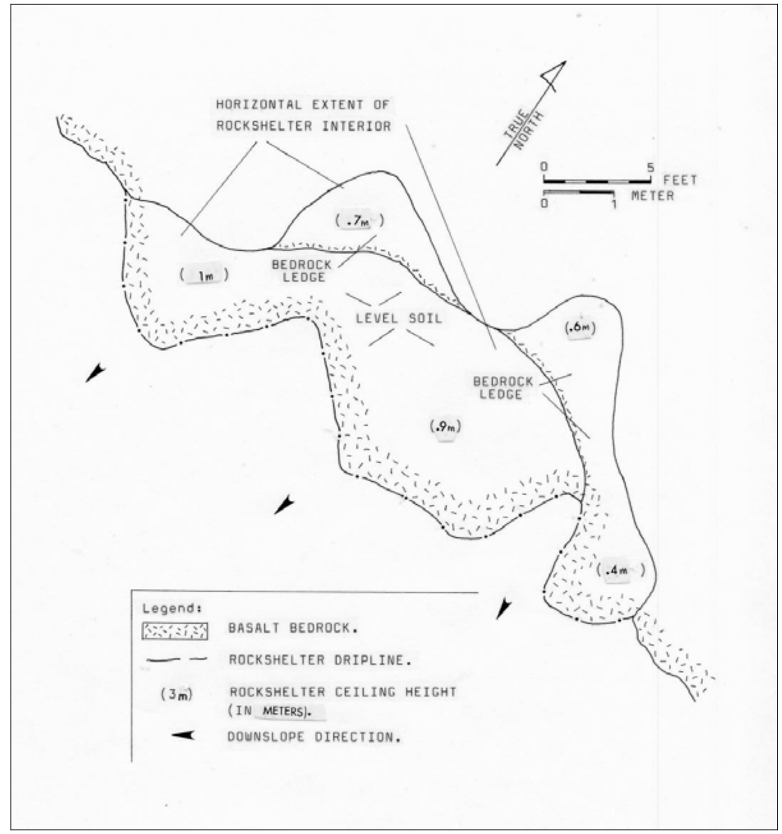

Figure 9. SIHP # 50-80-12-4328, Feature C; Plan View

Testing Results

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

2.5 SIHP #: 50-80-12-4338

Site Type:	Rock Shelter Complex (3 features)
Function:	Permanent Habitation
Probable Age:	Pre-contact
Condition:	Good
Dimensions:	See below

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

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

Feature B is located 4.5 m. (14.7 ft.) east of Feature A and is the next-to-largest rock shelter in this site complex. The shelter measures 4 m. (13.1 ft.) by 2.5 m. (8.2 ft.) with a ceiling height of .4 m. (1.3 ft.). The entrance and floor of the shelter stand 1 m. (3.2 ft.) above the surrounding ground surface. The entrance has been modified by the stacking of boulders and cobbles up to four courses high, which acts as a low barrier enclosing the shelter to some extent. The interior

floor surface of Feature B consists of some soil covered with scattered talus from ceiling collapse. This shelter, due to its linear configuration and small size, and its elevated position, likely served primarily as a sleeping shelter. No midden or artifacts were observed within Feature B shelter.

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

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

CSH personnel were unable to relocate this historic property during the initial reconnaissance for the preparation of this data recovery plan. Further efforts will be made to find it during the data recovery fieldwork.

2.6 SIHP # 50-80-12-6870

FORMAL TYPE:	Terrace, springs, and a rock shelter
FUNCTION:	Animal Husbandry
AGE:	Historic
# OF FEATURES:	5 (A-E)
DIMENSIONS:	42 m northeast/southwest by 8 m northwest/southeast
LOCATION:	*Mauka*/north corner of the project area
CONDITION:	Excellent

DESCRIPTION:

SIHP # 50-80-12-6870 is located halfway up the west side of an unnamed gulch at the southern end of the Waianae Mountains. The gulch eventually joins Makaīwa Gulch farther down the slope of the Makaīwa Hills. The sides of the gulch are steeply sloped and the area is dominated by invasive grasses and burnt *koa haole* trees. SIHP # 50-80-12-6870 is located approximately 50 m down the gulch from SIHP # 50-80-12-4313. SIHP # 50-80-12-6871 is located along the ridge top directly to the west of SIHP # 50-80-12-6870.

SIHP # 50-80-12-6870 is comprised of five features (Figure 10): Feature A is a terrace; Features B, C, and D are freshwater springs; and Feature E is a small rock shelter. The presence of the naturally occurring springs in the dry leeward portion of O'ahu is the likely reason why the terrace was constructed. The historic property measures 42 meters in a northeast/southwest direction and 8 meters in a northwest/southeast direction.

Feature A is a historic single-tiered terrace that extends for approximately 40 m (Figure 10). The level earthen filled terrace is created by a faced retaining wall down slope of the three springs. The terrace face, which incorporates bedrock outcrops extends for 32 m and has a

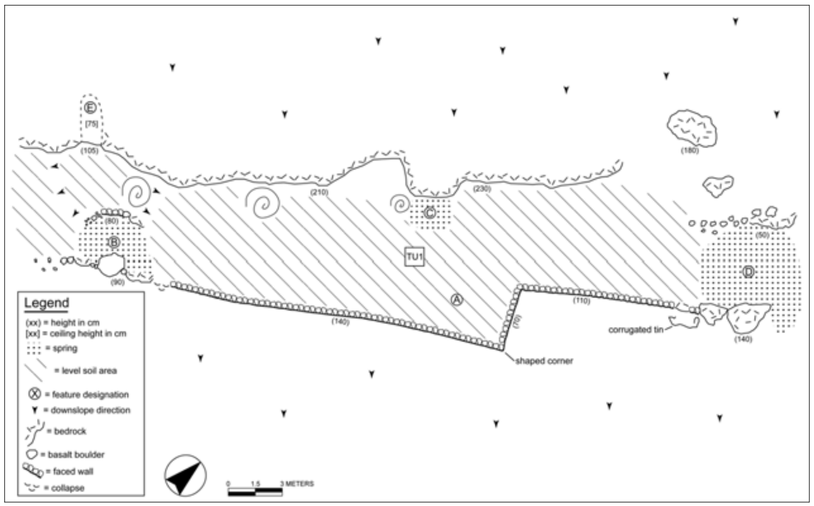

Figure 10. Plan view map of SIHP # 50-80-12-6870 showing features A through E

maximum height of 1.4 meters. The terrace encompasses approximately 200 m^2 between the terrace face and a large basalt outcrop.

The wall is constructed from tightly fitting and occasionally interlocked basalt boulders that are stacked between 3 and 7 courses high. The boulders range in size from 10x10x5 cm to 80x60x20 cm. Many of the rocks are tabular in shape and have been placed in a horizontal position. The edges of some of the rocks exhibit evidence of intentional flaking to modify their shape for a more precise fit in the terrace wall. The best example of this is the outward "shaped corner" (Figure 10) where all five courses of stones are closely aligned.

The wall has suffered a small amount of collapse due to sediment that has pushed some of the upper most rocks in the terrace wall off the top and down onto the downward slope. A rusted piece of corrugated sheet metal is located just down slope of the northeast end of the terrace wall.

All three of the springs in SIHP # 50-80-12-6870 can be characterized as slow freshwater seeps that only produce enough water to create a little mud and cause the immediately adjacent tufts of invasive grasses to turn green. Cattle have heavily disturbed the sediments at all three springs.

Feature B is the southwest most spring in SIHP # 50-80-12-6870. It is 4 m by 3 m (Figure 10) and is situated just east of a slightly raised portion of the terrace in front of the small rockshelter (Feature E) that is part of SIHP # 50-80-12-6870 (Figure 10).

Feature C is the smallest of the three springs, measuring 2.5 m by 1.5 m (Figure 10). It is centrally located within SIHP # 50-80-12-6870 at the base of the large bedrock outcrop (Figure 10).

Feature D, located at the northeastern end of SIHP # 50-80-12-6870 is the largest of the three springs. It is 5.5 m by 5.0 m (Figure 10). This spring has undergone the most cattle disturbance because the cows have to walk through it access the other two springs if they come from the *mauka* end of the historic property.

Feature E is a small natural rockshelter located in the southwest corner of SIHP # 50-80-12-6870 (Figure 10) immediately to the west of a raised portion of the terrace (Feature A). The rock shelter is 1.3 m wide at the opening, 2.5 meters deep, and has an interior height of 75 cm. There was no evidence of cultural material on the soil surface of the floor of the rockshelter.

SIHP # 50-80-12-6870 is comprised of four naturally occurring features – three springs and a rock shelter – and a historically constructed retaining wall that forms a large level terrace. The historic property is in excellent condition and retains a high degree of integrity. The site has likely served as a water source for animals and people for a long time. The terrace was likely constructed during the ranching period to allow easier access for cattle. The site is significant under criterion D, information content, of the HAR 13-284-6.

A single 1 m by 1 m test unit was excavated in the soil surface of Feature A adjacent to Feature C (Figure 10). The location for the test unit was chosen because the presence of water might have served as a reason for Native Hawaiians to frequent the area. The location was also chosen to examine the stratigraphy of the sediments retained by the terrace wall.

Two layers of sediment were present in the test unit. The upper-most was clay silt that has undergone substantial soil formation processes. The lower stratigraphic layer was silty clay with lesser soil formation. This layer likely has a higher clay percentage due the filtering of the smaller particles down through the sediment column. This lower layer ended on natural, highly decomposed, bedrock. Complete details of the stratigraphy are presented below.

Stratum I: 0-22 cmbs	A Horizon; 10 YR 3/3, dark brown; clay-silt; strong, course blocky structure, slightly hard dry consistency; plastic; no cementation; clear smooth lower boundary. No cultural materials were found in this stratum.
Stratum II: 22-37 cmbs	B Horizon; 10YR 4/4, dark yellowish brown; silty clay; moderate medium crumb structure, weakly coherent dry consistency; slightly plastic; no cementation. Small amounts of pig bone and tooth fragments were found in this layer. This layer terminates on extremely corroded bedrock.

Twenty-one pieces of highly weathered pig long bone shaft fragments (15.1g) were discovered near the bottom of the sediment. Two fragments (2.1g) of pig tooth were also found. The absence of any signs of human modification to the bones combined with the lack of any other evidence of human activity suggests that the presence of the bones is most likely the result of natural causes.

2.7 SIHP # 50-80-12-6871

FORMAL TYPE: Paved Area

FUNCTION: Indeterminate

AGE: Pre-contact

 # OF FEATURES: 1

DIMENSIONS: 42 m northeast/southwest by 8 m northwest/southeast

LOCATION: *Mauka*/north corner of the project area

CONDITION: Poor

DESCRIPTION:

SIHP # 50-80-12-6871 is located in the *mauka*/west corner of the Makaīwa Hills project area. It is the western-most historic property in the project area. SIHP # 50-80-12-6871 rests atop a ridge between two gulches. It is situated where the slope shifts from very gradual to a steeper grade. The location of the site affords commanding views of the western half of the ‘Ewa Plain including Barber’s Point, Deep Draft Harbor, Ko‘olina, Kapolei, and Pu‘u Pālailai.

SIHP #s 50-80-12-4313 and 50-80-12-6870 are located in the gulch immediately to the east of ridge that SIHP # 50-80-12-6871 sits on. An abandoned military reservation is located to the west of the historic property.

SIHP # 50-80-12-6871 is comprised of basalt boulders and large cobbles that have been placed to form a rough pavement on the ridge top (Figure 11). The presence of rocks in this area differs from the rest of the ridge where there are no clusters of stones. The pavement extends along the ridge top for approximately 45.0 m in a 21°/201° direction and 6.0 m in a 135°/315° direction.

The rocks that make up the historic property vary in size from variously shaped 10x10x10 cm cobbles to large flat tabular stones, some of which are 100x70x20 cm. Except for the stones that have been disturbed by the bulldozing, most of the stones are relatively level with the ground’s surface resulting in a paved effect.

SIHP # 50-80-12-6871 has been heavily disturbed by bulldozer activity (Figure 11). Both the east and west sides of the pavement have been completely removed by bulldozing, resulting in the inability to tell how wide the historic property originally was. The two bulldozed cuts converge at the *makai* end of the historic property, so it is also not possible to determine total length. Only 6.6 m of the original edge of the historic property can be observed along the northern/*mauka* portion of the site. There is no evidence of erosion within the historic property itself, but a large section of erosion has occurred in the bulldozed road cut to the east of the historic property (Figure 11).

Cultural consultants and CSH personnel identified one of the stones in the historic property as a stone image. It is located along the eastern edge of the historic property. It measures 75x60x40 cm. It has a water worn *puka* and several other water worn channels in the upward facing surface (Figure 12). It is possible that this is one of the stones discussed in the legend of Two Old Women who Turned to Stone *(Ka Loea Kālai‘āina*).

The Hawaiian language newspaper *Ka Loea Kālai‘āina* relates that near Pu‘uokapolei, on the plain of Pukaua, on the *mauka* side of the road, there was a large rock. The legend is as follows:

> There were two supernatural old women or rather peculiar women with strange powers and Pu‘ukaua belonged to them. While they were down fishing at Kualaka‘i [near Barbers Point] in the evening, they caught these things, ‘*a‘ama* crabs, *pipipi* shellfish, and whatever they could get with their hands. As they were returning to the plain from the shore and thinking of getting home while it was yet dark, they failed for they met a one-eyed person [bad omen]. It became light as they came near to the plain, so that passing people were distinguishable. They were still below the road and became frightened lest they be seen by men. They began to run - running, leaping, falling, sprawling, rising up and running on, without a thought of the *‘a‘ama* crabs and seaweeds that dropped on the way, so long as they would reach the upper side of the road. They did not go far for by then it was broad daylight. One woman said to the other, “Let us hide lest people see us,” and so they hid. Their bodies turned into stone and that is one of the famous things on this plain to this day, the stone body. This is the end of these strange women. When one visits the plain, it will do no harm to glance on the upper side of the road and see them standing on the plain. (*Ka Loea Kālai‘āina,* January 13, 1900)

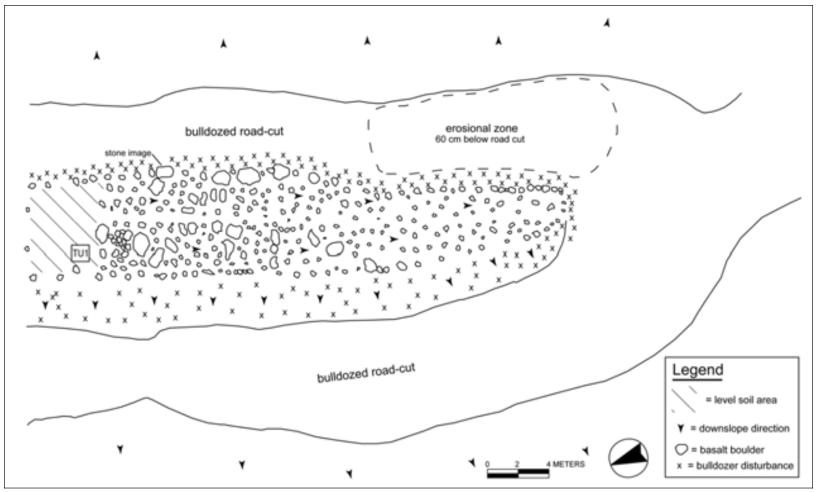

Figure 11. Plan view map of SIHP # 50-80-12-6871

Figure 12. Photograph of the stone image (75x60x40 cm) that is incorporated into SIHP # 50-80-12-6871

SIHP # 50-80-12-6871 is a paved area located on a promontory of a ridge at the southern end of the Wai‘anae Mountains. The historic property is comprised of primarily large tabular basalt boulders that form an elongated paved area. The construction technique and absence of any historic artifacts suggest that the site was constructed prehistorically. This site is unique in nature and CSH is unaware of any other site like it on O‘ahu.

The site’s proximity to the spring in the gulch to the east and it’s prominent location on the ridge suggest many possible functions for the site. It could have served as a trail marker, a resting place for people traveling from the coast to *mauka* villages, possibly even a religious function. Tom “Pohaku” Stone confirmed that the historic property was not an *hōlua* slide. The historic property also contains a stone image that is spoken about in the oral traditions of this portion of Honouliuli Ahupua‘a.

Based upon the site’s location, uniqueness, reference in oral traditions, and proximity to other historic properties on the landscape, SIHP # 50-80-12-6871 is significant under criteria D (information content) and E (importance to Native Hawaiians).

A single 1 m by 1 m test unit was excavated in the level soil surface at the *mauka* end of SIHP # 50-80-12-6871 (Figure 11). Two layers of fine-grained clay-silt characterized the sediments in the excavation. They differed in that the upper layer had undergone soil formation processes, and the lower layer had not. Complete details of the stratigraphy are presented below.

Stratum I: 0-18 cmbs	A Horizon; 10 YR 4/3, brown; clay-silt; moderate medium blocky structure, weakely coherent dry consistency; plastic; no cementation; clear smooth lower boundary. No cultural materials were found in this stratum. Numerous small basalt cobbles were contained in this layer.
Stratum II: 22-37 cmbs	B Horizon; 10YR 4/3, brown; clay-silt; structureless, loose dry consistency; slightly plastic; no cementation. No cultural material was discovered in this stratum. This layer terminates on extremely corroded bed rock

Section 3 Cultural Consultation

Throughout the course of this study there was close consultation with the Hawaiian community as summarized in Table 3 below and reported on in detail in the companion *Cultural Impact Assessment for the proposed Makaīwa Hills Project Honouliuli Ahupua'a, 'Ewa District, O'ahu TMK: [1] 9-1-15:17: Por. 005, 9-2-003: Por. 002, 005, and 84* (Souza et al. 2006). Only two sites (SIHP # 50-80-12-6870 and -6871) have been formally determined to be significant under Hawai'i State Registers of Historic Places criteria "E": that a Historic property has cultural significance to an ethnic group, including, but not limited to, religious structures, burials, and traditional cultural properties.

We submitted a copy of the *Archaeological Inventory Survey Addendum for the Maka'iwa Hills Project, Honouliuli Ahupua'a, 'Ewa District, O'ahu, TMK: [1] 9-1-015:005 por. and 017; 9-2-003:002 por., 005 por., and 084 por.* study report addressing sites 50-80-12-6870 and –6871 and a letter describing our findings to the Office of Hawaiian Affairs on January 22, 2007. A copy of the letter to OHA is included as Appendix B. No concerns or questions have been received from OHA to date. The Office of Hawaiian Affairs has previously (OHA letter of March 7, 2006) directed consultation with Mr. Shad Kane whose concerns have been taken into account. Cultural Surveys has been in consultation with OHA regarding this project of long-standing and will continue to invite their comment.

This determination was based in part on the perceptions of cultural consultants, specifically Mr. Tom "Pohaku" Stone and Mr. Shad Kane, of the cultural importance of SIHP # 50-80-12-6871 and of the anomalous stone in particular mentioned in the description for the site and shown in figure 12 above. The significance for these two sites was determined in consultation with the State Historic Preservation Division and in consideration of their review letter of December 27, 2006 (Log No 2006.4084, Doc No 0612amj09).

Table 3. Community Contacts and Comments (from Souza et al. 2006)

Name	Affiliation	Comments
Ailā , William	Hui Malama I Na Kupuna	Mr. Ailā feels it is very important to preserve the sites of this area. See Traditional Cultural Practices below for response.
Amaral, Annelle	‘Ahahui Siwila Hawaii O Kapolei Hawaiian Civic Club	Made referral to Shad Kane.
Cope, Aggie	Hale O Na‘auao Society	See Traditional Cultural Practices below for response.
Desoto, Frenchy	Wai‘anae Coast Archaeological Preservation Representative	Made referral to Gary Omori, William ‘Ailā .
Eaton, Arline	*Kupuna* at Iroquois Elementary School	See Traditional Cultural Practices below for response.
Enos, Eric	Cultural practitioner and director of Kalala Farms	Mr. Enos is concerned about the sites in the project area and feels the sites in Nānākuli Valley are related to the sites in the project area.
Flanders, Judith	Granddaughter of Alice Kamōkila Cambell	See Traditional Cultural Practices below for response.
Greenwood, Alice	O‘ahu Island Burial Council Member, Wai‘anae District	Aunty Alice spoke vaguely of a *mo‘olelo* (story) long ago about a village at Makaīwa- she recalls a story about the author of the *mo‘olelo* attending a ceremony in the area that mentioned possible burials. She remembers the *mo‘olelo* had the names of the unknown gulches. She also spoke about the *huakai‘pō* (procession of the night marchers) and *akua lele* (Flying god, usually a poison god sent to destroy, sometimes in the form of fireballs). See Traditional Cultural Practices below for response.
Johnson, Rubellite	Hawaiian scholar	Ms. Johnson recommended consulting people who are from the project area.
Josephides, Analu	O‘ahu Island Burial Council Member, Wai‘anae District	See Traditional Cultural Practices below for response.

Name	Affiliation	Comments
Kanahele, Kamaki	President of Nānākuli Homestead	See Traditional Cultural Practices below for response.
Kane, Shad	Member of the Makakilo, Kapolei, Honokai Hale Neighborhood Board and ‘Ahahui Siwila Hawaii O Kapolei Hawaiian Civic Club	Mr. Kane made two site visits with CSH to the project area. Mr. Kane is very concerned about the cultural sites within the project area and wants to be involved in the preservation process. He is also concerned about the view plane. See letter from ‘Ahahui Siwila Hawaii O Kapolei Hawaiian Civic Club in Appendix A.
Makaiwi, Martha	Makakilo, Kapolei, Honokai Hale Neighborhood Board No. 34	Made referral to Maeda Timson and Shad Kane.
McKeaque, Kawika	O‘ahu Island Burial Council member ‘Ewa District	See Traditional Cultural Practices below for response
Nāmu‘o, Clyde	Administrator at Office of Hawaiian Affairs	OHA letter of March 7, 2006
Philpotts, McD	Cultural practitioner and long time resident of Waimānalo ‘Ili	See Traditional Cultural Practices below for response.
Stone, Tom	Cultural Practitioner-Hōlua Expert	Mr. Stone made a site visit with CSH to the project area. Mr. Stone is concerned about human burials and cultural sites in the area.
Tiffany, Nettie	Kahu of Lanikūhonua and O‘ahu Island Burial Council member, ‘Ewa District	See Traditional Cultural Practices below for response.
Timson, Maeda	Member of the Makakilo, Kapolei, Honokai Hale Neighborhood Board No. 34 and President of Ua Au O Kapolei	Mrs. Timson shared two stories told to her by her Tutu Defreitas, and the lady in white. Her *tutu* would bless the *hale* with *ti* leaf and Hawaiian salt because all the *keiki* would get *maka‘u* (scared). They also had *ti* leaf on all four corners of the house for protection.

Section 4 Proposed Preservation Measures

This sections details the preservation measures that will be undertaken for the five historic properties addressed in this report. It discusses buffer zones, interim protection measures, and long-term preservation measures for each of the historic properties.

4.1 Interim Protection Measures

Interim protective measures would be the establishment of heavy machinery exclusion zones during all construction activities. Orange web event fencing or some similar highly visible continuous fencing will surround an area 6 m (20 ft) in radius from the outer edge of all historic properties designated for preservation. This continuous barrier would be erected under the supervision of CSH personnel prior to any significant construction work in the vicinity. No stockpiling of construction materials would be allowed within these interim protection areas. During the course of all construction activities within the project area an effort will be made to insure that sediment and water will not run down over the top of the overhangs that form the roofs of the rockshelters.

The prime contractor will be responsible for informing all sub-contractors and workers under his direction regarding the importance of avoiding the historic property.

4.2 Long-Term Preservation Plan Provisions

The scope of work for development of a long-term preservation plan is detailed in Hawaii Administrative Rules, Title 13, Sub-Title 13, chapter 277, "Rules Governing Requirements for Archaeological Site Preservation and Development". Section 6 specifies long-term preservation measures:

4.2.1 Long Term Buffer Zones

The long-term buffer zones would be permanent fencing surrounding an area 6 m (20 ft) in radius from the outer edge of all historic properties. The fencing will be installed under the supervision of CSH personnel. Construction activity within these buffer zones would be prohibited.

4.2.2 Demarcation of Buffer Zones

The buffer zones shall be demarcated using permanent fencing. Fences will be constructed from durable materials potentially including, but not limted to, chain-link, wood, and moss rock. A combination of different materials, such as a rock wall base with chain link on top, may also be utilized. The fences will have lockable gates positioned on the side of the site that will facilitate access.

The specific fencing materials will be selected to blend in to the surrounding infrastructure while insuring the protection of the historic property. For example, if no residential development is planned in the vicinity chain link may be used. More decorative fencing could potentially be used around a historic property if residential development is in close proximity.

4.2.3 Vegetation Clearing Methods

If vegetation removal is necessary, all clearing upon and around the historic properties will be done by hand or with hand-held tools. Allowable hand tools include, but are not be restricted to: chain saws, machetes, weed-eaters, and clippers. Herbicides may be used prior to manual clearing in order to minimize the volume of vegetation to be removed. It should be emphasized that during vegetation clearing, care should be exercised to avoid disturbance. No on-site or adjacent burning will be allowed. In general, wheeled vehicles will not be used within the buffer zone boundaries of the historic properties.

4.2.4 Stabilization

Stabilization of the interior of the rockshelters will not be necessary. Permanent barriers will be incorporated into the development of the project area to insure that water and sediment does not run down over the top of the rock shelters slated for preservation. These barriers will be located outside of the permanent fencing. This could be as simple as a low concrete or asphalt curb that channels the water from the top to the sides of the rock shelter. The specific water control features may vary slightly between the historic properties to accommodate the surrounding infrastructure.

4.2.5 Landscaping Plan

There is no landscaping plan anticipated for any of the archaeological preserve areas.

4.2.6 Pathways, Lighting, Other Hard-scape Structures within the Preserve Areas

There is no plan for specific hard-scape construction, pathways, or lighting in the vicinity of the historic properties designated for preservation.

4.2.7 Access to the Site

The preserve areas will be accessible within the reasonable public access to the residential neighborhood.

4.2.8 Handling of Litter

Any litter that is present at any of the historic properties will be removed from the area inside the long term buffer zone at the time of the erection of the permanent long-term fencing.

4.2.9 Approaches to Interpret and Inform the Public

Any interpretive program as may be appropriate for these historic properties will need to await the results of the data recovery program. Any such interpretive program will be subject to review, comment, and approval, by SHPD before being implemented.

A small sign would be placed on the fences surrounding each of the six sites reading:

PRESERVE HAWAII’S PAST FOR THE FUTURE

PLEASE DO NOT DISTURB THESE ARCHAEOLOGICAL SITES

Damage to these Historic Sites is Punishable

Under Chapter 6E-11, Hawai‘i Revised Statutes

4.2.10 Future Archaeological Research

Future archaeological research within the preserve sites will be allowed only with the written approval of a research plan by the SHPD and in coordination with the landowner.

4.2.11 Penalty

Non-compliance with the provisions and procedures of this plan once accepted by the SHPD shall result in a directive not to proceed with construction near the sites, and may result in a denial or revocation of SHPD’s written concurrence or agreement, and shall also be penalized as provided in section 6E-11, HRS and applicable laws.

Section 5 References Cited

Barrera, William Jr.
1985 West Beach Roadway Improvements: Archaeological Survey, Chiniago Inc.

Davis, Bertell D. and Alan E. Haun
1987 Interim Report: Phase 2 - Intensive Survey and Test Excavations West Beach Data Recovery Program, Honouliuli, Ewa, Island of Oahu, PHRI Inc.

Hammatt, Hallett H., Jennifer J. Robins, Mark Stride and Matthew J. McDermott
1991 An Archaeological Inventory Survey for the Makaiwa Hills Project Site, Honouliuli, ‘Ewa, O‘ahu (April 1991) Cultural Surveys Hawai‘i Kailua.

Neller, Earl
1985 A Preliminary Review and Evaluation of Archaeological Studies and Recommendations for the Proposed West Beach Estates at ‘Ewa, O‘ahu, State Preservation Office, Honolulu, HI.

O’Leary, Owen and Hallett H. Hammatt
2006 Archaeological Inventory Survey Addendum for the Makaīwa Hills Project, Honouliuli Ahupua‘a, ‘Ewa District, O‘ahu

Souza, Kēhaulani, David Shideler and Hallett H. Hammatt
2006 Cultural Impact Assessment for the proposed Makaīwa Hills Project Honouliuli Ahupua‘a, ‘Ewa District, O‘ahu TMK: [1] 9-1-15:17: Por. 005, 9-2-003: Por. 002, 005, and 84

Appendix A SHPD Acceptance Letter for the Archaeological Inventory Survey

Makaiwa

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
STATE HISTORIC PRESERVATION DIVISION
33 SOUTH KING STREET, 6TH FLOOR
HONOLULU, HAWAII 96813

WILLIAM W. PATY, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

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AQUATIC RESOURCES
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CONSERVATION AND RESOURCES ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION PROGRAM
LAND MANAGEMENT
STATE PARKS
WATER RESOURCE MANAGEMENT

June 13, 1991

Dr. Hallett H. Hammatt
Cultural Surveys of Hawaii
49 South Kalaheo Avenue
Kailua, HI 96734

Dear Dr. Hammatt:

SUBJECT: Review of second revised draft of An archaeological inventory survey for the Makaiwa Hills Project Site
Honouliuli, 'Ewa, O'ahu
TMK: 9-1-15: 5, 11, 17; 9-1-16: por. 9; 9-2-3: por. 2

Thank you for the copy of this report which we have reviewed and found to be a substantial improvement. The greatly expanded Land Use section was informative and interesting and convincingly establishes a context for the Makaiwa Hills project in the overall settlement pattern of Honouliuli, enabling better context for evaluating the significance of the sites found in the project area.

The description of survey methods makes it clear that the parcel was adequately surveyed, and we believe that all historic sites have been found. A total of 34 sites were recorded.

We concur with the significance assessments and appreciate the information on the distribution of dry caves that has changed our assessment of the significance of sites -4319, -4321, and -4338. We agree that 16 sites are "no longer significant" because sufficient information has been collected. We also agree that the 18 remaining sites are significant -- 14 (50-80-12-4312, -4313, -4317, -4318, -4322, -4324, -4325, -4326, -4328, -4331, -4332, -4334, -4336, and -4337) for their information content; 3 (50-80-12-4319, -4321, and -4338) because they are excellent examples of a particular site type and because of their information content; and 1 site (50-80-12-2893) because it is an excellent example of a site type, it has significant information content, and it has cultural significance to an ethnic group of the State. Thus, we agree that 18 significant historic sites remain in the project area.

We agree with the mitigation recommendations for the 18 significant sites -- preservation of site 2893; preservation with some data collection for 4 sites (4319, 4321, 4322, and 4328); and data recovery for the remaining 13 sites. As you have discussed on the telephone with Tom Dye, site 2893 has already been the subject of a detailed preservation plan, so that your report need not be concerned with other than the remnant portion that is included in your survey area.

Dr. Hallatt H. Hammatt
June 13, 1991
Page Two

Please note that Figures 9 and 11 still give measurements in feet, instead of meters. Also, site 50-80-12-4317 is still labeled a Circular Enclosure and described as a rectangular "U" shape. We would appreciate it if these inconsistencies could be corrected, with replacement pages submitted. With the understanding that these corrections will be shortly submitted, we find this document to be an acceptable archaeological inventory survey report.

When we receive a City & County permit for review, we will recommend that the project will have "no adverse effect" to significant historic sites, with the agreed upon mitigation commitment noted above. We will also then recommend a condition that would require approval of a detailed data recovery plan (scope of work) and of a detailed preservation plan by our office and the City & County and would require verification of the successful execution of the plans by our office and the City & County. Such a condition is a common procedure to ensure that the mitigation agreement is acceptably carried out.

Sincerely,

DON HIBBARD, Administrator
State Historic Preservation Division

cc: William E. Wanket, Department of General Planning,
City and County of Honolulu

Appendix B OHA Correspondence

Cultural Surveys Hawai‘i, Inc.
Archaeological and Cultural Impact Studies
Hallett H. Hammatt, Ph.D., President

P.O. Box 1114 • Kailua, Hawai‘i 96734 • Ph.: (808) 262-9972 • Fax: (808) 262-4950
dshideler@culturalsurveys.com • www.culturalsurveys.com

January 22, 2007

Clyde Nāmu‘o, Administrator
Office of Hawaiian Affairs
711 Kapi‘olani Boulevard
Honolulu, HI 96813

Dear Mr. Nāmu‘o:

A complementary copy of our archaeological inventory survey, *Archaeological Inventory Survey Addendum for the Maka‘iwa Hills Project, Honouliuli Ahupua‘a, ‘Ewa District, O‘ahu, TMK: [1] 9-1-015:005 por. and 017; 9-2-003:002 por., 005 por., and 084 por.*, is enclosed.

According to HAR chapter 13-284-6, and as per the preliminary SHPD review letter of December 27, 2006, the Office of Hawaiian Affairs must be consulted regarding historic properties assessed as eligible under criterion E.

Two historic properties recommended eligible to the State Register of Historic Properties under criteria D and E were identified during the survey. They are:

SIHP # 50-80-12-6870, a terrace, three springs, and a small rock shelter; and
SIHP # 50-80-12-6871, a paved area situated on a ridge top.

At site -6870, a single one-meter by one-meter test unit was excavated in the soil surface to a depth of 37 centimeters (14 ½ inches) below surface adjacent to the springs. Twenty-one pieces of highly weathered pig long bone shaft fragments (15.1 grams) were discovered near the bottom of the sediment. Two fragments (2.1 grams) of pig tooth were also found. The absence of any signs of human modification to the bones combined with the lack of any other evidence of human activity suggests that the presence of the bones is most likely the result of natural causes.

At site -6871, a single one-meter by one-meter test unit was excavated in the level soil surface to a depth of 37 centimeters (14 ½ inches) below surface at the *mauka* end of the paved area. No artifacts or cultural material were found.

Please call me with any questions or concerns you have about the location of the proposed project.

Sincerely,

David W. Shideler

David Shideler

Inventory Survey for the Maka‘iwa Hills Project, ‘Ewa, O‘ahu.

Archaeological Inventory Survey Addendum for the Makaīwa Hills Project Honouliuli Ahupua‘a, ‘Ewa District, O‘ahu TMK: [1] 9-1-015:005 por. and 017; 9-2-003:002 por., 005 por., and 084 por.

Prepared for

Group 70 International

Prepared by

Owen L. O’Leary, M.A.,

David W. Shideler, M.A.

and

Hallett H. Hammatt, Ph.D.

Cultural Surveys Hawai‘i, Inc.

Kailua, Hawai‘i

(Job Code: HONOU 13)

June 2007

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Management Summary

Reference	Archaeological Inventory Survey Addendum for the Makaīwa Hills Project, Honouliuli Ahupua'a, 'Ewa District, O'ahu (O'Leary, Shideler and Hammatt 2007)
Date	June 2007
Project Number (s)	Cultural Surveys Hawai'i Inc. (CSH) Job Code: HONOU 13
Investigation Permit Number	CSH completed the archaeological inventory survey investigation under state archaeological permit No. 0605 issued by SHPD, per Hawai'i Administrative Rules (HAR) Chapter 13-13-282.
Project Location	Makaīwa, Honouliuli, 'Ewa, O'ahu. TMK: [1] 9-1-015:005 por. and 017; 9-2-003:002 por., 005 por., and 084 por.
Land Jurisdiction	Makaiwa Hills LLC privately owns the project area.
Agencies	State Historic Preservation Division / Department of Land and Natural Resources (SHPD/DLNR)
Project Description	The proposed Makaīwa Hills project is a residential development, with supporting commercial uses, infrastructure and open space. Although specific details regarding the development within the project area are not available at this time, extensive disturbance is anticipated.
Project Acreage	The total project area is 1,780.705 acres.
Area of Potential Effect (APE) and Survey Acreage	The APE for the proposed project includes the two historic properties addressed in this inventory survey addendum. The survey area covered by this study is less than 1-acre.
Historic Preservation Regulatory Context	At the request of Group 70 International, CSH undertook this addendum to a previously conducted archaeological inventory survey (Hammatt et al. 1991). In consultation with SHPD, this addendum inventory survey investigation is designed to fulfill the state requirements for archaeological inventory survey [Hawai'i Administrative Rules (HAR) Chapter 13-13-276]. This document was prepared to support the proposed project's historic preservation review under HRS Chapter 6E-42 and HAR Chapter 13-13-284. It is also intended to support any project-related historic preservation consultation with stake-holding state, and county agencies and interested Native Hawaiian and community groups.
Fieldwork Effort	Owen L. O'Leary, M.A., and Jon Tulchin, B.A., completed the fieldwork on October 9 and 10, 2006. The fieldwork required a total of 4 person days to complete.
Number of Historic Properties Identified	Two: SIHP # 50-80-12-6870, a terrace, three springs, and a small rock shelter; SIHP # 50-80-12-6871, a paved area situated on a ridge top.

Historic Properties Recommended Eligible to the Hawai'i Register of Historic Places (Hawai'i Register)	Two: SIHP # 50-80-12-6870, a terrace, three springs, and a small rock shelter: significant under criteria D and E of the Hawai'i Administrative Rules 13-284-6. SIHP # 50-80-12-6871, a paved area situated on a ridge top: significant under criterion D and E of the HAR 13-284-6.
Historic Properties Recommended Ineligible to the Hawai'i Register	None
Effect Recommendation	Due to the extensive ground disturbance associated with the proposed project, CSH's effect recommendation is "effect, with agreed upon mitigation commitments".
Mitigation Recommendation	As a form of mitigation for these two sites, CSH recommends, in agreement with Group 70 International and Makaiwa Hills LLC, that both sites be subjected to data recovery and subsequent preservation. Both of these sites will be included in the data recovery and preservation plans that are currently in preparation.

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Section 1 Introduction

1.1 Project Background

The project area addressed by this study is located on the southern slopes of the Wai'anae Mountains above the 'Ewa Plain in southwestern O'ahu and includes TMK: [1] 9-1-015:005 por. and 017; 9-2-003:002 por., 005 por., and 084 por. (Figure 1, Figure 2, and Figure 3). Makaīwa Hills LLC owns the 1,780.705-acre project area.

At the request of Group 70 International, Cultural Surveys Hawi'i Inc. (CSH) has prepared this archaeological inventory survey addendum for the Makaīwa Hills Project, Honouliuli Ahupua'a, 'Ewa District, O'ahu to address two archaeological sites on the State Inventory of Historic Properties (SIHP # 50-80-12-6870 and 50-80-12-6871) that were discovered during preliminary fieldwork for the preparation of a data recovery plan and a preservation plan for the same project area.

The project area was originally the subject of an archaeological inventory survey (Hammatt et al. 1991). Thirty-four historic properties were identified, 17 of which were recommended for data recovery. Five of the 17 were recommended for preservation. Because 15 years had passed since the last archaeological inspection of the project area CSH field personnel conducted a reconnaissance of the project area to relocate the 17 historic properties in February 2006. During this fieldwork two additional historic properties were identified in the *mauka*/west corner of the project area. The State Historic Preservation Division / Department of Land and Natural Resources (SHPD/DLNR) requested that an archaeological inventory survey addendum be completed to document the two historic properties (Johnson to O'Leary on September 26, 2006)(See Appendix A).

In consultation with SHPD, this addendum inventory survey investigation is designed to fulfill the state requirements for archaeological inventory survey [Hawai'i Administrative Rules (HAR) Chapter 13-13-276]. This document was prepared to support the proposed project's historic preservation review under HRS Chapter 6E-42 and HAR Chapter 13-13-284. It is also intended to support any project-related historic preservation consultation with stake-holding state, and county agencies and interested Native Hawaiian and community groups.

The two historic properties are being recommended for data recovery and preservation and will be included in the data recovery and preservation plans that are currently in preparation.

1.2 Scope of Work

The archaeological inventory survey and its accompanying report documented the two additional historic properties. The following scope of work satisfies State and County requirements for an archaeological inventory survey [per HAR 13-13-276]:

1. Consultation with community members as part of the inventory survey process. This consultation required contacting knowledgeable members of the community and requesting information on historic and cultural issues related to the two historic properties.

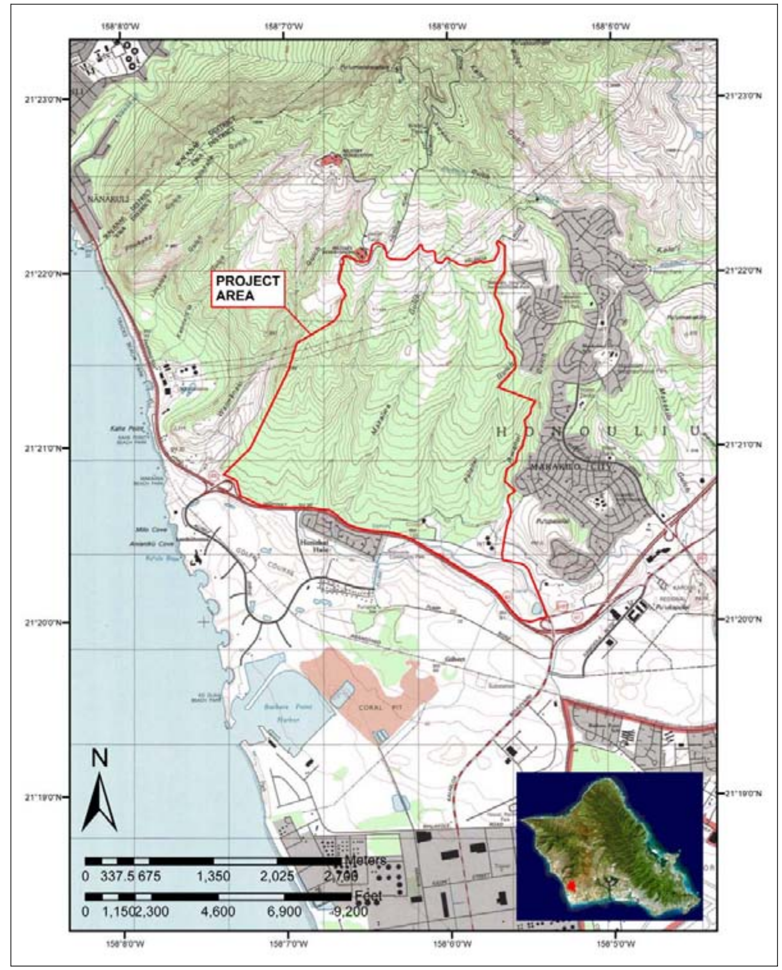

Figure 1. A portion of the 1998 'Ewa USGS 7.5-minute topographic quadrangle showing the current project area

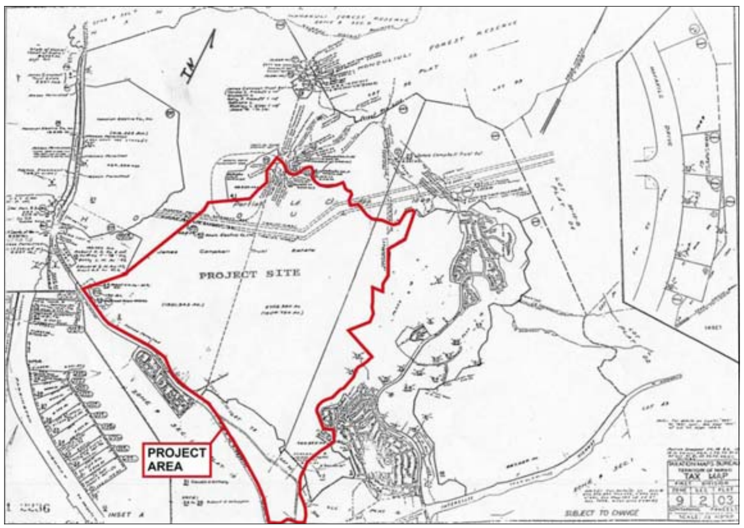

Figure 2 Tax Map Key (TMK) [1] 9-2-03 showing the Makaīwa Hills project area

Figure 3. Portion of the Oahu, Hawaii EarthData High-Resolution Orthoimagery – vol001 showing the location of the Makaīwa Hills Project Area

2. The two historic properties were described and mapped with evaluation of function, interrelationships, and significance. Documentation included photographs and scale drawings of all historic properties. All historic properties were assigned State Inventory of Historic Properties (SIHP) numbers. All historic properties were also located with GPS survey equipment.
3. Limited subsurface testing to determine if subsurface deposits were located in the archaeological sites, and, if so, evaluate their significance.
4. Research on historic and archaeological background, including search of historic maps, written records, and Land Commission Award documents. This research focused on the specific area with general background on the ahupua‘a and district and emphasizes settlement patterns.
5. Preparation of this inventory survey report including the following:
    a. A topographic map of the survey area showing the locations of all historic properties;
    b. Results of consultation with knowledgeable community members about the property and its historical and cultural issues;
    c. Description of all historic properties with selected photographs, scale drawings, and discussions of function;
    d. Historical and archaeological background sections summarizing pre-contact and historic land use as they relate to the project area’s historic properties;
    e. A summary of historic property categories and their significance in an archaeological and historic context;

Recommendations based on all information generated that will specify what steps should be taken to mitigate impact of development on the project area’s significant historic properties - such as data recovery (excavation) and preservation of specific areas. These recommendations were developed in consultation with the client and the State agencies.

This scope of work also includes full coordination with the State Historic Preservation Division (SHPD), and County relating to archaeological matters. This coordination takes place after consent of the owner or representatives.

1.3 Environmental Setting

1.3.1 Built Environment

Presently, the majority of the project area is being used for cattle grazing. An active water trough and cattle pen are situated just south of Pālehua Road and an extensive wire fence, which includes stone wall sections crosscuts the slope at approximately the 600 ft. contour, retaining the majority of the cattle within this northern enclosure.

TMK [1] 9-1-015:11 & 23 are small exclusions zones within the project area because they are government property where large water tanks are already located.

1.3.2 Natural Environment

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

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

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

-Stony steep land (rsy) (ridges - majority of project area)

-Lualualei extremely stony clay (LPE) (lower gulches)

-Helemano silty clay (HLMG) (ridge crests)

-Honouliuli clay (HxA, HxB) (lowlands to southeast)

-Mahana-Badland complex (MBL) (heavily eroded *mauka* lands)

-Lualualei stony clay (LvB) (low lands to southeast)

-Ewa silty clay loam (EaB) (lowlands to southeast)

-Molokai silty clay loam (MuC) (lowlands to southeast)

-Ewa stony silty clay (EwC) (lowlands to southeast)

-Rock land (rRK) (steep land above Waimanalo Gulch)

-Mahana silty clay loam (MC) (higher soil covered ridges)

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

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

Vegetation type and density varies according to the topographical environment and erosional effects within the project area. The vegetation adjacent to the deeply eroded stream channels during the winter months (within the flood zones) is extremely thick and lush with tall grasses predominating, often reaching a height of 2 m. The upper valley slopes are characterized by clusters of trees and low shrubs and grasses surrounded by pockets of denuded ground surface.

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

a) Lowland zone - open grassland on the leeward side;

b) Lower Forest - beginning about 1000 feet and richer in species than the rainforest; *kukui*, *‘ōhia ai*, *koa*, *kalia*, sandalwood, *‘ōhia lehua*, *hau*, *ti*, *ape*, *pia*, banana, ginger, birdnest fern and *honohono*, as well as grasses and cyperaceous plants;

c) Specifically leeward lower forest - *ohe*, *wiliwili*, *maile*, *halapepe* and *alani*, with almost no undergrowth.

Historical accounts presented by Frierson (1972:5-6) describe these lower forest species as extending to 500 feet, with the presence of sandalwood observed down to as low as 300 feet. The lower forest then is hypothesized to have covered at least the upper one-third of the project area. The higher site density may correlate to the lower fringes of this forest. Viewing the heavily eroded and fairly open landscape today one is impressed by the dramatic effects of herbivore grazing in the last 150 years in terms of vegetation changes and erosion. This was always a rain shadow slope and we may more accurately envisage a parkland community rather than a thick forest.

Section 2 Methods

2.1 Field Methods

The fieldwork component of the archaeological inventory survey investigation was accomplished over a two-week period from October 9 and 10, 2006. The CSH field crew consisted of Owen O‘Leary, M.A., and Jon Tulchin, B.A. The fieldwork required 4 person-days to complete. Fieldwork consisted documenting each historic property with a written field description, site maps, photographs and limited subsurface testing at select archaeological sites. Each site was located using Trimble Pro XR GPS survey technology (accuracy <1 m).

Subsurface testing consisted of the partial excavation, by hand, of the two historic properties. A 1-meter by 1-meter test unit was excavated in each of the historic properties. The purpose of the subsurface testing was to aid in determining the function of located surface sites, as well as to possibly obtain datable materials for later radiocarbon dating. All excavated material was sifted through a 1/8 in. wire mesh screen to separate out the soil matrix, then all cultural material was collected for analysis in the lab. Each test excavation was documented with a scale section profile, photographs, and sediment descriptions. Sediment descriptions included characterizations of Munsell color designations, compactness, texture, structure, inclusions, cultural material present, and boundary distinctness and topography.

2.2 Laboratory Methods

Laboratory analyses of material recovered from limited subsurface testing within the project area included the identification of vertebrate faunal material. All vertebrate faunal material was identified and analyzed at the Cultural Surveys Hawai‘i laboratory in Kailua, Hawai‘i.

2.3 Document Review

Historic and archival research included information obtained from the UH Hamilton Library, the State Historic Preservation Division Library, the Hawai‘i State Archives, the State Survey Office, and the Archives of the Bishop Museum. Previous archaeological reports for the area were reviewed, as were historic maps and primary and secondary historical sources.

2.4 Consultation

Hallett H. Hammatt, Ph. D., Owen L. O’Leary, M.A., and Kēhaulani Souza, B.A. conducted a site visit of the two historic properties addressed in this report with Tom “Pohaku” Stone, M.A. Pacific Island Studies, and Shad Kane. The site visit took place on August 18, 2006

Mr. Stone is a cultural practitioner with expertise in *hōlua* sleds. He was consulted because of the ambiguous nature of SIHP # 50-80-12-6871. In his opinion the paved area on the ridge was not an *hōlua* slide. Extensive study and personal construction of Native Hawaiian-style terraces and walls, led Mr. Stone to conclude that the terrace face in SIHP # 50-80-12-6870 was of historic origin.

Shad Kane is a long time member of the Nature Conservancy, the ʻAhahui Sivila Hawaiʻi O Kapolei Hawaiian Civic Club, and the Makakilo/Kapolei/Honokai Hale Neighborhood Board. He has worked with the noted Kumu Hula John Kaʻimikaua on the establishment of a cultural center below Puʻuokapolei. Like Mr. Stone, Mr. Kane felt that the terrace at SIHP # 50-80-12-6870 was historic in origin. He did note that the water sources would have made the historic property an important site for Native Hawaiian people who were traveling between the coast and the *mauka* villages.

No additional historic properties were identified as a result of the cultural consultations, but the information provided by Mr. Stone was helpful in eliminating one possible function of SIHP # 50-80-12-6871.

As requested by the State Historic Preservation Division in a letter dated December 27, 2006, a copy of a summary of findings has been sent to the Office of Hawaiian Affairs for consultation (Appendix B). Consultation is a requirement to necessary to comply with HAR Chapter 13-284-6 since sites 6870 and 6871 are both eligible under criterion E.

Section 3 Background Research

3.1 Traditional and Historical Background

3.1.1 Prehistory and Early History

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

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

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

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

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

> Koʻolina is in Waimānalo near the boundary of ʻEwa and Waiʻanae. This was a vacationing place for chief Kākuhihewa and the priest Napuaikamao was the caretaker of the place. Remember reader, this Koʻolina is not situated in the Waimanalo on the Koʻolau side of the island but the Waimanalo in ʻEwa. It is a lovely and delightful place and the chief, Kākuhihewa loved this home of his (in Sterling and Summers 1978:41).

John Papa ʻĪʻī describes a network of Leeward Oʻahu trails which in later historic times encircled and crossed the Waiʻanae Range, allowing passage from West Loch to the Honouliuli lowlands, past Puʻu Kapolei and Waimānalo Gulch to the Waiʻanae coast and onward circumscribing the shoreline of Oʻahu (ʻĪʻī, 1959:96-98). Following ʻĪʻī's description, a portion of this trail network would have passed along the southern boundary of the project area, roughly running along the present Farrington Highway.

Other early historical accounts of the general region typically refer to the more populated areas of the ‘Ewa District, where missions and schools were established and subsistence resources were perceived to be greater. However, the presence of archaeological sites along the barren coral plains and coast of southwest Honouliuli Ahupua‘a, as well as those identified within the present study area along the slopes of the Wai‘anae Range, indicate that pre-contact and early historic populations also adapted to these less inviting areas, despite the environmental hardships.

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

1) "early", c. 1790:

Prickly pear cactus, *Opuntia tuna*

Haole koa, *Leucaena glauca*

Guava, *Psidium guajava*

2) 1835-1840

Burmuda [sic] grass, *Cynodon dactylon*

Wire grass, *Eleusine indica*

3) Lantana, *Lantana camara*

The *kiawe* tree was also introduced during this period, either in 1828 or 1837 (Frierson 1972: 11).

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

3.1.2 Mid to late 19th Century

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

Samuel Kamaukau relates the following about Kekau‘onohi as a child:

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

Kekau'onohi was one of Liholiho's (Kamehameha II's) wives, and after his death, she lived with her half-brother, Luanu‘u Kahala‘i‘a, who was governor of Kaua‘i (in Hammatt and Shideler 1990: 20). Subsequently, Kekau‘ōnohi ran away with Queen Ka‘ahumanu's stepson, Keli‘i-ahonui, and then became the wife of Chief Levi Ha‘alelea. Upon her death on June 2, 1851, all her property was passed on to her husband and his heirs. When Levi Ha‘alelea died the property went to his surviving wife, who in turn leased it to James Dowsett and John Meek in 1871 for stock running and grazing.

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

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

Ewa Plantation Co. grew quickly and continued in full operation up into modern times. As a means to generate soil deposition on the coral plain and increase arable land in the lowlands, the Ewa Plantation Co. installed ditches running from the lower slopes of the mountain range to the lowlands and then plowed the slopes vertically just before the rainy season to induce erosion (Frierson 1972:17). Two ditches, which were likely used for this procedure, are still present along the southern boundary of the project area.

3.1.3 Modern Land Use

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

3.2 Previous Archaeological Research

The coral plains of ‘Ewa have been the focus of more than 50 archaeological studies over the last two decades, largely as the result of required compliance with county, state, and federal legislation. The Kalaeloa (Barber’s Point) area is one of the most studied places in Polynesia (Figure 4). Those studies will not be reviewed in detail in this inventory survey addendum. This addendum will focus on the few studies that comprise the small amount of research that has been conducted along the southern slopes of the Wai‘anae Range.

The earliest attempt to record archaeological remains in Honouliuli Ahupua‘a was made by Thomas Thrum (1906) (Table 1). He reports the existence of a *heiau* located on Pu‘u Kapolei, approximately 1 mile (1.6 km) southeast of the current project area. Pu‘u Kapolei Heiau is described as “Ewa-size and class unknown. Its walls thrown down for fencing” (Thrum 1906:46).

In his surface survey of 1930, archaeologist J. Gilbert McAllister recorded the specific locations of important sites, and the general locations of less important sites (at least at Honouliuli). Archaeological investigations by McAllister along the southern slopes of the Wai‘anae Range identified a number of sites that are of interest.

McAllister documents Pu‘u Kapolei Heiau as Site 138 and notes:

> The stones from the heiau supplied the rock crusher which was located on the side of this elevation, which is about 100 feet away on the sea side. There was formerly a large rock shelter on the sea side where Kamapuaa (the pig-god) is said to have lived with his grandmother (Kamaunuaniho). (McAllister 1933:108)

McAllister's Site 136 is located near Mauna Kapu, northwest of the current project area, and is described as a small platform on the ridge dividing the ‘Ewa and Wai‘anae districts. The 4 to 6 square foot platform was constructed of coral and basalt stones, and was believed to be an altar (McAllister 1933:107). It is noted to have been destroyed by the time of Sterling and Summers’ work in the late 1950’s (Sterling and Summers 1978:32).

McAllister’s Site 137 is at Pu‘u Ku‘ua, a prominent landmark 1.8 miles (2.9 km) north of the current project area. Pu‘u Ku‘ua Heiau is described by McAllister as:

> (Destroyed) The heiau was located on the ridge overlooking Nanakuli as well as Honouliuli at the approximate height of 1800 feet. Most of the stones of the heiau were used for a cattle pen located on the sea side of the site. The portion of the heiau which has not been cleared for pineapple has been planted in ironwoods. (McAllister 1933:32)

The presence of Pu‘u Ku‘ua *heiau*, provides some archaeological evidence of the Pu‘u Ku‘ua settlement described in the Hawaiian Newspaper “*Ka Loea Kalai‘āina*”.

None of these sites are in the immediate vicinity of the current project area. However, the presence of extant or former archaeological remains demonstrates Hawaiian use of these *mauka* lands.

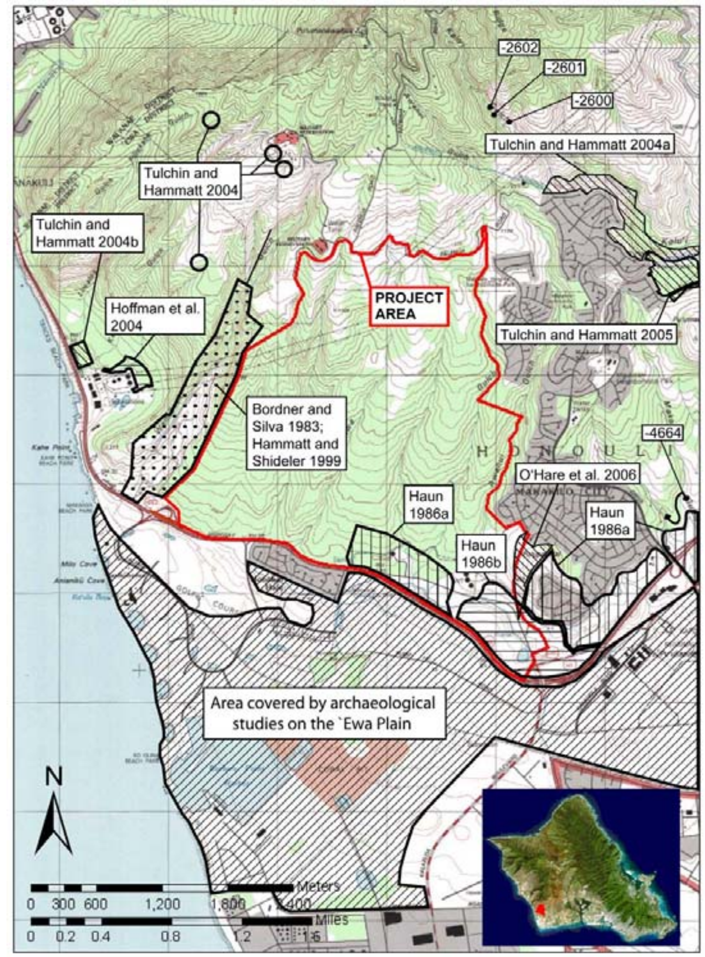

Figure 4. A portion of the 1998 ‘Ewa USGS 7.5-minute topographic quadrangle showing the current project area and previous archaeology completed in the vicinity

Table 1. Previous Archaeological Investigations in the Uplands of Honouliuli Ahupua‘a

Reference	Type of Investigation	General Location	Findings
Bordner 1977a	Archaeological Reconnaissance	Proposed Makaīwa Gulch Landfill Site	No archaeological sites identified
Bordner 1977b	Archaeological Reconnaissance	Proposed Kalo‘i Gulch Landfill Site	3 sites (-2600, -2601, -2602), low stacked boulder walls
Bordner and Silva 1983	Archaeological Reconnaissance and Historical Documentation:	Proposed Waimānalo Gulch Landfill Site	No archaeological sites identified
Sinoto 1988	Archaeological Reconnaissance	Makakilo Golf Course	low stacked boulder wall (-1975)
Bath 1989	Petroglyph Documentation	Waimānalo Gulch	3 petroglyphs (-4110)
Hammatt et al. 1991	Archaeological Inventory Survey	Makaīwa Hills Project Site	34 sites, including pre-contact habitation and agricultural features, rock shelters, petroglyphs, *ahu*, and various sugar cane cultivation infrastructure
Hammatt 1992	Archaeological Inventory Survey	KAIM Radio Tower, Pālehua	No archaeological sites identified
Nakamura et al. 1993	Archaeological Inventory Survey	Makakilo D and D-1 Development Parcels	cement irrigation flume (-4664)
Borthwick 1997	Archaeological Assessment	Satellite Multi-Ranging Station, Pālehua	No archaeological sites identified
Dega et al. 1998	Archaeological Inventory Survey	UH West O‘ahu	Two historic site complexes, (50-80-08-5593 historic irrigation system and 50-80-09-2268 Waiahole Ditch System)
Hammatt and Shideler 1999	Archaeological Inventory Survey and Assessment	Waimānalo Gulch Sanitary Landfill Project Site	Battery Arizona Complex and modern “shrine” site
Hoffman et al. 2004	Archaeological Assessment	30 acres next to the Kahe Power Plant	No historic properties
Tulchin and Hammatt 2004	Archaeological Field Inspection	North of Waimānalo Gulch	Three pre-contact archaeological features

Reference	Type of Investigation	General Location	Findings
Tulchin and Hammatt 2004a	Archaeological Inventory Survey	86 acres in Kalo‘i Gulch	4 historic era sites: concrete and iron structures (-6680), boulder clearing mounds (-6681), small terrace (-6682), and a portion of the Waiāhole Ditch (-2268)
Tulchin and Hammatt 2004b	Archaeological Inventory Survey	24 acres next to the Kahe Power Plant	4 sites (-6647 to -6650): predominantly historic ranching era related ruins
Tulchin and Hammat 2005	Archaeological Inventory Survey	71 acres north of Pu‘umakakilo	3 sites: pre-contact agricultural alignment and mound (-6666), plantation-era boulders walls and ditch (-6667), and a pre-contact agricultural terrace (-6668)

Recent archaeological investigations in the southern Wai‘anae Range have generally been focused on deep gulch areas for potential landfill locations, lower slopes for residential development, and mountain peaks for antennae or satellite tracking infrastructure (Table 1).

Relatively few archaeological sites have been located by archaeological studies made in the vicinity of the current project area (Figure 4). Kalo‘i Gulch, which borders the northern portion of the current project area, was also surveyed as a potential landfill location (Bordner 1977b). The archaeological reconnaissance survey included lands within Kalo‘i Gulch and its smaller tributaries from the *makai* end of the gulch up to the 1,400 ft elevation. It was noted that lands at the base of the gulch, *makai* of an historic quarry, were extensively modified by bulldozing. In the *mauka* portions of the project area, three sites, possibly pre-contact, were identified (Figure 4). The three historic properties (50-80-12-2600, -2601, -2602) consisted of low stacked basalt boulder walls located along the north side of the Kalo‘i Stream channel.

During the initial archaeological survey of the lower portions of Waimānalo Gulch (the future site of the Waimānalo Gulch Sanitary Landfill), up to the 430-foot elevation, no archaeological sites were identified (Bordner and Silva 1983). In 1989, three petroglyph units (historic property 50-80-12-4110) were located within the previously surveyed parcel (Bath 1989). Historic property 50-80-12-4110 is located in the southwest corner of Waimānalo Gulch, at approximately 80 ft. elevation.

Further archaeological study within Waimānalo Gulch was conducted for the expansion of the sanitary landfill (Hammatt and Shideler 1999). No archaeological sites were located with the project area, however two sites, the Battery Arizona bunker complex and a modern “shrine” site, were observed along the northern ridge which separates Waimānalo Gulch from the HECO Kahe Power Plant property. The stones of the “shrine” site were understood to have been previously relocated from the central portion of Waimānalo Gulch circa 1988.

Makaīwa Gulch, the next major gulch east of Waimānalo Gulch was also surveyed as a potential landfill location (Bordner 1977a). The reconnaissance survey included lands within Makaīwa Gulch from Farrington Highway, *mauka* to the approximate 1000 ft (305 m) elevation. No significant archaeological sites were identified.

Archaeological studies relevant for the current project area are two reports by Alan Haun of the archaeological firm Paul H. Rosendahl, Inc. (PHRI). The first is a letter report entitled *Preliminary Archaeological Reconnaissance Survey for Environmental Assessment (EA) ‘Ewa Town Center/ Secondary Urban Center, Land of Honouliuli, ‘Ewa, Island of Oahu (TMK: 9-1-15: Por. 4, 5, 17; 9-1-16:1, Por. 4, 6, 9, 16, 18, 24, 30: 9-2-19: Por. 1)* (Haun 1986a). This study covered a petition area of approximately 1,400 acres, and extends into the *makai* portion of the current project area (Figure 4). The second is *Preliminary Archaeological Reconnaissance Survey for Environmental Assessment (EA) ‘Ewa Town Center/ Secondary Urban Center, Land of Honouliuli, ‘Ewa, Island of Oahu* (*TMK: 9-1-15: Por., 5, 17; 9-1-16:Por. 9)* (Haun 1986b). This study covered a petition area of approximately 200 acres and overlaps the southeast corner of the current project area (Figure 4).

The Haun studies note the extensive modification for sugarcane cultivation and conclude that only two sites had been previously reported in the vicinity: the OR&L alignment (SIHP 50-80-12-9714) well to the south of the current project area and the *heiau* and large rock shelter recorded by McAllister (1933) on Pu‘uokapolei (SIHP 50-80-12-138). Pu‘uokapolei was outside of the Haun study area and was not checked by him during his field survey. Haun identified two sites within the current project area: an irrigation ditch (a portion of the same SIHP 50-80-12-4341 identified during the 200-acre survey), and a rock wall that paralleled the irrigation ditch. This wall was later designated Site 50-80-12-4314. Both of these historic properties were later addressed by Hammatt et al. (1991) and found to be non-significant.

In 1990 Cultural Surveys Hawaii was requested by William E. Wanket Inc., Land Use Consultant for the Estate of James Campbell, to undertake an archaeological inventory survey for the approximately 1,780.705-acre proposed Makaīwa Hills development project (TMK 9-1-15: 5, 11, 17; 9-1-16: Portion 9; 9-2-03: Portion 2) located in the *ahupua‘a* of Honouliuli, ‘Ewa, Island of O‘ahu. The archaeological inventory survey (Hammatt et al. April 1991) was reviewed and approved by the State Historic Preservation Division.

The survey and limited testing were conducted between September 24 and late October, 1990. During the fieldwork, 34 historic properties were located, including habitation structures (permanent and temporary), agricultural features (terrace and mounds), rock shelters, a possible rock shelter quarry, petroglyphs, *ahu*(s) and various other structures associated with sugarcane cultivation attributable to the ‘Ewa Plantation Company.

Eighteen of the 34 recorded historic properties were considered "likely to yield information important to prehistory and history". Of these 18 historic properties, four were also evaluated as an excellent example of a site type. Thus, it was recommended that all of the 17 historic properties that were considered significant be subjected to a program of subsurface testing followed by intensive excavation of selected sites to address scientific/informational significance preceding developmental impact and removal of sites. It was additionally recommended that the four sites evaluated as excellent site types be considered for preservation pending results of

subsurface testing. SIHP # 50-80-12-2893, already recommended for preservation, is no longer in the project current area.

Of the 34 historic properties, sixteen, including structures associated with the Ewa Plantation Company, historic cattle walls and various other amorphous and disturbed mounds and *ahu*(s), were considered to be no longer significant and were not recommended for further work. Detailed data recovery and preservation plans were called for to be prepared and submitted to the State Historic Preservation Office (DLNR) for review and approval.

Surface collection took place in only a handful or historic properties. Only two 50 cm square test units were excavated and no radiocarbon samples were submitted for dating.

Archaeological inventory survey of the Makakilo D and D-1 Development Parcels included lands on the southern and western slopes of Pu‘u Makakilo, adjacent to the golf course property. A single historic property, a cement irrigation flume (SIHP # 50-80-12-4664), was located in the southern portion of the project area near the H-1 Freeway (Nakamura et al. 1993).

Tulchin and Hammatt (2004a) conducted an inventory survey of the approximately 86-acre proposed Pālehua Community Association (PCA) Common Areas on the northwestern side of Makakilo. The elevation of that project area (approximately 400-1100 ft) makes it comparable to the present project area. Historic sites located during the inventory survey included: a complex of concrete and iron structures associated with industrial rock quarry operations (SIHP # 50-80-12-6680); three boulder mounds believed to be related to land clearing or ditch construction by the O‘ahu Sugar Co. (SIHP # 50-80-12-6681); a small terrace believed to function as an historic water diversion feature (SIHP # 50-80-12-6682); and a remnant portion of the Waiāhole Ditch (SIHP # 50-80-09-2268). No pre-contact historic properties were identified.

A parcel of land adjacent to the Kahe Power Plant was the subject of an archaeological inventory survey (Tulchin and Hammat 2004b). Four historic properties were identified. The first (SIHP # 50-80-12-6647), consists of a ranch-related stacked limestone slab wall, an agricultural terrace, and a possible fishing shrine. The second (SIHP # 50-80-12-6648) includes three cement, brick and dressed basalt boulder ruins related to an historic structure. The third (SIHP # 50-80-12-6649) is an historic water diversion wall. The fourth (SIHP # 50-80-12-6650) comprises a collection of predominantly limestone boulder and cobble agricultural mounds and platforms.

An additional 30 acres adjacent to the Kahe Power Plant were the subject of an archaeological assessment (Hoffman et al. 2004). No historic properties were discovered.

Tulchin and Hammatt (2004) undertook a field inspection of four locations to the north of Waimanalo Gulch. Three small stone features were identified: an *ahu*, a stone terrace, and a small C-shape. An archaeological inventory survey was recommended should any construction activities be proposed for those parcels of land.

Tulchin and Hammat (2005) conducted an additional inventory of a 71-acre parcel adjoining the PCA which had been previously surveyed. Three historic properties were identified. SIHP # 50-80-12-6666 is a pre-contact agricultural alignment and mound. SIHP # 50-80-12-6667 consists of plantation-era stacked basalt boulder walls and a ditch. SIHP # 50-80-12-6668 is made up of two features: a single alignment of upright basalt boulders and a small, low terrace. Both features were thought to be pre-contact agricultural features.

Section 4 Results of Fieldwork

This section describes SIHP #s 50-80-12-6870 and 50-80-12-6871, along with the excavations undertaken within them. The location of the two historic properties within the project area can be seen in Figure 5.

4.1 SIHP # 50-80-12-6870

FORMAL TYPE:	Terrace, springs, and a rock shelter
FUNCTION:	Animal Husbandry
AGE:	Pre-contact and historic
# OF FEATURES:	5 (A-E)
DIMENSIONS:	42 m northeast/southwest by 8 m northwest/southeast
LOCATION:	*Mauka*/north corner of the project area
CONDITION:	Excellent

DESCRIPTION:

SIHP # 50-80-12-6870 is located halfway up the west side of an unnamed gulch at the southern end of the Waianae Mountains. The gulch eventually joins Makaīwa Gulch farther down the slope of the Makaīwa Hills. The sides of the gulch are steeply sloped and the area is dominated by invasive grasses and burnt *koa haole* trees. SIHP # 50-80-12-6870 is located approximately 50 m down the gulch from SIHP # 50-80-12-4313. SIHP # 50-80-12-6871 is located along the ridge top directly to the west of SIHP # 50-80-12-6870.

SIHP # 50-80-12-6870 is comprised of five features (Figure 6): Feature A is a terrace; Features B, C, and D are freshwater springs; and Feature E is a small rock shelter. The presence of the naturally occurring springs in the dry leeward portion of O‘ahu is the likely reason why the terrace was constructed. The historic property measures 42 meters in a northeast/southwest direction and 8 meters in a northwest/southeast direction.

4.1.1 Feature A

Feature A is a historic single-tiered terrace that extends for approximately 40 m (Figure 7). The level earthen filled terrace is created by a faced retaining wall down slope of the three springs. The terrace face, which incorporates bedrock outcrops extends for 32 m and has a maximum height of 1.4 meters. The terrace encompasses approximately 200 m^2 between the terrace face and a large basalt outcrop.

The wall is constructed from tightly fitting and occasionally interlocked basalt boulders that are stacked between 3 and 7 courses high. The boulders range in size from 10x10x5 cm to 80x60x20 cm. Many of the rocks are tabular in shape and have been placed in a horizontal position. The edges of some of the rocks exhibit evidence of intentional flaking to modify their

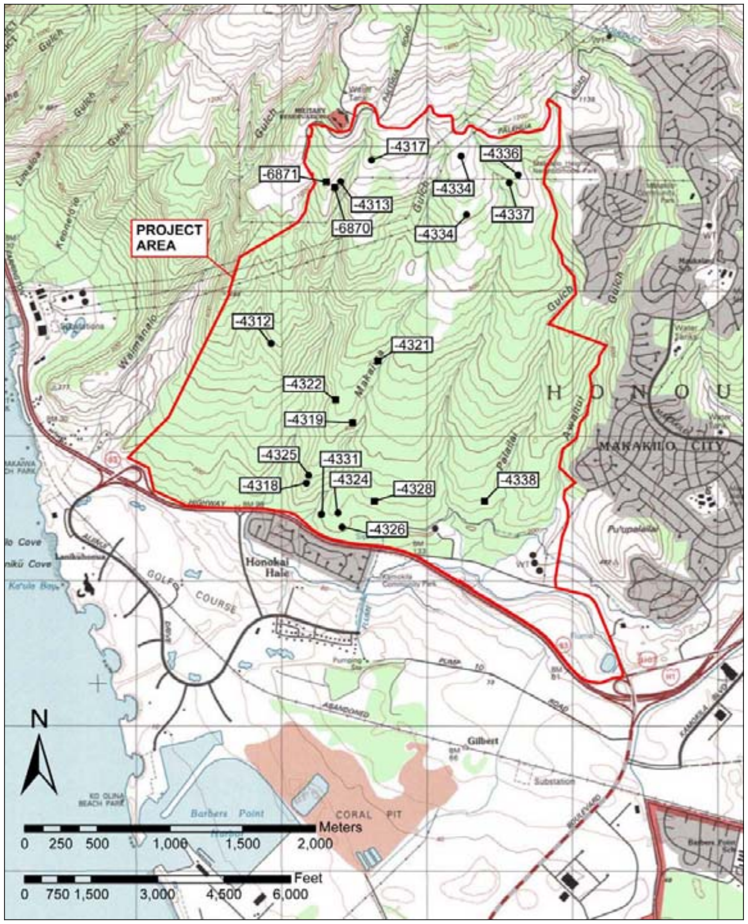

Figure 5. A portion of the 1998 ‘Ewa USGS 7.5-minute topographic quadrangle showing the project area and the locations of the historic properties within it that are slated for data recovery (circles and squares) and preservation (squares); all SIHP #s are be proceeded with 50-80-12

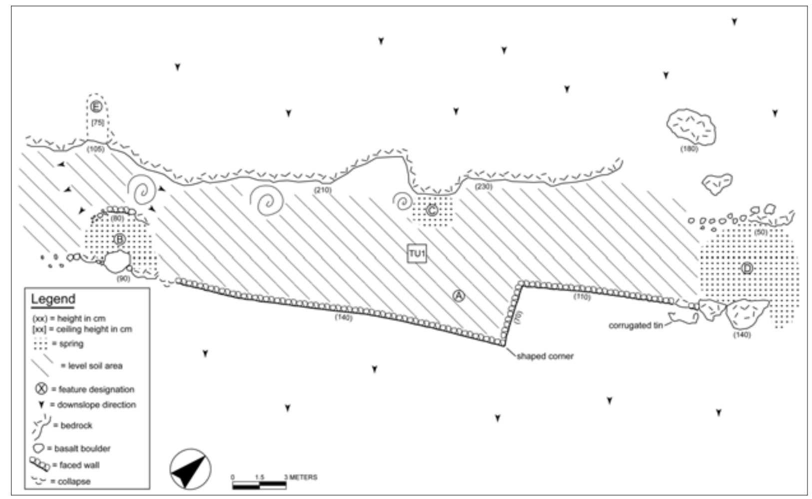

Figure 6. Plan view map of SIHP # 50-80-12-6870 showing features A through E

shape for a more precise fit in the terrace wall. The best example of this is the outward "shaped corner" (Figure 6 and Figure 7) where all five courses of stones are closely aligned.

The wall has suffered a small amount of collapse due to sediment that has pushed some of the upper most rocks in the terrace wall off the top and down onto the downward slope. A rusted piece of corrugated sheet metal is located just down slope of the northeast end of the terrace wall.

4.1.2 Feature B

All three of the springs in SIHP # 50-80-12-6870 can be characterized as slow freshwater seeps that only produce enough water to create a little mud and cause the immediately adjacent tufts of invasive grasses to turn green. Cattle have heavily disturbed the sediments at all three springs.

Feature B is the southwest most spring in SIHP # 50-80-12-6870. It is 4 m by 3 m (Figure 8) and is situated just east of a slightly raised portion of the terrace in front of the small rockshelter (Feature E) that is part of SIHP # 50-80-12-6870 (Figure 6).

4.1.3 Feature C

Feature C is the smallest of the three springs, measuring 2.5 m by 1.5 m (Figure 9). It is centrally located within SIHP # 50-80-12-6870 at the base of the large bedrock outcrop (Figure 6).

4.1.4 Feature D

Feature D, located at the northeastern end of SIHP # 50-80-12-6870 is the largest of the three springs. It is 5.5 m by 5.0 m (Figure 10). This spring has undergone the most cattle disturbance because the cows have to walk through it access the other two springs if they come from the *mauka* end of the historic property.

4.1.5 Feature E

Feature E is a small natural rockshelter located in the southwest corner of SIHP # 50-80-12-6870 (Figure 6) immediately to the west of a raised portion of the terrace (Feature A). The rock shelter is 1.3 m wide at the opening, 2.5 meters deep, and has an interior height of 75 cm. There was no evidence of cultural material on the soil surface of the floor of the rockshelter.

4.1.6 Summary

SIHP # 50-80-12-6870 is comprised of four naturally occurring features – three springs and a rock shelter – and a historically constructed retaining wall that forms a large level terrace. The historic property is in excellent condition and retains a high degree of integrity. The site has likely served as a water source for animals and people for a long time. The terrace was likely constructed during the ranching period to allow easier access for cattle. The site is significant under criteria D (information content) and E (importance to Native Hawaiians) of the HAR 13-284-6.

Figure 7. Photograph showing a portion of SIHP # 50-80-12-6870, Feature A and the shaped corner; view to the southwest

Figure 8. Photograph showing SIHP # 50-780-12-6870, Feature B; view to the northeast

Figure 9. Photograph showing SIHP # 50-780-12-6870, Feature C; view to the north

Figure 10. Photograph showing SIHP # 50-780-12-6870, Feature D; view to the south

4.1.7 Subsurface Testing

A single 1 m by 1 m test unit was excavated in the soil surface of Feature A adjacent to Feature C (Figure 6). The location for the test unit was chosen because the presence of water might have served as a reason for Native Hawaiians to frequent the area. The location was also chosen to examine the stratigraphy of the sediments retained by the terrace wall.

Two layers of sediment were present in the test unit (Figure 11 and Figure 12). The upper-most was clay silt that has undergone substantial soil formation processes. The lower stratigraphic layer was silty clay with lesser soil formation. This layer likely has a higher clay percentage due the filtering of the smaller particles down through the sediment column. This lower layer ended on natural, highly decomposed, bedrock (Figure 13). Complete details of the stratigraphy are presented below.

Stratum I: 0-22 cmbs	A Horizon; 10 YR 3/3, dark brown; clay-silt; strong, course blocky structure, slightly hard dry consistency; plastic; no cementation; clear smooth lower boundary. No cultural materials were found in this stratum.
Stratum II: 22-37 cmbs	B Horizon; 10YR 4/4, dark yellowish brown; silty clay; moderate medium crumb structure, weakly coherent dry consistency; slightly plastic; no cementation. Small amounts of pig bone and tooth fragments were found in this layer. This layer terminates on extremely corroded bedrock.

Twenty-one pieces of highly weathered pig long bone shaft fragments (15.1g) were discovered near the bottom of the sediment. Two fragments (2.1g) of pig tooth were also found. The absence of any signs of human modification to the bones combined with the lack of any other evidence of human activity suggests that the presence of the bones is most likely the result of natural causes.

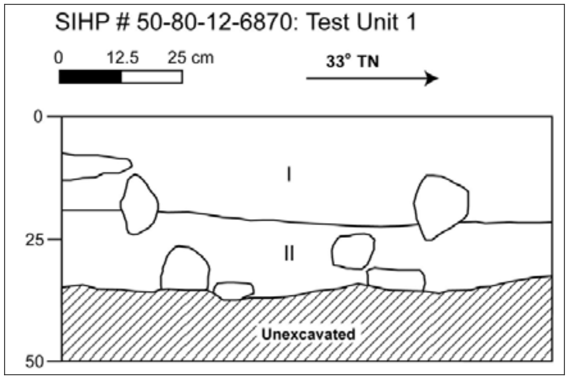

Figure 11. Profile of the northwest wall of Test Unit 1 in SIHP # 50-80-12-6870

Figure 12. Photograph of the profile of the northwest wall of Test Unit 1 in SIHP # 50-80-12-6870; view to the northwest

Figure 13. Photograph showing the end of excavation of Test Unit 1 in SIHP # 50-80-12-6870, Feature A; view to the northeast

4.2 SIHP # 50-80-12-6871

FORMAL TYPE: Paved Area

FUNCTION: Indeterminate

AGE: Pre-contact

 # OF FEATURES: 1

DIMENSIONS: 42 m northeast/southwest by 8 m northwest/southeast

LOCATION: *Mauka*/north corner of the project area

CONDITION: Poor

DESCRIPTION:

SIHP # 50-80-12-6871 is located in the *mauka*/west corner of the Makaīwa Hills project area. It is the western-most historic property in the project area. SIHP # 50-80-12-6871 rests atop a ridge between two gulches. It is situated where the slope shifts from very gradual to a steeper grade. The location of the site affords commanding views of the western half of the ‘Ewa Plain including Barber’s Point, Deep Draft Harbor, Ko‘olina, Kapolei, and Pu‘u Palailai.

SIHP #s 50-80-12-4313 and 50-80-12-6870 are located in the gulch immediately to the east of ridge that SIHP # 50-80-12-6871 sits on. An abandoned military reservation is located to the west of the historic property.

SIHP # 50-80-12-6871 is comprised of basalt boulders and large cobbles that have been placed to form a rough pavement on the ridge top (Figure 14). The presence of rocks in this area differs from the rest of the ridge where there are no clusters of stones. The pavement extends along the ridge top for approximately 45.0 m in a 21°/201° direction and 6.0 m in a 135°/315° direction.

The rocks that make up the historic property vary in size from variously shaped 10x10x10 cm cobbles to large flat tabular stones, some of which are 100x70x20 cm. Except for the stones that have been disturbed by the bulldozing, most of the stones are relatively level with the ground’s surface resulting in a paved effect.

SIHP # 50-80-12-6871 has been heavily disturbed by bulldozer activity (Figure 14). Both the east and west sides of the pavement have been completely removed by bulldozing, resulting in the inability to tell how wide the historic property originally was. The two bulldozed cuts converge at the *makai* end of the historic property, so it is also not possible to determine total length. Only 6.6 m of the original edge of the historic property can be observed along the northern/*mauka* portion of the site. There is no evidence of erosion within the historic property itself, but a large section of erosion has occurred in the bulldozed road cut to the east of the historic property (Figure 14).

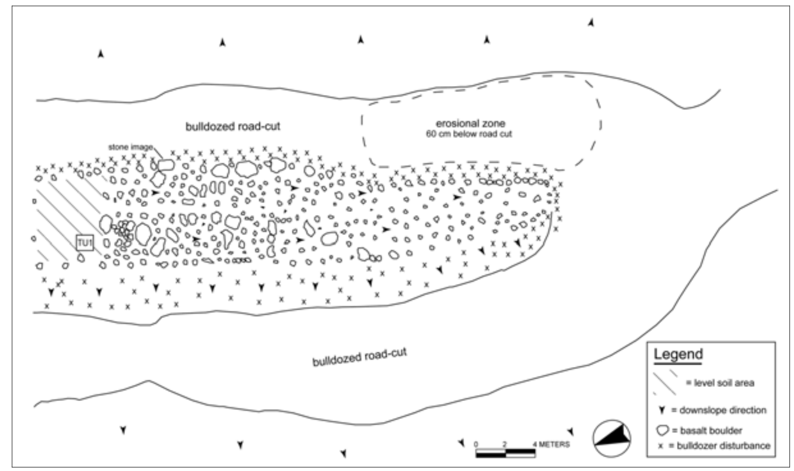

Figure 14. Plan view map of SIHP # 50-80-12-6871

Figure 15. Photograph showing SIHP # 50-80-12-6871; view to the north

Figure 16. Photograph showing SIHP # 50-80-12-6871; view to the south

4.2.1 Stone Image

Cultural consultants and CSH personnel identified one of the stones in the historic property as a stone image. It is located along the eastern edge of the historic property. It measures 75x60x40 cm. It has a water worn *puka* and several other water worn channels in the upward facing surface (Figure 17). It is possible that this is one of the stones discussed in the legend of Two Old Women who Turned to Stone *(Ka Loea Kālai‘āina*).

The Hawaiian language newspaper *Ka Loea Kālai‘āina* relates that near Pu‘uokapolei, on the plain of Pukaua, on the *mauka* side of the road, there was a large rock. The legend is as follows:

> There were two supernatural old women or rather peculiar women with strange powers and Pu‘ukaua belonged to them. While they were down fishing at Kualaka‘i [near Barbers Point] in the evening, they caught these things, ‘*a‘ama* crabs, *pipipi* shellfish, and whatever they could get with their hands. As they were returning to the plain from the shore and thinking of getting home while it was yet dark, they failed for they met a one-eyed person [bad omen]. It became light as they came near to the plain, so that passing people were distinguishable. They were still below the road and became frightened lest they be seen by men. They began to run - running, leaping, falling, sprawling, rising up and running on, without a thought of the *‘a‘ama* crabs and seaweeds that dropped on the way, so long as they would reach the upper side of the road. They did not go far for by then it was broad daylight. One woman said to the other, “Let us hide lest people see us,” and so they hid. Their bodies turned into stone and that is one of the famous things on this plain to this day, the stone body. This is the end of these strange women. When one visits the plain, it will do no harm to glance on the upper side of the road and see them standing on the plain. (*Ka Loea Kālai‘āina,* January 13, 1900)

4.2.2 Summary

SIHP # 50-80-12-6871 is a paved area located on a promontory of a ridge at the southern end of the Wai‘anae Mountains. The historic property is comprised of primarily large tabular basalt boulders that form an elongated paved area. The construction technique and absence of any historic artifacts suggest that the site was pre-contact construction. This site is unique in nature and CSH is unaware of any other site like it on O‘ahu.

The site’s proximity to the spring in the gulch to the east and it’s prominent location on the ridge suggest many possible functions for the site. It could have served as a trail marker, a resting place for people traveling from the coast to *mauka* villages, possibly even a religious function. Tom “Pohaku” Stone confirmed that the historic property was not an *hōlua* slide. The historic property also contains a stone image that is spoken about in the oral traditions of this portion of Honouliuli Ahupua‘a.

Based upon the site’s location, uniqueness, reference in oral traditions, and proximity to other historic properties on the landscape, SIHP # 50-80-12-6871 is significant under criteria D (information content) and E (importance to Native Hawaiians).

Figure 17. Photograph of the stone image (75x60x40 cm) that is incorporated into SIHP # 50-80-12-6871

4.2.3 Subsurface Testing

A single 1 m by 1 m test unit was excavated in the level soil surface at the *mauka* end of SIHP # 50-80-12-6871 (Figure 14). Two layers of fine-grained clay-silt characterized the sediments in the excavation (Figure 18 and Figure 19). They differed in that the upper layer had undergone soil formation processes, and the lower layer had not. Complete details of the stratigraphy are presented below.

Stratum I: 0-18 cmbs	A Horizon; 10 YR 4/3, brown; clay-silt; moderate medium blocky structure, weakely coherent dry consistency; plastic; no cementation; clear smooth lower boundary. No cultural materials were found in this stratum. Numerous small basalt cobbles were contained in this layer.
Stratum II: 22-37 cmbs	B Horizon; 10YR 4/3, brown; clay-silt; structureless, loose dry consistency; slightly plastic; no cementation. No cultural material was discovered in this stratum. This layer terminates on extremely corroded bed rock (Figure 20).

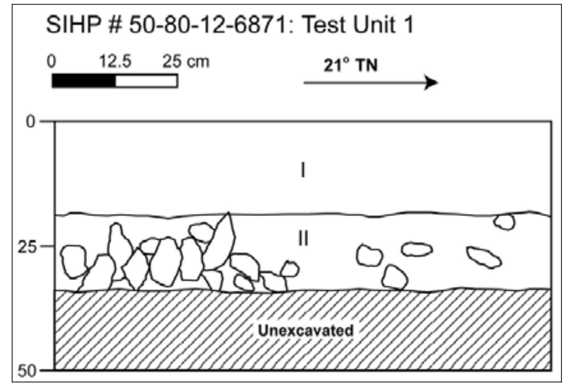

Figure 18. Profile of the west wall of Test Unit 1 in SIHP # 50-80-12-6871

Figure 19. Photograph of the profile of the west wall of Test Unit 1 in SIHP # 50-80-12-6871; view to the west

Figure 20. Photograph showing the end of excavation of Test Unit 1 in SIHP # 50-80-12-6871; view to the northeast

Section 5 Results of Laboratory Analysis

The vertebrate remains recovered from Stratum II of Test Unit 1 in SIHP # 50-80-12-6870 were identified in the CSH laboratory using skeletal comparative skeletal materials. Based upon morphology, density, and texture the 21 bone fragments (15.1 g) were identified as being pig (*Sus scrofa*). Two tooth fragments (2.1 g) were also identified as *S. scrofa*.

The remains do not exhibit any taphonomic traces of human modification such as stone tool marks or burning.

Section 6 Summary and Interpretation

At the request of Group 70 International, CSH has completed this archaeological inventory survey addendum for two historic properties within the Makaīwa Hills project area. The two historic properties were discovered during the relocation and assessment of 17 archaeological sites that were originally identified during a 1991 archaeological inventory survey (Hammatt et al. 1991).

The first site documented in this addendum is SIHP # 50-80-12-6870, a cluster of five features. The main feature is a historic ranching-era terrace. This terrace has been constructed to create a large level soil area in front of three natural springs. The final feature of the historic property is a small rockshelter. A single test unit was excavated in the terrace adjacent to one of the springs. Small amounts of naturally occurring S. scrofa remains were discovered.

The second site discussed in this report is SIHP # 50-80-12-6871. It is a paved area comprised of large tabular basalt boulders prominently positioned on a ridge top overlooking the western half of the 'Ewa Plain.

These two historic properties must be interpreted in a larger cultural landscape context. SIHP # 50-80-12-6870 would have served as a water source for Native Hawaiians working, living, and passing through the drier lower slopes of the Makaīwa Hills. SIHP # 50-80-12-6871 possibly functioned as a resting place, a trail marker, or possibly had a religious role. The excavation of a test unit did not reveal any further information regarding site function.

A more complete understanding of these two archaeological sites will be achieved through a further study of them, and the other historic properties both in and outside of the current project area.

Section 7 Significance Assessments

The inventory survey investigation and documentation of the two historic properties discussed in this archaeological inventory survey investigation have provided sufficient information for significance evaluations. Significance is determined after evaluation of each historic property in light of the five broad criteria used by the Hawai'i State Registers of Historic Places. The criteria are the following:

- A Historic property reflects major trends or events in the history of the state or nation.
- B Historic property is associated with the lives of persons significant in our past.
- C Historic property is an excellent example of a site type.
- D Historic property has yielded or may be likely to yield information important in prehistory or history.
- E Historic property has cultural significance to an ethnic group, including, but not limited to, religious structures, burials, and traditional cultural properties.

SIHP # 50-80-12-6870 is recommended eligible to the State Register of Historic Properties under criteria D and E. The presence of water in a normally dry section of the island would have served to attract both animals and people. As stated in a letter from the SHPD, December 27, 2006, "it is extremely unlikely that ancient Hawaiians following a traditional lifestyle would not have known about, and made use of, these springs. The fact that that they are small takes nothing away from their probable significance to Ancient Hawaiians, who were masters at utilizing seemingly marginal (according to modern standards) resources." This was also likely the closest water source for native Hawaiians who were working in the quarry rockshelter (SIHP # 50-80-12-4322) and living in the nearby rockshelters (SIHP #s 50-80-12-4319 and -4312) (See figure Figure 5). Further excavation will likely reveal more about human activity in the proximity of the springs.

SIHP # 50-80-12-6871 is recommended to the State Register under criteria D and E. It is located along a main trail route between *mauka* villages and religious sites and the ocean. It is also located in close proximity to the water sources at SIHP # 50-80-12-6870. The unique nature, prominent location, and potential for further understanding based upon future examinations of additional archaeological sites – even outside the current project area – make the potential for this site to yield valuable information very high.

The historic property's incorporation of a traditionally recognized stone image in this historic property and its prominent location lend weight to the possibility that this historic property may have a religious function. For these reasons SIHP # 50-80-12-6871 is recommended to the State Register under criteria E.

Table 2. Historic Property Summary Table for the Project Area Including Significance Assessments and Recommended Mitigation.

SIHP #	Property Description	Number of Features	Apparent Age	Recommended Significance Under Hawai'i Register Criteria	Mitigation Recommendation
50-80-12-6870	Terrace, Three Springs and a small Rockshelter	5	Pre-contact and Historic	D and E	Data Recovery and Preservation
50-80-12-6871	Paved Area	1	Pre-contact	D and E	Data Recovery and Preservation

Section 8 Project Effect and Mitigation Recommendations

8.1 Project Effect

The proposed Makaīwa Hills project is a residential development with supporting commercial uses, infrastructure and open space. Although specific details regarding the development within the project area are not available at this time, extensive disturbance is anticipated.

In light of this CSH recommends "effect, with agreed upon mitigation commitments" for the two historic properties discussed within this archaeological inventory survey addendum.

8.2 Mitigation Recommendations

As a form of mitigation for these two sites, CSH recommends, in agreement with Group 70 International and Makaīwa Hills LLC, that both sites be subjected to data recovery and subsequent preservation. Both of these sites will be included in the data recovery and preservation plans that are currently in preparation.

8.3 Disposition of Materials

The vertebrate materials collected from SIHP # 50-80-12-6870 will be stored in the CSH laboratory until the completion of the data recovery fieldwork. At that time all of the materials collected from investigations within the project area will be transferred to a permanent curation facility to be chosen in consultation with the landowner and SHPD.

Section 9 References Cited

Bath, Joyce
1989 *Waimanalo Gulch Petroglyphs*, SHPD, DLNR, State of Hawaii, Honolulu, HI.

Bordner, Richard M.
1977a *Archaeological Reconnaissance of the Proposed Makaiwa Gulch Landfill Site, ‘Ewa, O‘ahu,* Archaeological Research Center Hawai‘i, Inc.

1977b *Archaeological Reconnaissance of the Proposed Kalòi Gulch Landfill Site, ‘Ewa, O‘ahu Island*, Archaeological Research Center Hawai‘i, Inc.

Bordner, Richard M. and Carol Silva
1983 *Archaeological Reconnaissance and Historical Documentation: Waimanalo Gulch, Oahu, TMK:9-2-03:2,40,13 (por).*

Borthwick, Douglas
1997 *Archaeological Assessment for the proposed Ministry of Transportation Satellite Multi-Ranging Station (MTSAT-MRS) project site, Palehua, Honouliuli, Ewa, Oahu Island, Hawaii (TMK 9-2-3: por 2),* Cultural Surveys Hawai‘i, Kailua, HI.

Dega, Michael F., Randy Ogg, Michael T. Carson, and Leina‘ala Benson
1998 *An Archaeological Inventory Survey of the University of Hawai‘i West O‘ahu Campus, District of ‘Ewa, Island of O‘ahu, Hawai‘i (TMK 9-2-02:01, 9-2-02:03, 9-2-02:05),* Scientific Consultant Services, Honolulu, HI.

Frierson, Barbara
1972 *A Study of Land Use and Vegetation Change: Honouliuli, 1790-1925*, Manuscript prepared for Graduate Seminar in Geography (750), University of Hawaii, Honolulu.

Hammatt, Hallett H.
1992 *Archaeological Inventory Survey of Proposed K-A-I-M Radio Tower, Palikea, Honouliuli, ‘Ewa, O‘ahu (TMK 9-2-005:013 Portion),* Cultural Surveys Hawai‘i, Kailua, HI.

Hammatt, Hallett H., Jennifer J. Robins, Mark Stride and Matthew J. McDermott
1991 *An Archaeological Inventory Survey for the Makaiwa Hills Project Site, Honouliuli, ‘Ewa, O‘ahu* (April 1991) Cultural Surveys Hawai‘i Kailua, HI.

Hammatt, Hallett H. and David W. Shideler
1999 *An Archaeological Inventory Survey and Assessment for the Waimanalo Gulch Sanitary Landfill Project Site, Honouliuli, ‘Ewa, O‘ahu,* Draft, Cultural Surveys Hawaii, Kailua, HI.

1990 *Archaeological Inventory Survey of the West Loch Bluffs Project Site, Honouliuli, ‘Ewa, O‘ahu*, Cultural Surveys Hawaii, Kailua, HI.

Handy, E.S. Craighill and Elizabeth G. Handy
1972 *Native Planters in Old Hawaii: Their Life, Lore, and Environment*, Bishop Museum Bulletin 233, Honolulu.

Haun, Alan E.
1986a *Preliminary Archaeological Reconnaissance Survey for Environmental Assessment (EA) Ewa Town Center/Secondary Urban Center Land of Honouliuli, ‘Ewa, Island of O‘ahu, (TMK 9-1-15 and 9-1-16).* Paul H. Rosendahl, Ph.D., Inc., Hilo, Hawai‘i.

1986b *Preliminary Archaeological Reconnaissance Survey for Environmental Assessment (EA) Ewa Town Center/Secondary Urban Center Land of Honouliuli, Ewa, Island of Oahu, (TMK 9-1-15:Por. 5, 17: 9-1-16:Por. 9).* Paul H. Rosendahl, Ph.D., Inc., Hilo, Hawai‘i.

Haun, Alan E. and Marion Kelly
1984 *Research Design for an Archaeological Survey of Naval Communication Area Radio Transmission Facility, Lualualei; and Naval Air Station, Barbers Point, Oahu, Hawaii*, Dept. of Anthropology, Bishop Museum, Honolulu.

Hoffman, Tracy, Todd Tulchin, Hallett H. Hammatt
2004 *Archaeological Assessment of an Approximately 30-Acre Parcel Adjacent to the Kahe Power Plant, Honouliuli Ahupua‘a, ‘Ewa District, Island Of O‘ahu (TMK: 9-2-03:27),* Cultural Surveys Hawai‘i, Kailua, HI.

‘Ī‘ī, John Papa
1959 *Fragments of Hawaiian History*, Revised, Bishop Museum Press, Honolulu, HI.

McAllister, J. Gilbert
1933 *Archaeology of Oahu*. Bulletin 104. Bishop Museum: Honolulu.

Nakamura, Barry S., Jeffery Pantaleo, and Aki Sinoto
1993 *Archaeological Inventory Survey of Proposed Development Parcels D and D-1 Makakilo, Honouliuli, ‘Ewa, O‘ahu Island (TMK 9-2-3:18 por.; 75 por.; 81 por.),* Aki Sinoto Consulting, Honolulu, HI.

Native Register
1847-53 *Native Register of Kuleana Claims to Quiet Land Titles in the Hawaii Islands*, State of Hawaii Archives, Honolulu, HI.

Sinoto, Aki
1988 *Surface Survey of the Proposed Makakilo Golf Course, ‘Ewa, O‘ahu*, Bishop Museum, Honolulu, HI.

Sterling, Elspeth P. and Catherine C. Summers (comp.)
1978 *Sites of O`ahu*, Dept. of Anthropology, B.P. Bishop Museum, Honolulu.

Thrum, Thomas G.
1906 "Heiaus and Heiau Sites Throughout the Hawaiian Islands, in Thos. G. Thrum, compiler, *Hawaiian Almanac and Annual* for 1907, pp. 38-47, Honolulu, HI.

Tulchin, Jon and Hallett H. Hammatt
2004 *Archaeological Field Inspection for the Proposed HECO Meteorological Observation Stations, Honouliuli Ahupua‘a, ‘Ewa District, Island of O‘ahu (TMK: 9-2-03),* Cultural Surveys Hawai‘i, Kailua, HI.

Tulchin, Todd and Hallett H. Hammatt

2005 *Archaeological Inventory Survey Of the Approximately 71-AcreProposed Pālehua East B Project,Makakilo, Honouliuli Ahupua`a, 'Ewa District, Island of O'ahu (TMK: 9-2-03: 76 and 78),* Cultural Surveys Hawai'i, Kailua, HI.

2004a *Archaeological Inventory Survey Of the Approximately 86-Acre Proposed Pālehua Community Association (PCA) Common Areas Parcels, Makakilo, Honouliuli Ahupua'a, 'Ewa District, Island of O'ahu (TMK: 9-2-03: 78 por. and 79)* Cultural Surveys Hawai'i, Kailua, HI.

2004b *Archaeological Inventory Survey of an Approximately 24-Acre Parcel Adjacent to the Kahe Power Plant, Honouliuli Ahupua'a, 'Ewa District, Island of O`ahu (TMK: 9-2-03:27),* Cultural Surveys Hawai'i, Kailua, HI.

Appendix A SHPD Correspondence

Page 1 of 1

Owen O'Leary

From: Adam.M.Johnson@hawaii.gov
Sent: Tuesday, September 26, 2006 4:37 PM
To: ooleary@culturalsurveys.com
Subject: Maka'iwa Hill Project

Aloha Owen,

As per our telephone conversation earlier today, SHPD is requesting an addendum inventory survey for the Maka'iwa Hills project. We believe that the addendum AIS is necessary due to the recent identification of two new historic properties within the project area. The addendum AIS does not need to have an extensive background history, which is in the original AIS; but, we do ask that the previous archaeology section reflect the work that has occurred in the region in the interim between the original Maka'iwa Hill AIS and the current study (16 years). We will issue a site number for the pavement feature in a separate email. Also, because this site has been initially assessed as possibly being religious/ceremonial in function; we feel that it is eligible under criteria E as well as D.

Adam Johnson
Oahu Assistant Archaeologist
State Historic Preservation Division
601 Kamokila Blvd., Suite 555
Kapolei, HI 96707

10/18/2006

LINDA LINGLE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
STATE HISTORIC PRESERVATION DIVISION
601 KAMOKILA BOULEVARD, ROOM 555
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CONSERVATION AND RESOURCES ENFORCEMENT
ENGINEERING
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
KAHOOLAWE ISLAND RESERVE COMMISSION
LAND
STATE PARKS

December 27, 2006

Dr. Hallett H. Hammatt
Cultural Surveys of Hawai'i, Inc.
P.O. Box 1114
Kailua, Hawai'i 96734

LOG NO: 2006.4084
DOC NO: 0612amj09
Archaeology

Dear Dr. Hammatt:

SUBJECT: Chapter 6E-42 Historic Preservation Review –
Archaeological Inventory Survey Addendum for the Makaiwa Hills Project
Hono'uli'uli Ahupua'a, 'Ewa District, Island of O'ahu
TMK: (1) 9-1-015:005 (por.) & 017, 9-2-003:002 (por.), 005 (por.) & 084 (por.)

Thank you for the opportunity to review the aforementioned document, which we received on November 21, 2006. In an email correspondence from a member of our staff to Mr. Owen O'Leary dated September 26, 2006, we stated the following:

> …SHPD is requesting an addendum inventory survey for the Maka'iwa Hills project. We believe that the addendum AIS is necessary due to the recent identification of two new historic properties within the original AIS; but, we do ask that the previous archaeology section reflect the work that has occurred in the region in the interim between the original Maka'iwa Hills AIS and the current study (16 years)…

Two historic properties were documented during this addendum archaeological inventory survey: SIHP No. 50-80-12-6870, a historic terrace, three springs, and a small rockshelter; and, SIHP No. 50-80-12-6871, a paved area located on a ridge top. The latter site also includes a unique "stone image" that appears to be a rare, traditional occurrence.

We do not concur with your interpretation of Site 6870 as solely historic in age, as stated in your description of this site (p.20-23). According to your own text (p.23), "The site [6870] has likely served as a water source for animals and people for a long time." We believe the site should be interpreted as Pre-contact and historic in age, given the obvious importance of fresh water in this otherwise dry (leeward) setting. It is extremely unlikely that ancient Hawaiians following a traditional lifestyle would not have known about, and made use of, these springs. The fact that they are small takes nothing away from their probable significance to ancient Hawaiians, who were masters at utilizing seemingly marginal (according to modern standards) resources.

You have assessed Site 6870 as eligible for the State Register of Historic Places under criterion D. Given the almost certain Pre-contact usage of these three small springs, we believe this site should also be assessed as eligible under criteria E.

Page 2
Dr. Hammatt

You have assessed Site 6871 as eligible under criteria D and E. We concur with this assessment.

Also, according to HAR Chapter 13-284-6, the Office of Hawaiian Affairs (OHA) must be consulted regarding historic properties assessed as eligible under criterion E.

Given our lack of concurrence regarding your interpretation and assessment of Site 6780, and the need for additional consultation with OHA on both of these sites, we are unable, at this time, to comment on your proposed mitigation commitments. As soon as we receive a revised report, we will make every effort to expedite our review.

Please contact Mr. Adam Johnson (O'ahu Assistant Archaeologist) at (808) 692-8015 if you have any questions or concerns regarding this letter.

Aloha,

Melanie Chinen
Melanie Chinen, Administrator
State Historic Preservation Division

amj:

cc: Mr. Jesse Yorke, OHA

Appendix B OHA Correspondence

Cultural Surveys Hawai'i, Inc.
Archaeological and Cultural Impact Studies
Hallett H. Hammatt, Ph.D., President

P.O. Box 1114 • Kailua, Hawai'i 96734 • Ph.: (808) 262-9972 • Fax: (808) 262-4950
dshideler@culturalsurveys.com • www.culturalsurveys.com

January 22, 2007

Clyde Nāmu'o, Administrator
Office of Hawaiian Affairs
711 Kapi'olani Boulevard
Honolulu, HI 96813

Dear Mr. Nāmu'o:

A complementary copy of our archaeological inventory survey, *Archaeological Inventory Survey Addendum for the Maka'iwa Hills Project, Honouliuli Ahupua'a, 'Ewa District, O'ahu, TMK: [1] 9-1-015:005 por. and 017; 9-2-003:002 por., 005 por., and 084 por.*, is enclosed.

According to HAR chapter 13-284-6, and as per the preliminary SHPD review letter of December 27, 2006, the Office of Hawaiian Affairs must be consulted regarding historic properties assessed as eligible under criterion E.

Two historic properties recommended eligible to the State Register of Historic Properties under criteria D and E were identified during the survey. They are:

SIHP # 50-80-12-6870, a terrace, three springs, and a small rock shelter; and
SIHP # 50-80-12-6871, a paved area situated on a ridge top.

At site -6870, a single one-meter by one-meter test unit was excavated in the soil surface to a depth of 37 centimeters (14 ½ inches) below surface adjacent to the springs. Twenty-one pieces of highly weathered pig long bone shaft fragments (15.1 grams) were discovered near the bottom of the sediment. Two fragments (2.1 grams) of pig tooth were also found. The absence of any signs of human modification to the bones combined with the lack of any other evidence of human activity suggests that the presence of the bones is most likely the result of natural causes.

At site -6871, a single one-meter by one-meter test unit was excavated in the level soil surface to a depth of 37 centimeters (14 ½ inches) below surface at the *mauka* end of the paved area. No artifacts or cultural material were found.

Please call me with any questions or concerns you have about the location of the proposed project.

Sincerely,

David M. Shideler

David Shideler

Inventory Survey for the Maka'iwa Hills Project, 'Ewa, O'ahu.

Appendix H
Cultural Impact Assessment

Cultural Impact Assessment
For the Proposed Makaīwa Hills Project
Honouliuli Ahupua‘a, ‘Ewa District, O‘ahu Island

TMK: [1] 9-1-15:17: Por. 005 and
9-2-03: Por. 002, 005, and 084

by

Kēhaulani E. Souza, B.A.
David W. Shideler, M.A.
and
Hallett H. Hammatt, Ph.D.

Prepared for
Group 70 International

Prepared by
Cultural Surveys Hawai‘i, Inc.
Kailua, Hawai‘i
(Honou 68)

November 2006

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Management Summary

Report Reference	Cultural Impact Assessment for the proposed Makaīwa Hills Project Honouliuli Ahupua‘a, ‘Ewa District, O‘ahu TMK: [1] 9-1-15:17: Por. 005, 9-2-003: Por. 002, 005, and 84
Project Number	CSH Job Code Honou 68
Location	The project area includes three main gulches Makaīwa, Pālailai and Awanui Gulch along with three other unknown named gulches all located in Honouliuli, ‘Ewa, O‘ahu. The property is bounded by Farrington Highway to the south and Palehua Road to the north. Waimānalo Gulch is on the west and the residential community of Makakilo is on the east.
Project Acreage	1,780.705-acre.
Date Submitted	October 2006
Agencies	State of Hawai‘i Department of Health (DOH)/ Office of Environmental Quality Control (OEQC)
Project Description	The proposed Makaīwa Hills project is a residential development with supporting commercial uses, infrastructure and open space. Although specific details regarding the development within the project area are not available at this time, extensive disturbance is anticipated.
Document Purpose	Article IX and XII of the state constitution, other state laws, and the courts of the state require government agencies to promote and preserve cultural beliefs, practices and resources of native Hawaiians and other ethnic groups pursuant to this legal mandate, cultural Surveys Hawaii Inc. (CSH) conducted an analysis of the proposed projects impacts on cultural practices and features identified within the project area. CSH prepared this report in accordance with the requirement set forth under Hawaii revised status as amended (HRS), Chapter 343 and the OEQC's guidelines for assessing cultural impacts
Methodology	As partial fulfillment for the Scope of Work (SOW), consultation with organizations and the community were conducted to identify *kūpuna* and other individuals with knowledge of the history of the project area and its surroundings. The organizations consulted included the Office of Hawaiian Affairs, the O‘ahu Island Burial Council, ‘Ahahui Siwila Hawai‘i O Kapolei Hawaiian Civic Club, ‘Ewa Neighborhood Board. A few site visits were conducted with Shad Kane, Tom Stone, Group 70, and Campbell Estate.

Recommendations	The community contacts queried for this cultural impact assessment identified the following key concerns related specifically to the proposed Makaīwa Hills project residential development: • The *huaka'i pō* (procession of the night marchers) should be taken into account in the housing development design plans. Several community participants in this study stated that it is very important to keep the pathway clear of visual and structural blockage from *mauka* to *makai* on the east ridge of Waimānalo Gulch and the west ridge of Makaīwa Gulch to allow the *huaka'i pō* to continue. Further consultation with community to ascertain the alignment and buffer zone for the *huaka'i pō* is adivised. • Although the land has been dramatically altered, there remains a possibility that burials and other archeological sites may be present in and around the proposed project area. • It was also strongly recommended that the project should incorporate the traditional place names of the surrounding area into the proposed development to sustain a connection to the past.

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Section 1 Introduction

1.1 Project Background

At the request of Group 70 International, Inc., Cultural Surveys Hawai'i, Inc. (CSH) completed this cultural impact assessment for the proposed Makaīwa Hills Project Honouliuli Ahupua'a, 'Ewa District, O'ahu TMK: [1] 9-1-015:005 por. and 017; 9-2-003:002 por., 005 por., and 084 por. The proposed Makaīwa Hills project is a residential development with supporting commercial uses, infrastructure and open space. Although specific details regarding the development within the project area are not available at this time, extensive disturbance is anticipated. The project area includes three main gulches Makaīwa, Pālailai and Awanui Gulch along with three other unknown named gulches all located in Honouliuli, 'Ewa, O'ahu. The property is bounded by Farrington Highway to the south, and Palehua Road to the north. Waimānalo Gulch is on the west and the residential community of Makakilo is on the east. This area is depicted on a 1998 'Ewa USGS 7.5-minute topographic quadrangle map, a Tax Map Key and an aerial photograph (Figures 1,2,&3).

1.2 Mandate

The purpose of this Cultural Impact Assessment is to consider the effects of the proposed Makaīwa Hills Project may have on traditional cultural practices. The Hawai'i State Constitution, Article XII, Section 7 protects "all rights" of native Hawaiians that are "customarily and traditionally exercised for subsistence, cultural and religious purposes".

In 1997, the Office of Environmental Quality Control issued *Guidelines for Assessing Cultural Impacts*. The Guidelines discuss the types of cultural practices and beliefs that might be assessed including subsistence, commercial, residential, agricultural, access-related, recreational, and religious and spiritual customs. The types of cultural resources subject to assessment may include traditional cultural properties or other types of historic sites, both man-made and natural, including submerged cultural resources, which support such cultural practices and beliefs.

Most recently, H. B. No. 2895 was passed by the 20th Legislature, and approved by Governor Cayetano as Act 50 on April 26, 2000. The bill acknowledges that,

> . . . the past failure to require native Hawaiian cultural impact assessments has resulted in the loss and destruction of many important cultural resources and has interfered with the exercise of native Hawaiian culture. The legislature further finds that due consideration of the effects of human activities on native Hawaiian culture and the exercise thereof is necessary to ensure the continued existence, development, and exercise of native Hawaiian culture.

This bill issues a directive that "…environmental assessments or environmental impact statements should identify and address effects on Hawai'i's culture, and traditional and customary rights."

The process for evaluating cultural impacts is constantly evolving. There continue to be gray areas and unresolved issues pertaining to traditional access and gathering rights. Act 50 is an attempt to balance the scales between traditional lifestyles and development and economic growth.

This assessment is meant to be informational. The Scope of Work (SOW) was designed to meet the cultural impact concerns of the Office of Hawaiian Affairs (OHA), the Office of Environmental and Quality Control (OEQC) and any other state and county agencies involved in the review process for the proposed project.

1.3 Scope of Work

The scope of work for the Cultural Impact Assessment is summarized as follows:

1) Examination of historical documents, Land Commission Awards, historic maps, with the specific purpose of identifying traditional Hawaiian activities including gathering of plant, animal and other resources or agricultural pursuits as may be indicated in the historic record.
2) A review of the existing archaeological information pertaining to the sites on the property as they may allow us to reconstruct traditional land use activities and identify and describe the cultural resources, practices and beliefs associated with the parcel and identify present uses, if appropriate.
3) Conduct oral interviews with persons knowledgeable about the historic and traditional practices in the project area and region. We anticipate contacting more than forty people and carrying out both formal and informal interviews.
4) Preparation of a report on items 1-3 summarizing the information gathered related to traditional practices and land use. The report will assess the impact of the proposed action on the cultural practices and features identified.

1.4 Methodology

Background research included a review of previous archaeological studies on file at the State Historic Preservation Division, and a review of geology and cultural history documents at Hamilton Library at the University of Hawai‘i, the Hawai‘i State Archives, the Mission House Museum Library, the Hawai‘i Public Library, and the Archives of the Bishop Museum. Further research included a study of historic photographs at the Hawai‘i State Archives and the Archives of the Bishop Museum, a study of historic maps at the Hawai‘i State Archives and the Archives of the Bishop Museum, and a study of historic maps at the Survey Office of the Department of Accounting and General Services. Information on LCAs was accessed through Waihona ‘Āina Corporation’s Māhele Data Base (www.waihona.com).

1.4.1 Identification of Knowledgeable Community Members

As partial fulfillment for the Scope of Work (SOW), consultation with organizations and the community were conducted to identify *kūpuna* and other individuals with knowledge of the history of the project area and its surroundings. The organizations consulted included the Office of Hawaiian Affairs, the O‘ahu Island Burial Council, ‘Ahahui Siwila Hawai‘i O Kapolei Hawaiian Civic Club, ‘Ewa Neighborhood Board.

Based on recommendations from organizations and the community, individuals were contacted for information gathering sessions See Community Contact Table 4 below. These sessions were conducted in-person or by telephone. A few site visits were conducted with Shad Kane, Tom Stone, Group 70, and Campbell Estate to observe sites previously documented and new potential sites.

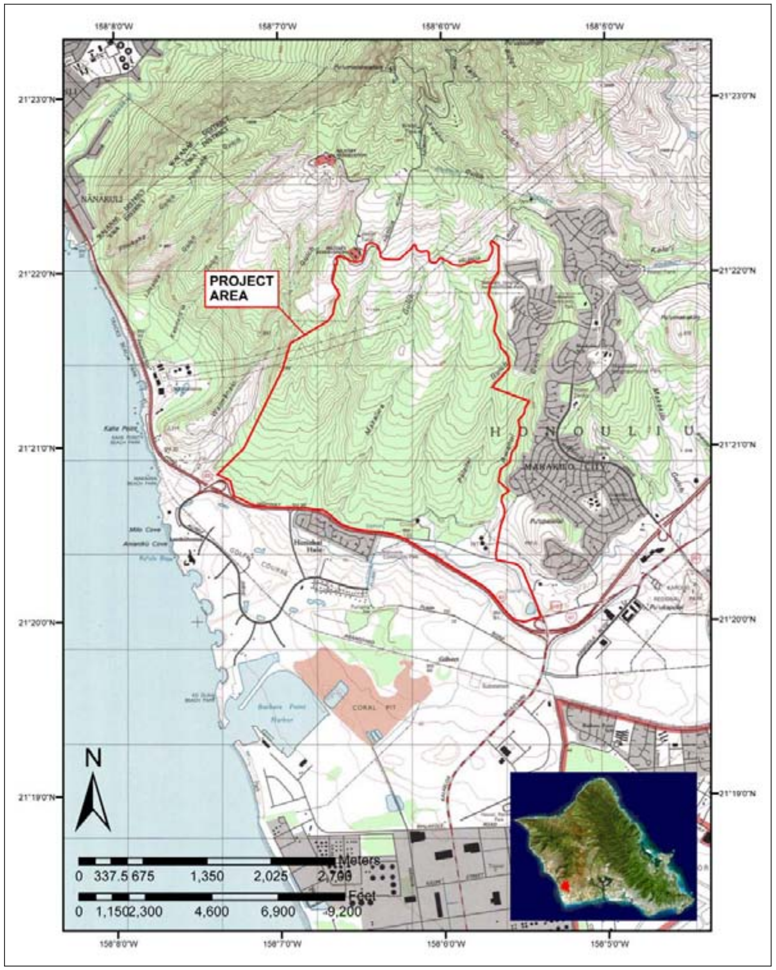


Figure 1. A portion of the 1998 'Ewa USGS 7.5-minute topographic quadrangle showing the current project area

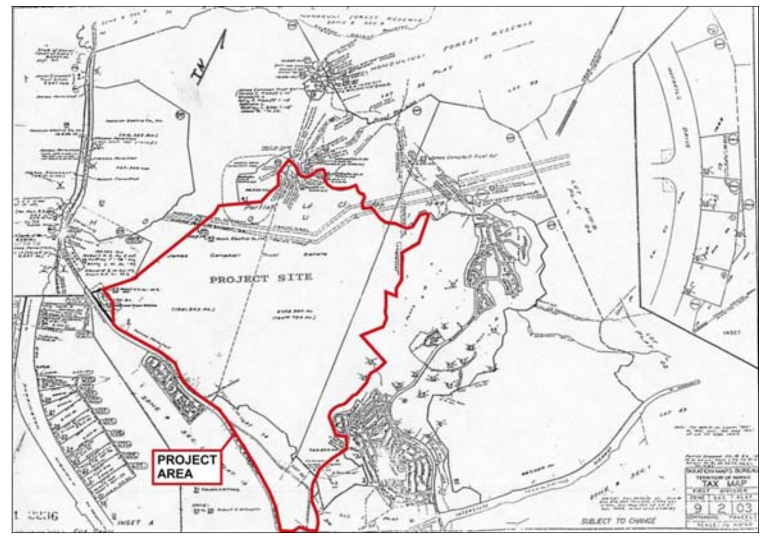


Figure 2. Tax Map Key (TMK): 9-2-03 showing Makaiwa Hills project area

Figure 3. Portion of the Oahu, Hawaii EarthData High-Resolution Orthoimagery – vol001 showing the location of the Makaīwa Hills Project Area

1.5 Environmental Setting

1.5.1 Natural Environment

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

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

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

-Stony steep land (rsy) (ridges - majority of project area)

-Lualualei extremely stony clay (LPE) (lower gulches)

-Helemano silty clay (HLMG) (ridge crests)

-Honouliuli clay (HxA, HxB) (lowlands to southeast)

-Mahana-Badland complex (MBL) (heavily eroded *mauka* lands)

-Lualualei stony clay (LvB) (low lands to southeast)

-Ewa silty clay loam (EaB) (lowlands to southeast)

-Molokai silty clay loam (MuC) (lowlands to southeast)

-Ewa stony silty clay (EwC) (lowlands to southeast)

-Rock land (rRK) (steep land above Waimanalo Gulch)

-Mahana silty clay loam (MC) (higher soil covered ridges)

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

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

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

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

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

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

1.5.2 Built Environment

Presently, the majority of the project area is being used for cattle grazing. An active water trough and cattle pen are situated just south of Palehua Road and an extensive wire fence, which

includes stone wall sections, crosscuts the slope at approximately the 600 ft. contour retaining the majority of the cattle within this northern enclosure.

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

1.5.3 Modern Land Use

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

Section 2 Background Research

2.1 Introduction to the Cultural Landscape

The project area is situated on the eastern side of the Wai‘anae Mountains in the Honouliuli *Ahupua‘a* (traditional land division) sub-divided into the ‘Ili of Waimānalo in the *moku* or district of ‘Ewa. The *ahupua‘a* of Honouliuli is the largest traditional *ahupua‘a* land unit on the island of O‘ahu. Honouliuli includes all the land from the western boundary of Pearl Harbor (West Loch or Kaihuopala‘ai) westward around the southwest corner of O‘ahu to the ‘Ewa\ Wai‘anae District Boundary with the exception of the west side of the harbor entrance which is in the *ahupua‘a* of Pu‘uloa (the ‘Ewa Beach/Iroquois Point area). Honouliuli Ahupua‘a includes approximately nineteen kilometers (twelve miles) of open coastline from One‘ula westward to the boundary known as Pili o Kahe. The *ahupua‘a* extends *mauka*, almost pie-shaped, from West Loch nearly to Schofield Barracks in Wahiawā; the western boundary is the Wai‘anae Mountain crest running north as far as Pu‘u Hapapa (or to the top of Ka‘ala Mountain according to some).

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

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

1) Twelve miles of coastline with continuous shallow fringing reef that offered rich marine resources.

2) Four miles of frontage on the waters of West Loch which offered extensive fisheries (mullet, *awa*, shellfish), as well as frontage suitable for development of fishponds (for example, Laulaunui)
3) The lower portion of Honouliuli Valley in the ‘Ewa plain offered rich level alluvial soils with plentiful water for irrigation from the stream as well as abundant springs. This land would have stretched well up the valley.
4) A broad limestone plain which because of innumerable limestone sink holes offered a nesting home for a large population of avifauna. This resource may have been one of the early attractions to human settlement.
5) An extensive upland forest zone extending as much as twelve miles inland from the edge of the coastal plain. As Handy and Handy have pointed out, the forest was much more distant from the lowlands here than it was on the windward side, but on the leeward side was more extensive (1972:469). Much of the upper reaches of the *ahupua‘a* would have had species-diverse forest with *kukui, ‘ōhia*, sandalwood, *hau*, *kī*, banana, etc.
6) A network of trails giving access to Lualualei and Wai‘anae coastal reaches.

2.2 Main Areas of Settlement

Within this natural setting archaeological and traditional sources show a general pattern of three main areas of settlement within the *ahupua‘a*: a coastal zone, the Honouliuli taro lands, and inland settlement at Pu‘u Ku‘ua.

2.2.1 The Coastal Zone - Kalaeloa (Barbers Point), Ko‘Ōlina (West Beach)

Kalaeloa (Barbers Point)

Archaeological research at Barbers Point has focused on the areas in and around the newly constructed Deep Draft Harbor (Barrera, 1975; Davis and Griffin, 1978; Hammatt and Folk, 1981, McDermott *et al.* 2000). Series of small clustered shelters, enclosures and platforms show limited but recurrent use at the shoreline zone for marine oriented exploitation. This settlement covers much of the shoreline with more concentrated features around small marshes and wet sinks. Immediately behind the shoreline under a linear dune deposit is a buried cultural layer believed to contain some of the earliest habitation evidence in the area.

A significant attraction of the area to early Hawaiians was the plentiful and easily exploited bird population. Particular evidence for taking of petrel occurs at Site -2763 (Hammatt and Folk, 197:213). Initial heavy exploitation of nesting seabirds and other species in conjunction with habitat destruction probably led to early extinction.

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

Davis and Griffin (1978) distinguish functional classes of sites, based on surface area size and argue that the Barbers Point settlement consists of functionally integrated multi-household residence groups. Density contours of midden (by weight) and artifacts (by numbers) plotted for residence sites by Hammatt and Folk (1981) generally indicate narrowly defined spatial foci of discard, possibly indicating continuous use, or at least with no refurbishing or additions to the structures through time (Hammatt and Folk, 1981). The focus is small habitation sites, typically lacking the full range of features found in large permanent residence complexes such as high platforms, complex enclosures, and ceremonial sites.

Ko‘Ōlina (West Beach)

There are three major studies on the Ko‘Ōlina project area (Davis *et al*, 1986a; Davis *et al*., 1986b; and Davis and Haun, 1987). Davis documents around 180 component features at 48 sites and site complexes consisting of habitation sites, gardening areas, and human burials. Chronologically the occupation covers the entire span of Hawaiian settlement in what Davis and Haun describe as "one of the longest local sequences in Hawaiian prehistory" (Davis and Haun, 1987:37). The earliest part of the sequence relates to the discovery of an inland marsh and early dates were also obtained for the beachfront site (Lanikūhonua) and an inland rock shelter.

2.2.2 Honouliuli Taro Lands

Centered around the west side of Pearl Harbor at Honouliuli Stream and its broad outlet into the West Loch are the rich irrigated lands of the *‘ili* of Honouliuli which give the *ahupua‘a* its name. The major archaeological reference to this area is Dicks, Haun and Rosendahl (1987) who documented remnants of a once-widespread wetland system (*lo‘i* and fishponds) as well as dryland cultivation of the adjacent slopes. In association with this research, Carol Silva conducted "Historic Research Relative to the Land of Honouliuli" (Appendix A, Dicks *et al*., 1987) and the reader is referred to this work for an overview of the history of the *‘ili* of Honouliuli.

The area bordering West Loch was clearly a major focus of population within the Hawaiian Islands and this was a logical response to the abundance of fish and shellfish resources in proximity to a wide expanse of well-irrigated bottomland suitable for wetland taro cultivation. The earliest detailed map (Malden, 1825) shows all the roads of southwest O‘ahu coalescing and descending the *pali* as they funnel into the locality (i.e. Honouliuli Village) which gave the *ahupua‘a* of Honouliuli its name. Dicks *et al*. (1987:78-79) conclude, on the basis of nineteen carbon isotope dates and three volcanic glass dates that "Agricultural use of the area spans over 1,000 years." Undoubtedly, Honouliuli was a locus of habitation for thousands of Hawaiians. Prehistoric population estimates are a matter of some debate but it is worth pointing out that in the earliest mission census (Schmitt, 1973:19) 1831-1832, the land (*‘āina*) of Honouliuli contained 1,026 men, women, and children. It is not clear whether this population relates to Honouliuli Village or to the entire *ahupua‘a* but the village probably contained the vast majority of the district's population at that time. The nature of the reported population structure for Honouliuli (less than 20% children under twelve years of age) and the fact that the population decreased more than 15% in the next four years (*Ibid*.:22) suggests that the prehistoric population of Honouliuli Village may well have been significantly greater than it was in 1831-1832. A conservative estimate would be that tens of thousands of Hawaiians lived and died at Honouliuli Village.

2.2.3 Pu‘uku‘ua: Inland Settlement

Documentation of inland settlement in Honouliuli *Ahupua‘a* is more problematic in that there are relatively few historical or archaeological sources. However, it is mentioned in Mo‘olelo that

the area of Pu‘uku‘ua, on the east side of the Wai‘anae Ridge, north of the current project area, seven miles inland of the coast, was a Hawaiian place of great importance.

In 1899, the Hawaiian language Newspaper "*Ka Loea Kālai‘āina*" relates a story of Pu‘uku‘ua as "a place where chiefs lived in ancient times" and a "battle field," "thickly populated." This area was well known by all O‘ahu chiefs and customary for them to visit. The term Kauwā was first used here because of a one armed chiefess who was ashamed and ran when other chiefs would visit. She was not a Kauwā she only behaved as one. The article:

> The chiefs of old, who lived at that time, were of divine descent. The two gods [Kāne and Kanaloa] looked down on the hollow [vicinity of Pu‘u Ku‘ua] and saw how thickly populated it was. The mode of living here was so that chiefs and commoners mixed freely and they were so like the lowest of people (*Kauwā*). That is what these gods said and that was the time when the term *kauwā* was first used, and was used for many years afterwards. After the first generations of chiefs had passed away and their descendants succeeded them, a chiefess Oahu to visit this place to see the local chiefs. They did this always. When the time came in which a new chiefess ruled, an armless chiefess, she ran away to hide when other chiefs came to visit as usual because she was ashamed of her lack of an arm. Because she was always running away because of being ashamed the chiefs that visited her called her the low-born (kauwā). Thus the term remained in the thoughts down to this enlightened period. She was no truly a kauwā but was called that because she behaved like one. This was how they were made to be *kauwā*. When the ruling chief wished to go to Waikīkī for sea bathing he asked the chief just below him in rank, "How are my planting places at Pu‘u Ku‘ua, [a place in the Wai‘anae Range famous as a *kauwā* residence and place of mixed caste] have they not produced young suckers?" The chief next to him answered, "There are some suckers," and sent someone for them. When the men, women and children least expected it, the messenger came to get some of the children. The father stood up and took his sons to Waikīkī Then, when the ruling chief went sea bathing, he sent an attendant to get the boys and take them to a shallow place where the ruling chief would come. Then the ruler placed a hand on each of the boys, holding them by the necks. The words he uttered were, "My height has not been reached! My height has not been reached!" He advanced and held onto the boys until the sea was up to his chest. The boys floated on the water face down. The father on shore called out, "Lie still in the sea of your Lord," and so on. (*Ka Loea Kālai‘āina*, July 8, 1899)

McAllister recorded three sites in this area, two *heiau* (sites 134 Pu‘u Kuina and 137 Pu‘uku‘ua; both destroyed) and a series of enclosures in Kukuilua which he calls "*kuleana* sites" (McAllister, 1933). On the opposite side of the Wai‘anae range along the trail to Pōhākea Pass Cordy (2002) states "Kākuhihewa was said to have built (or rebuilt) Nīoi‘ula, a *po‘okanaka heiau* (1,300 sq. m.) in Hālona in upper Lualualei, along the trail to Pōhākea Pass leading into ‘Ewa, ca. A.D. 1640-1660" (Cordy, 2002:36). There is no direct archaeological evidence available to the authors' knowledge that intensive Hawaiian settlement occurred along the Pōhākea Pass trail but it is considered as a place of higher probability for traditional Hawaiian sites, based on the above indications. John Papa ‘Ī‘ī (1959) described a journey that Liholiho took which led him and an entourage through inland Honouliuli and over Pōhākea Pass.

Geographically, the area receives sufficient quantities of water and would have had abundant locally available forest resources.

2.3 Traditional and Legendary Accounts of Honouliuli

Honouliuli, O'ahu is associated with a number of legendary accounts. Many of these concern the actions of gods or demi-gods such as Kāne, Kanaloa, Māui, Kamapua'a, the reptile deity Maunauna, the shark deity Ka'ahupāhau, and the demigod hero Palila. There are several references to chiefly lineages and references to the ruling chiefs Hilo-a-Lakapu and Kūali'i, (Ko 'Ōlina is reported to have been a vacationing place for Kākuhihewa). Traditional and legendary accounts are presented below starting with the one's pertaining to Pōhākea Pass and then in a loose arrangement from more mythological accounts of gods and demi-gods to accounts of a more historical nature. There is no sharp distinction in this regard.

2.3.1 The Naming of Honouliuli (Legend of Lepeamo'a)

In the Legend of Lepeamoa, the chicken-girl of Pālama, Honouliuli is the name of the husband of the chiefess Kapālama and grandfather of Lepeamoa (Thrum 1923:164-184). "Her grandfather gave his name, Honouliuli to a land district west of Honolulu..." (Thrum 1923:170). Westervelt (1917:209) gives an almost identical account.

2.3.2 The Pele Family at Honouliuli

Kapolei (beloved Kapo), specifically the 166-foot high cone of that name, is understood to have been named in reference to the volcano goddess Pele's sister Kapo (Pukui *et al.* 1974:89). Pōhākea Pass is understood as one of the resting places of Pele's sister Hi'iaka as she was returning from Kaua'i with Pele's lover Lohiau (Fornander 1919 Vol. V :188 note 6). A considerable number of *mele* (songs) and *pule* (prayers) are ascribed to Hi'iaka as she stood at the summit of Pōhākea (*Aluna au a Pōhākea, Kū au, nānā ia Puna...*)(Emerson 1915:162-168). From this vantage point Hi'iaka could see, through her powers of vision, that her beloved *lehua* groves and friend Hopoe at Puna, Hawai'i Island had been blasted by her jealous sister Pele. She could also see that in her canoe, off the coast of Wai'anae, Lohiau was seducing her traveling companion Wahine'ōma'o! A spring located at Kualaka'i near Barbers Point was named Hoaka-lei (lei reflection) because Hi'iaka picked *lehua* flowers here to make a lei and saw her reflection in the water.

2.3.3 Keahumoa, Residence of Māui's Grandfather (Legend of Māui's Flying Expedition)

In the Legend of Māui's Flying Expedition (Thrum 1923:252-259) Māui-kupua looks toward Pōhākea Pass and sees his wife, Kumulama, being carried away by chief Pe'ape'amakawalu. After failing to recover her, Māui returns and tells his problems to his mother, Hina. Hina instructs her son to go to Keahumoa and visit his grandfather Kuolokele who lives there in a large hut. The hump-backed Kuolokele returns home with a load of potato leaves and Māui cures him by striking him in the back with a stone (which Kuolokele throws to Waipahu where it remains). Kuolokele has Māui gather *kī* leaves *'ie'ie* vines and bird feathers from which the old man fabricates a "bird-ship" (*moku-manu*) which Māui uses to defeat Pe'ape'amakawalu and recover his wife. They return to Kuolokele's house where they feast and Māui eats Pe'ape'amakawalu's eyeballs.

2.3.4 Kāne and Kanaloa and the Boundaries of 'Ewa (Simeon Nawaa account)

It seems likely the boundaries of the western-most *ahupua'a* of 'Ewa were and still are often contested between the Wai'anae and 'Ewa people:

> When Kāne and Kanaloa were surveying the islands they came to O'ahu and when they reached Red Hill saw below them the broad plains of what is now 'Ewa. To mark boundaries of land they would throw a stone and where the stone fell would be the boundary line...They hurled the stone as far as the Wai'anae Range and it landed somewhere in the Waimānalo section...Eventually the stone was found at Pili o Kahe. This is a spot where two small hills of the Wai'anae Range come down parallel on the boundary between Honouliuli and Nānākuli ('Ewa and Wai'anae). The ancient Hawaiians said the hill on the 'Ewa side was the male and the hill on the Wai'anae side was female. The stone was found on the Waianae side hill and the place is known as Pili oKahe (Pili= to cling to, Kahe= to flow). The name refers, therefore, to the female or Waianae side hill. And that is where the boundary between the two districts runs. (Simeon Nawaa In Sterling and Summers 1978:1)

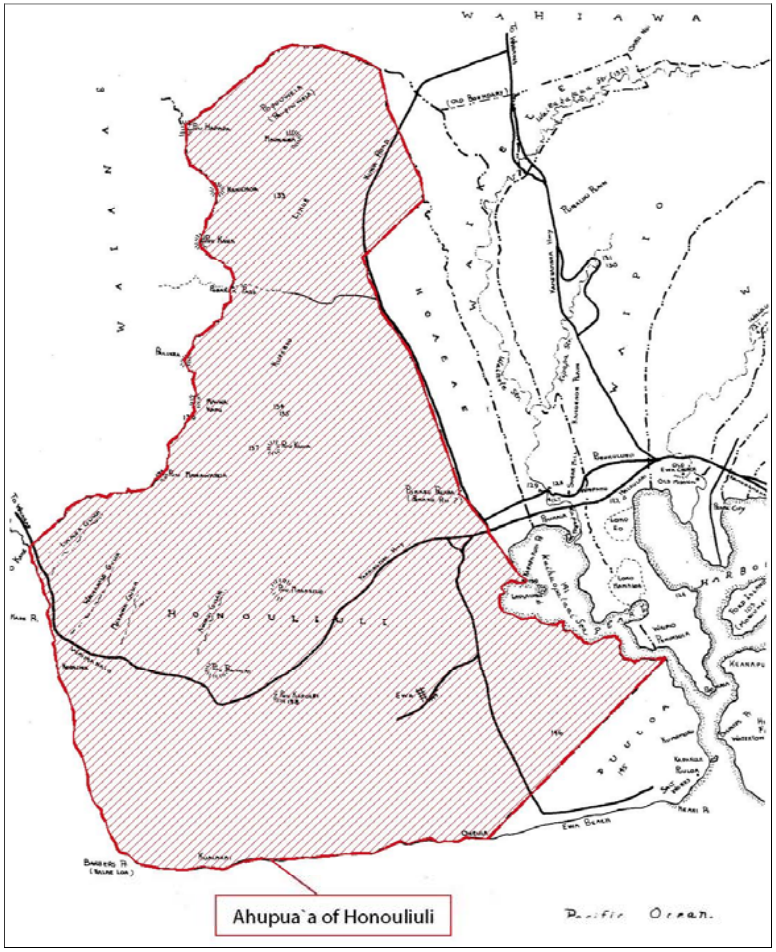
2.3.5 Kamapua'a the pig god is associated with Honouliuli:

> Kamapua'a subsequently conquered most of the island of O'ahu, and, installing his grandmother [Kamaunuaniho] as queen, took her to Puuokapolei, the lesser of the two hillocks forming the southeastern spur of the Wai'anae Mountain Range, and made her establish her court there. This was to compel the people who were to pay tribute to bring all the necessities of life from a distance, to show his absolute power over all. (Nakuina 1904:50)

Emma Nakuina goes on to note: "A very short time ago [prior to 1904] the foundations of Kamaunuaniho's house could still be seen at Puuokapolei" (Nakuina 1904:50). Another account (*Ka Loea Kālai'āina* January 13, 1900) speaks of Kekeleaiku, the older brother of Kamapua'a, who also was said to have lived on Pu'uokapolei.

2.3.6 Home of the Shark-Goddess Ka'ahupāhau (Legend of Ka'ehuikimanōo Pu`uloa)

In the Legend of Ka'ehuikimanōo Pu'uloa (Thrum 1923:293-306) the Big Island shark god, Ka'ehuiki travels to visit the famous shark deity Ka'ahupāhau "reaching Honouliuli, the royal residence." Ka'ahupāhau is said to have lived in a royal cave at Honouliuli (Thrum 1923:302).



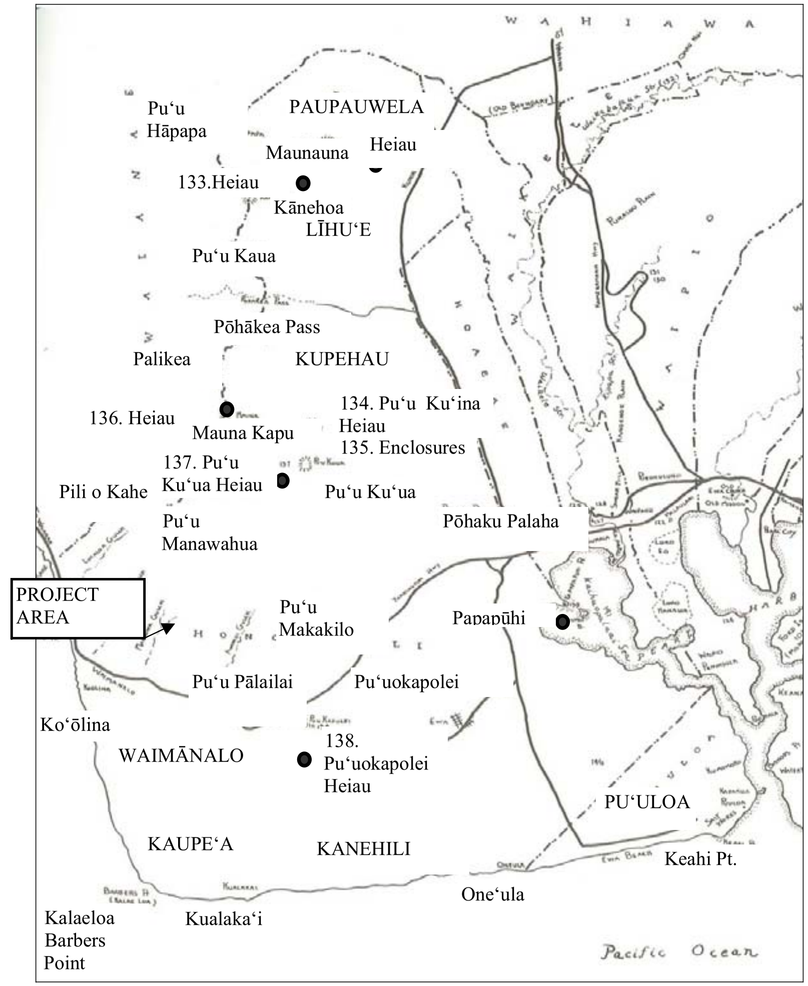


Figure 4. Place Names of Honouliuli (adapted from Sterling and Summers 1978)

2.3.7 The Frightened Populace of Honouliuli *(He Ka‘ao no Palila)*

In the Legend of Palila the *kupua* or demigod hero of Kaua‘i lands at Ka‘ena point with his fabulous war club (*lā‘au pālau*), which required eighty men to carry it, and crosses into Honouliuli through the Pōhākea Pass. He descends to the plain of Keahumoa:

> *Kū kēia i laila nānā i ke kū ka ea o ka lepo i nā kānaka, e pahu aku ana kēia i ka lā‘au pālau aia nei i kai o Honouliuli, kū ka ea o ka lepo o ka honua, me he ōla‘i la, maka‘u nā kānaka holo a hiki i Waikele*
>
> At this place he stood and looked at the dust as it ascended to the sky caused by the people who had gathered there; he then pushed his war club toward Honouliuli. When the people heard something roar like an earthquake they were afraid and they all ran to Waikele ... (Fornander 1917 Vol. V 136-153)

2.3.8 Two Old Women who Turned to Stone *(Ka Loea Kālai‘āina)*

The Hawaiian language newspaper *Ka Loea Kālai‘āina* relates that near Pu‘uokapolei, on the plain of Pukaua, on the *mauka* side of the road, there was a large rock. The legend is as follows:

> There were two supernatural old women or rather peculiar women with strange powers and Pu‘ukaua belonged to them. While they were down fishing at Kualaka‘i [near Barbers Point] in the evening, they caught these things, ‘*a‘ama* crabs, *pipipi* shellfish, and whatever they could get with their hands. As they were returning to the plain from the shore and thinking of getting home while it was yet dark, they failed for they met a one-eyed person [bad omen]. It became light as they came near to the plain, so that passing people were distinguishable. They were still below the road and became frightened lest they be seen by men. They began to run - running, leaping, falling, sprawling, rising up and running on, without a thought of the *‘a‘ama* crabs and seaweeds that dropped on the way, so long as they would reach the upper side of the road. They did not go far for by then it was broad daylight. One woman said to the other, “Let us hide lest people see us,” and so they hid. Their bodies turned into stone and that is one of the famous things on this plain to this day, the stone body. This is the end of these strange women. When one visits the plain, it will do no harm to glance on the upper side of the road and see them standing on the plain. (*Ka Loea Kālai‘āina,* January 13, 1900)

2.3.9 The Strife of Nāmakaokapāo‘o and Puali‘i (*Ka‘ao no* Nāmakaokapāo‘o *)*

In the Legend of Nāmakaokapāo‘o the brave boy, Nāmakaokapāo‘o, and his mother, Pōka‘ī, appear to have been living near the coast but were quite destitute (*‘ilihune loa*). His mother met Puali‘i when he came from Līhu‘e to fish at Honouliuli and the family went to live on the plains of Keahumoa (*ke kula o Keahumoa*). Puali‘i kept sweet potato patches (*māla ‘uala*) and fished for *ulua*. Following a dispute over sweet potatoes, Nāmakaokapāo‘o defeated his step-father, Puali‘i and:

> *Lālau aku la o Nāmakaokapāo‘o i ke po‘o o Puali‘i a kiola aku la i kai o Waipouli, he ana ma kahakai o Honouliuli, o kona loa, ‘elima mile ka loa…*

> Nāmakaokapāo‘o picked up Puali‘i’s head and threw it towards Waipouli, a cave situated on the beach at Honouliuli (a distance of about five miles)... (Fornander 1917 Vol. V 274-277)

2.3.10 The Story of Kaihuopala‘ai Pond, Honouliuli (*Ka‘ao no Maikohā)*

In the Legend of Maikohā a sister of Maikohā (a deified hairy man who became the god of tapa makers) named Kaihuopala‘ai, journeys to O‘ahu:

> *‘Ike aku la o Kaihuopala‘ai i ka maikai o Kapapaapuhi, he kāne e noho ana ma Honouliuli ma ‘Ewa. Moe iho la lāua, a noho iho la o Kaihuopala‘ai i laila a hiki i kēia lā. ‘Oia kēlā loko kai e ho‘opuni ia nei i ka ‘anae, nona nā i‘a he nui loa, a hiki i kēia kākau ana.*
>
> Kaihuopala‘ai saw a goodly man by the name of Kapapaapuhi who was living at Honouliuli, ‘Ewa; she fell in love with him and they were united, so Kaihuopala‘ai has remained in ‘Ewa to this day. She was changed into that fishpond in which mullet are kept and fattened, and that fishpond is used for that purpose to this day [1919]. (Fornander 1917 Vol. V 270-271)

2.3.11 The Traveling Mullet of Honouliuli (Fish Stories and Superstitions)

The story of (Ka)Ihuopala‘ai is also associated with the tradition of the *‘anae-holo* or traveling mullet (Thrum 1907:270-272):

> The home of the *‘anae-holo* is at Honouliuli, Pearl Harbor, at a place called Ihuopala‘ai. They make periodical journeys around to the opposite side of the island, starting from Pu‘uloa and going to windward, passing successively Kumumanu, Kalihi, Kou, Kālia, Waikīkī, Ka‘alāwai, and so on, around to the Ko‘olau side, ending at Lā‘ie, and then returning by the same course to their starting point.(Thrum 1907:271)

In Thrum’s account, Ihuopala‘ai is a male who possesses a Kū‘ula or fish god which supplied the large mullet known as *‘Anae*. His sister lived in Lā‘ie and there came a time when there were no fish. She sent her husband to visit Ihuopala‘ai who was kind enough to send the fish following his brother-in-law on his trip back to Lā‘ie.

This story is associated with the only proverb or poetical saying identified with Honouliuli:

> *Ka i‘a hali a ka makani*
>
> The fish fetched by the wind (Pukui 1983: # 1330)

Pukui explains “The *‘anaeholo*, a fish that travels from Honouliuli, where it breeds, to Kaipāpa‘u on the windward side of O‘ahu. It then turns about and returns to its original home. It is driven closer to shore when the wind is strong.” Whether this saying was used in contexts other than in reference to mullet is unclear.

2.3.12 Honouliuli and the Head of Hilo-a-Lakapu (Legend of the Sacred Spear-point)

In the Legend of the Sacred Spear-point (Kalākaua 1888:209-225) is a reference to the Hawai‘i Island chief Hilo-a-Lakapu. Following his unsuccessful raid against O‘ahu “he was slain at Waimano, and his head was placed upon a pole near Honouliuli for the birds to feed upon"(Kalākaua 1888:224).

2.3.13 The Strife at Honouliuli from which Kūali'i unites Hawai'i nei (Mo'olelo o Kūali'i)

The celebrated chief, Kūali'i, is said to have lead an army of twelve thousand *('ekolu mano*) against the chiefs of Ko'olauloa with an army of twelve hundred *('ekolu lau*) upon the plains of Keahumoa (Fornander 1917 Vol. IV 364-401). Perhaps because the odds were so skewed the battle was called off and the *ali'i* of Ko'olau ceded (*ha'awi a'e*) the districts of Ko'olauloa, Ko'olaupoko, Waialua and Wai'anae to Kūali'i. When the *ali'i* of Kaua'i heard of this victory at Honouliuli they gave Kaua'i to Kūali'i as well and thus he became possessed of all the islands (*a lilo a'e la nā moku a pau ia Kūali'i mai Hawai'i a Ni'ihau*). The strife at Honouliuli was the occasion of the recitation of a song for Kūali'i by a certain Kapa'ahulani (*Ka Pule Ana a Kapa'ahulani*) that makes passing reference in word play to the blue poi which appeases the hunger of Honouliuli (*Uliuli ka poi e piha nei - o Honouliuli*).

2.3.14 The Last Days of Kahahana and Honouliuli (The Land is the Sea's)

In the tradition of the prophecy of the kahuna Kaopulupulu, Moke Manu relates that the deposed O'ahu chief Kahahana fled for his life:

> Upon the arrival here at O'ahu of Kahekili, Kahahana fled, with his wife Kekuapoi, and friend Alapa'i, and hid in the shrubbery of the hills. They went to Āliamanu, Moanalua, to a place called Kinimakalehua; then moved along to Keanapua'a, and Kepo'okala, at the lochs of Pu'uloa, and from there to upper Waipi'o; thence to Wahiawā, Helemano, and on to Līhu'e; thence they came to Po'ohilo, at Honouliuli, where they first showed themselves to the people and submitted themselves to their care. (Thrum 1907:203-214)
>
> Through treachery, Kahahana was induced to leave Po'ohilo, Honouliuli and was killed on the plains of Hō'ae'ae (Thrum 1907:213-214).

2.3.15 Pu'uokapolei and the Reckoning of the Seasons (Kamakau)

Samuel Kamakau relates:

> …the people of O'ahu reckoned from the time when the sun set over Pu'uokapolei until it set in the hollow of Mahinaona and called this period Kau [summer], and when it moved south again from Pu'uokapolei and it grew cold and the time came when young sprouts started, the season was called from their germination ('*ōilo*) the season of *Ho'oilo* [winter, rainy, season]. (*Mo'olelo Hawai'i* Vol. I, Chap. 2, p. 23)

2.3.16 Honouliuli in the Poetry of Halemano (Ka'ao no Halemano)

In the Legend of Halemano the romantic O'ahu anti-hero chants a love song with a reference to Honouliuli:

> *Huli a'e la Ka'ala kau i luna, Waiho wale kai o Pōka'ī, Nānā wale ke aloha i Honouliuli, Kokolo kēhau he makani no Līhu'e…*

> Search is made to the top of Ka'ala, The lower end of Pōka'ī is plainly seen. Love looks in from Honouliuli, The dew comes creeping, it is like the wind of Līhu'e... (Fornander 1917 Vol. V 252)

2.4 Legends and Traditional Places in Upland Honouliuli

2.4.1 Kahalaopuna at Pōhākea Pass

One of the most popular legends of O'ahu is that of Kahalaopuna (or Kaha) a young woman of Mānoa who is slandered by others and is then killed by her betrothed, Kauhi, a chief from Ko'olau, O'ahu. While the numerous accounts (Day 1906:1-11, Fornander 1919 Vol. V :188-193, Kalākaua 1888:511-522, Nakuina 1904:41-45, Patton 1932:41-49, Skinner 1971:220-223, Thrum 1907:118-132, Westervelt 1907a 127-137, Westervelt 1907b 84-93) vary in details they typically have Kahalaopuna slain and then revived repeatedly with the aid of a protective owl spirit. Kauhi forces her to hike west from Mānoa through the uplands until they get to Pōhākea Pass through the southern Wai`anae Range in north Honouliuli. At Pōhākea Pass, Kauhi beats her with a stick until she is very dead ("*Ia hahau ana a Kauhi i ka lā'au, make loa o Kahalaopuna*"). Her spirit (*'uhane*) flies up into a *lehua* tree and chants for someone to go notify her parents of her fate. Upon hearing the news her parents fetch Kahalaopuna back to Mānoa and she is restored to life.

2.4.2 *Mo'o* at Maunauna (*Kuokoa*)

Moses Manu in recounting the Legend of Keaomelemele makes a reference to a *mo'o* (fabulous lizard, dragon, serpent) named Maunauna who lived above Līhu'e (presumably at the landform of that name in extreme northern Honouliuli) and who was regarded as a bad lizard (*Kuokoa* April 25, 1885).

2.4.3 Paupauwela and Līhu'e

Paupauwela, also spelled Popouwela (derivation unknown), is the name of the land area in the extreme *mauka* section of Honouliuli *Ahupua'a.* The land area of Līhu'e is just *makai* of this land, and extends into the *ahupua'a* of Waipi'o (adjacent to the eastern border of Honouliuli). Both place names are mentioned in a chant recorded by Abraham Fornander, which was composed as a *mele* for the O'ahu king, Kūali'i, as he was preparing to battle Kuiaia, the chief of Wai'anae:

Where? Where is the battle field	*Ihea, ihea la ke kahua,*
Where the warrior is to fight?	*Paio ai o ke koa-a?*
On the field of Kalena,	*I kai i kahua i Kalena,*
At Manini, at Hanini,	*I Manini, i Hanini*
Where was poured the water of the god	*I ninia i ka wai akua,*
By your work at Malamanui;	*I ko hana i Malamanui*
On the heights of Kapapa, at Paupauwela,	*Ka luna o Kapapa, i Paupauwela,*
Where they lean and rest;	*I ka hilinai i ke kalele,*
At the hala trees of indolent Halahalanui,	*Ka hala o Halahalanui maauea,*
At the ohia grove of Pule-e	*E kula ohia ke Pule-e,*
The god of Lono, of Makalii	*Ke 'kua o Lono o Makalii*

Thr fragrant branch of the Ukulonoku,	*Ka lala aalao Ukulonoku,*
Mayhap from Kona, from Lihue,	*No Kona paha, no Lihue.*
For the day at Maunauna	*No ka la i Maunauna,*
For the water at Paupauwela.	*No ka wai i Paupauwela.*
Red is the water of Paupauwela,	*Ula ka wai i Paupauwela,*
From the slain at Malamani,	*Ke kilau o Malamani,*
The slain on the ridge at Kapapa.	*Ka moo kilau I Kapapa.*

(Fornander 1917, Vol. IV, Part 2:384-386).

The derivation of the place name Līhu‘e (meaning “cold chill”) is illustrated in the following poem; all other places names mentioned in this poem are in Waipi‘o:

> The icy wind of Lihue plied its spurs,
> Pulling up the bridle of Haleauau,
> Speeding headlong over Kalena
> And running over the plain of Kanoenoe
> (*Ka Loea Kālai‘āina*, July 22, 1899, translated in Sterling and Summers 1978:21)

This explains the meaning of a Hawaiian saying “*Hao na kēpā o Līhu‘e i ke anu*” (The spurs of Līhu‘e dig in with cold) (Pukui 1983:#479).

The icy winds of Honouliuli are also noted in a *mele* for the high king Kūali‘i. In this *mele*, the cold winds of Kumomoku and Leleiwe, near Pu‘uloa in Honouliuli are compared unfavorably to the god Kū.

Not like these are thou, Ku	*Aole i like Ku.*
[Nor] the rain that brings the land breeze,	*Ia ua hoohali kehau,*
Like a vessel of water poured out.	*Mehe ipu wai ninia la,*
Nor to the mountain breeze of Kumomoku,	*Na hau o Kumomoku;*
[The] land breeze coming round to Leleiwi.	*Kekee na hau o Leleiwi,*
Truly, have you not known?	*Oi ole ka oe i ike*
The mountain breezes, that double up your back,	*I ka hau kuapuu.*
[That make you] sit crooked and cramped at Kaimohala,	*Kekee noho kee, o Kaimohala,*
The Kanehili at Kaupea?	*O Kanehili i Kaupea-la*
Not like these are thou, Ku.	*Aole i like Ku.*

(Fornander 1917, Vol. IV, Part II:390-391)

In the Legend of Halemano (Fornander 1919, Vol. V, Part II:252), the romantic O‘ahu anti-hero chanted a love song with a reference to the winds of Līhu‘e:

Search is made to the top of Ka‘ala,	*Huli a‘e la Ka‘ala kau i luna,*
The lower end of Pōka‘ī is plainly seen.	*Waiho wale kai o Pōka‘ī,*
Love looks in from Honouliuli,	*Nānā wale ke aloha i Honouliuli,*
The dew comes creeping, it is like the wind of Līhu‘e...	*Kokolo kēhau he makani no Līhu‘e.*

The wind of Līhu‘e and others in the region are also named by Moses K. Nakuina, as follows:

> Moa‘e-kū is of ‘Ewaloa
> Kēhau is of Waiopua
> Waikōloa is of Līhu‘e
> Kona is of Pu‘uokapolei
> Maunuunu is of Pu‘uloa
> (Nakuina 1992:43)

The *ali‘i* (chiefly class) were closely associated with Līhu‘e, which had habitation areas and playing grounds set aside for their sports. ‘Ewa

> Lolale was the father and Keleanohoapiapi the mother of Ka-lo-kaholi-a-Lale. He was born in the land of Lihue and there he was reared into manhood. He excelled in good looks and greatly resembled his mother.
>
> In the olden days the favorite occupation of Lihue chiefs was spear throwing and the best instructors hailed from this locality. (*Ka Nūpepa Kū‘oko‘a*, Aug. 26, 1865, translation in Sterling and Summers 1978:23)

Līhu‘e was also the home of a famous cannibal king-man, Kaupe, who overthrew the ruling chiefs to become the paramount power between Nu‘uanu and the sea. He had a home and a *heiau* in Līhu‘e. Kaupe was a *kapua*, a supernatural being who could take the form of a man or a dog; this type of dog man was known as an ‘*ōlohe*. Although he left the O‘ahu *ali‘i* alone, he killed many commoners in the area, and eventually sailed to the island of Hawai‘i on a raid, where he captured a chief’s son; he planned to sacrifice this boy at his *heiau* in Līhu‘e. The father came to O‘ahu, and with the help of the priests of the Hawaiian hero, Kahanaiakeakua, was able to free his son, escape back to Hawai‘i, and eventually kill the dog-man, Kaupe (Westervelt 1963:90-96).

2.4.4 Hill of Maunauna

The hill Maunauna lies between the lands Paupauwela and Līhu‘e. one translation of Maunauna is “mountain sent [on errands]. Two servant *mo‘o* who lived here had no keepers to supply their needs” (Sterling and summers 1:178a. in Pukui *et al.* 1974:149). It was at Maunauna, according to one tradition, that the forces of the chiefs Kūali‘i and Kuiaia of Wai‘anae met to do battle, but was averted when a *mele* honoring the god Kū was chanted (see previous section). (Fornander 1917, Vol IV, Part 2:348). In the Legend of Ke-ao-melemele, a woman named Paliuli traveled in this area.

> In a very short time she [Paliuli] walked over the plain of Ewa; Ewa that is known as the land of the silent fish [pearl oysters]…She went on to the plain of Punalu‘u and turned to gaze at Maunauna point and the plain of Lihue. (Manu 1885, translation in Sterling and Summers 1978:21)

Certain place names in the uplands, including Maunauna, are also mentioned in the story of Lo-lae’s Lament. The place of Lolale’s residence is given in King Kalākaua’s version of this story. According to him (Kalākaua 1990:232): “There lived there at that time in Lihue, in the district of ‘Ewa, on the island of Oahu, a chief named Lo-lale, son of Kalona-iki, and brother of Piliwale, the *alii-nui*, or nominal sovereign, of the island, whose court was established at Waialua.”

> In this story, Lolale was a chief of O‘ahu who asked his friend Kalamakua to find him a bride (Kalākaua 1990:228-246; Skinner 1971:217-219). Kalamakua traveled to Maui and chose Kelea, the chief’s sister, and returned with her to O‘ahu; during this time the two grew close. Kelea lived with Lolale for a while, but he was a silent type that was often away from home playing sports and walking in the woodlands. Longing for Kalamakua, Kelea decided to leave her husband, Lolale voiced no “spoken bitterness;” however, after she left, he sang this lament:
>
> Farewell, my partner of the lowland plains,
> On the waters of Pohakeo, above Kanehoa,
> On the dark mountain spur of Mauna-una!
> O, Lihue, she is gone!
> Sniff the sweet scent of the grass,
> The sweet scent of the wild vines
> That are twisted by Waikoloa,
> By the winds of Waiopua,
> My flower!
> As if a mote were in my eye.
> The pupil of my eye is troubled.
> Dimness covers my eyes. Woe is me!
> [Kalākaua 1990:244-245].

2.5 Prehistory and Early History

Various Hawaiian legends and early historical accounts indicate that the *ahupua‘a* of Honouliuli was once widely inhabited by pre-contact populations, including at least recreational use by the Hawaiian *ali‘i*. This would be attributable for the most part to the plentiful marine and estuarine resources available at the coast, along which several sites interpreted as permanent habitations and fishing shrines were located. Other attractive subsistence-related features of the *ahupua‘a* include irrigated lowlands suitable for wetland taro cultivation (Hammatt and Shideler, 1990), as well as the lower forest area of the mountain slopes for the procurement of forest resources.

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

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

These upper valley slopes may have also been a significant resource for sporadic quarrying of basalt for the manufacturing of stone tools. This is evidenced in part by the existence of a

probable quarrying site (50-80-12-4322) in Makaīwa Gulch at 152 m. (500 ft.) a.m.s.l. (Hammatt et al. 1991).

The Hawaiian *ali‘i* were also attracted to the region, which is steeped in myth.

> Ko ‘Ōlina is in Waimānalo near the boundary of ‘Ewa and Wai‘anae. This was a vacationing place for chief Kākuhihewa and the priest Napuaikamao was the caretaker of the place. Remember reader, this Ko Ōlina is not situated in the Waimānalo on the Ko‘olau side of the island but the Waimānalo in ‘Ewa. It is a lovely and delightful place and the chief, Kākuhihewa loved this home of his. (*Ke Au Hou* July 13, 1910

Other early historical accounts of the general region typically refer to the more populated areas of the ‘Ewa district, where missions and schools were established and subsistence resources were perceived to be greater. However, the presence of archaeological sites along the barren coral plains and coast of southwest Honouliuli *Ahupua‘a*, indicate that prehistoric and early historic populations also adapted to less inviting areas, despite the environmental hardships.

Barbers Point is named after Captain Henry Barber who ran aground on October 31, 1796. Subsequent to western contact in the area, the landscape of the ‘Ewa plains and Wai‘anae slopes was adversely affected by the removal of the sandalwood forest, and the introduction of domesticated animals and new vegetation species. Domesticated animals including goats, sheep and cattle were brought to the Hawaiian Islands by Vancouver in the early 1790s, and allowed to graze freely about the land for some time after. It is unclear when the domesticated animals were brought to O‘ahu; however, L.A. Henke reports the existence of a longhorn cattle ranch in Wai‘anae prior to 1840 (in Frierson, 1972;10). During this same time, perhaps as early as 1790, exotic vegetation species were introduced to the area. These typically included vegetation best suited to a terrain disturbed by the logging of sandalwood forest and eroded by animal grazing. The following dates of specific vegetation introduced to Hawai‘i are given by R. Smith and outlined by Frierson:

> 1) "early", c. 1790:
> Prickly pear cactus, *Opuntia tuna*
> Haole koa, *Leucaena glauca*
> Guava, *Psidium guajava*
>
> 2) 1835-1840
> Burmuda [sic] grass, *Cynodon dactylon*
> Wire grass, *Eleusine indica*
> 3) 1858 Lantana, *Lantana camara*
>
> The *kiawe* tree was also introduced during this period, either in 1828 or 1837. (1972:10-11)

Figure 5 Trails of Leeward O‘ahu as Described by ‘Ī‘ī. Map by Paul Rockwood. (‘Ī‘ī, 1959:96)

2.6 Mid to late 19th Century

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

Samuel Kamaukau relates the following about Kekau‘onohi as a child:

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

Kekau'onohi was one of Liholiho's (Kamehameha II's) wives, and after his death, she lived with her half-brother, Luanu‘u Kahala‘i‘a, who was governor of Kaua‘i (in Hammatt and Shideler 1990: 20). Subsequently, Kekau‘ōnohi ran away with Queen Ka‘ahumanu's stepson, Keli‘i-ahonui, and then became the wife of Chief Levi Ha‘alelea. Upon her death on June 2, 1851, all her property was passed on to her husband and his heirs. When Levi Ha‘alelea died the property went to his surviving wife, who in turn leased it to James Dowsett and John Meek in 1871 for stock running and grazing.

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

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

Ewa Plantation Co. grew quickly and continued in full operation up into modern times. As a means to generate soil deposition on the coral plain and increase arable land in the lowlands, the Ewa Plantation Co. installed ditches running from the lower slopes of the mountain range to the lowlands and then plowed the slopes vertically just before the rainy season to induce erosion (Frierson 1972:17). Two ditches, which were likely used for this procedure, are still present along the southern boundary of the project area.

2.7 Summary

Based on the above summary of areas of Honouliuli settlement the following general considerations are made to place the project area in the context of the *ahupua'a* pattern. 1). There are three areas of Hawaiian settlement in the *ahupua'a*; two are well documented and the inland settlement in the vicinity of Pu'uku'ua is problematic. The two well documented areas are

a) The extensive limestone plain with recurrent use habitations for fishermen and gatherers and sometime gardeners, and

b) The rich cultivated lands of Honouliuli *'ili* for extensive wetland taro and clearly the *ahupua'a* population center;

2) The uplands around Pu'uku'ua (approximately three miles north of the current project area) were most likely utilized for agriculture and forest resources. These uplands would include the current project area, though based on the previous documentation of similar areas little in the way of traditional permanent occupation sites would be expected.

3) Honouliuli is designed as a unit to contain all the geographic elements of a typical Hawaiian valley *ahupua'a*, except they are arranged geomorphically in an atypical relationship. The *ahupua'a* is not organized around a single drainage network but shares the west portions of Waikele drainage in its upper reaches. A typical and highly advantageous characteristic for human subsistence is included in a vast coastline and fringing reef, an extensive limestone plain which would support only limited agriculture but may have been excellent for bird catching in early times. The richest forest land for foraging for wood, birds, feathers, etc. would have been the east slope of the Wai'anae Range, in the general vicinity of the current project area. The *mauka/makai* route would have been up Honouliuli Gulch or up the Makakilo ridge, paralleling the coast from Honouliuli Gulch to Kahe. The most convenient route to *mauka* lands, even from the western end of the coast (Ko'Ōlina) would have been *mauka* only to the base of the hills and then either up the Makakilo Ridge or northeast to a trail to Pu'uku'ua and Pōhākea Pass. The *makai* slope is the dry side of the ridge line. Here streams would respond to rainfall quickly but drain quickly leaving little available water for even short-term use.

4) The *makai* slope of the Wai'anae Range (i.e. *mauka* of Ko'Ōlina) was not heavily utilized. We can see some very limited evidence of part-time agriculture in and around gulches and two foci of sparse habitation with the first limited to *makai* portions of gulches and upper coastal flats. This habitation is considered a *mauka* component or continuation of the Ko'Ōlina coastal settlement rather than an independent focus. The second focus, separated from the first by a barren zone, is generally above the 800 foot elevation and includes the current project area (eastern flank of Wai'anae Range). This *mauka* habitat, which could have been supported by seasonal dryland planting and forest foraging, may be the lower portion of a thinly scattered but widespread zone of settlement. This zone stretches eastward and northeast along the east Wai'anae Range slopes and may increase in intensity along the better watered lands forming the *mauka* western boundary of Honouliuli.

5) The central place of the *ahupua'a* of Honouliuli in terms of population, as well as cultivated foods, was the *'ili* of Honouliuli. There is good reason to assume, given the

lack of intensive agricultural resources in other locations during pre-contact times, that all other habitation zones were economically and socially co-dependent.

Within the project area, approximately 30% of the land has undergone significant land altering activities associated with commercial agricultural ventures. The plowing and grading of the land has likely disturbed many archaeological resources that existed prior to Western influences.

Section 3 Previous Archaeological Research in the Vicinity

This cultural impact assessment report will focus on the previously accomplished archaeological inventory survey of the present Makaiwa Hills project area (Hammatt et al. 1991) and the few studies that comprise the small amount of research that has been conducted along the southern slopes of the Wai‘anae Range in Honouliuli Ahupua‘a (Figure 6).

The earliest attempt to record archaeological remains in Honouliuli Ahupua‘a was made by Thomas Thrum (1906) (Table 1). He reports the existence of a *heiau* located on Pu‘u Kapolei, approximately 1 mile (1.6 km) southeast of the current project area. Pu‘u Kapolei Heiau is described as "Ewa-size and class unknown. Its walls thrown down for fencing" (Thrum 1906:46).

In his surface survey of 1930, archaeologist J. Gilbert McAllister recorded the specific locations of important sites, and the general locations of less important sites (at least at Honouliuli). Archaeological investigations by McAllister along the southern slopes of the Wai‘anae Range identified a number of sites that are of interest.

McAllister documents Pu‘u Kapolei Heiau as Site 138 and notes:

> The stones from the heiau supplied the rock crusher which was located on the side of this elevation, which is about 100 feet away on the sea side. There was formerly a large rock shelter on the sea side where Kamapuaa (the pig-god) is said to have lived with his grandmother (Kamaunuaniho). (McAllister 1933:108)

McAllister's Site 136 is located near Mauna Kapu, northwest of the current project area, and is described as a small platform on the ridge dividing the ‘Ewa and Wai‘anae districts. The 4 to 6 square foot platform was constructed of coral and basalt stones, and was believed to be an altar (McAllister 1933:107). It is noted to have been destroyed by the time of Sterling and Summers' work in the late 1950's (Sterling and Summers 1978:32).

McAllister's Site 137 is at Pu‘u Ku‘ua, a prominent landmark 1.8 miles (2.9 km) north of the current project area. Pu‘u Ku‘ua Heiau is described by McAllister as:

> (Destroyed) The heiau was located on the ridge overlooking Nanakuli as well as Honouliuli at the approximate height of 1800 feet. Most of the stones of the heiau were used for a cattle pen located on the sea side of the site. The portion of the heiau which has not been cleared for pineapple has been planted in ironwoods. (McAllister 1933:32)

The presence of Pu‘u Ku‘ua *heiau*, provides some archaeological evidence of the Pu‘u Ku‘ua settlement described in the Hawaiian Newspaper "*Ka Loea Kalai‘āina*".

None of these sites are in the immediate vicinity of the current project area. However, the presence of extant or former archaeological remains demonstrates Hawaiian use of these *mauka* lands.

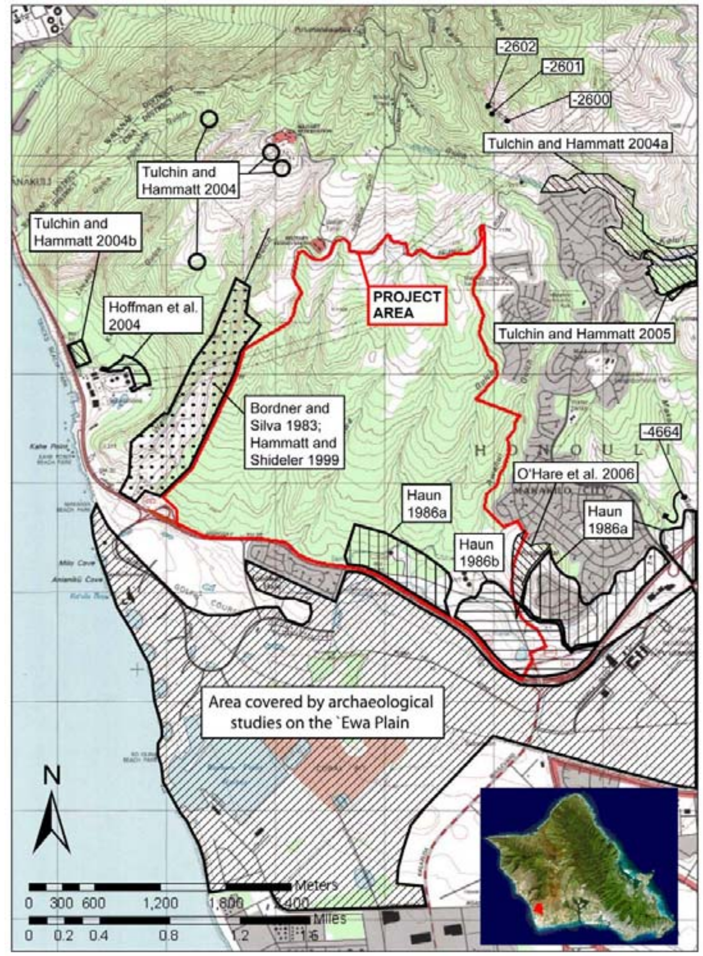


Figure 6. A portion of the 1998 ‘Ewa USGS 7.5-minute topographic quadrangle showing the current project area and previous archaeology completed in the vicinity

Table 1. Previous Archaeological Investigations in the Uplands of Honouliuli Ahupua'a

Reference	Type of Investigation	General Location	Findings
Bordner 1977a	Archaeological Reconnaissance	Proposed Makaīwa Gulch Landfill Site	No archaeological sites identified
Bordner 1977b	Archaeological Reconnaissance	Proposed Kalo'i Gulch Landfill Site	3 sites (-2600, -2601, -2602), low stacked boulder walls
Bordner and Silva 1983	Archaeological Reconnaissance and Historical Documentation:	Proposed Waimānalo Gulch Landfill Site	No archaeological sites identified
Sinoto 1988	Archaeological Reconnaissance	Makakilo Golf Course	low stacked boulder wall (-1975)
Bath 1989	Petroglyph Documentation	Waimānalo Gulch	3 petroglyphs (-4110)
Hammatt et al. 1991	Archaeological Inventory Survey	Makaīwa Hills Project Site	34 sites, including prehistoric habitation and agricultural features, rock shelters, petroglyphs, *ahu*, and various sugar cane cultivation infrastructure
Hammatt 1992	Archaeological Inventory Survey	KAIM Radio Tower, Pālehua	No archaeological sites identified
Nakamura et al. 1993	Archaeological Inventory Survey	Makakilo D and D-1 Development Parcels	cement irrigation flume (-4664)
Borthwick 1997	Archaeological Assessment	Satellite Multi-Ranging Station, Pālehua	No archaeological sites identified
Dega et al. 1998	Archaeological Inventory Survey	UH West O'ahu	Two historic site complexes, (50-80-08-5593 historic irrigation system and 50-80-09-2268 Waiahole Ditch System)
Hammatt and Shideler 1999	Archaeological Inventory Survey and Assessment	Waimānalo Gulch Sanitary Landfill Project Site	Battery Arizona Complex and modern "shrine" site
Hoffman et al. 2004	Archaeological Assessment	30 acres next to the Kahe Power Plant	No historic properties
Tulchin and Hammatt 2004	Archaeological Field Inspection	North of Waimānalo Gulch	Three prehistoric archaeological features

Reference	Type of Investigation	General Location	Findings
Tulchin and Hammatt 2004a	Archaeological Inventory Survey	86 acres in Kalo'i Gulch	4 historic era sites: concrete and iron structures (-6680), boulder clearing mounds (-6681), small terrace (-6682), and a portion of the Waiāhole Ditch (-2268)
Tulchin and Hammatt 2004b	Archaeological Inventory Survey	24 acres next to the Kahe Power Plant	4 sites (-6647 to -6650): predominantly historic ranching era related ruins
Tulchin and Hammat 2005	Archaeological Inventory Survey	71 acres north of Pu'umakakilo	3 sites: prehistoric agricultural alignment and mound (-6666), plantation-era boulders walls and ditch (-6667), and a prehistoric agricultural terrace (-6668)

Recent archaeological investigations in the southern Wai'anae Range have generally been focused on deep gulch areas for potential landfill locations, lower slopes for residential development, and mountain peaks for antennae or satellite tracking infrastructure (Table 1).

Relatively few archaeological sites have been located by archaeological studies made in the vicinity of the current project area (Figure 6). Kalo'i Gulch, which borders the northern portion of the current project area, was also surveyed as a potential landfill location (Bordner 1977b). The archaeological reconnaissance survey included lands within Kalo'i Gulch and its smaller tributaries from the *makai* end of the gulch up to the 1,400 ft elevation. It was noted that lands at the base of the gulch, *makai* of an historic quarry, were extensively modified by bulldozing. In the *mauka* portions of the project area, three sites, possibly prehistoric, were identified (Figure 6). The three historic properties (50-80-12-2600, -2601, -2602) consisted of low stacked basalt boulder walls located along the north side of the Kalo'i Stream channel.

During the initial archaeological survey of the lower portions of Waimānalo Gulch (the future site of the Waimānalo Gulch Sanitary Landfill), up to the 430-foot elevation, no archaeological sites were identified (Bordner and Silva 1983). In 1989, three petroglyph units (historic property 50-80-12-4110) were located within the previously surveyed parcel (Bath 1989). Historic property 50-80-12-4110 is located in the southwest corner of Waimānalo Gulch, at approximately 80 ft. elevation.

Further archaeological study within Waimānalo Gulch was conducted for the expansion of the sanitary landfill (Hammatt and Shideler 1999). No archaeological sites were located with the project area, however two sites, the Battery Arizona bunker complex and a modern "shrine" site, were observed along the northern ridge which separates Waimānalo Gulch from the HECO Kahe Power Plant property. The stones of the "shrine" site were understood to have been previously relocated from the central portion of Waimānalo Gulch circa 1988.

Makaīwa Gulch, the next major gulch east of Waimānalo Gulch was also surveyed as a potential landfill location (Bordner 1977a). The reconnaissance survey included lands within Makaīwa Gulch from Farrington Highway, *mauka* to the approximate 1000 ft (305 m) elevation. No significant archaeological sites were identified.

Archaeological studies relevant for the current project area are two reports by Alan Haun of the archaeological firm Paul H. Rosendahl, Inc. (PHRI). The first is a letter report entitled *Preliminary Archaeological Reconnaissance Survey for Environmental Assessment (EA) 'Ewa Town Center/ Secondary Urban Center, Land of Honouliuli, 'Ewa, Island of Oahu (TMK: 9-1-15: Por. 4, 5, 17; 9-1-16:1, Por. 4, 6, 9, 16, 18, 24, 30: 9-2-19: Por. 1)* (Haun 1986a). This study covered a petition area of approximately 1,400 acres, and extends into the *makai* portion of the current project area (Figure 6). The second is *Preliminary Archaeological Reconnaissance Survey for Environmental Assessment (EA) 'Ewa Town Center/ Secondary Urban Center, Land of Honouliuli, 'Ewa, Island of Oahu* (*TMK: 9-1-15: Por., 5, 17; 9-1-16:Por. 9)* (Haun 1986b). This study covered a petition area of approximately 200 acres and overlaps the southeast corner of the current project area (Figure 6).

The Haun studies note the extensive modification for sugarcane cultivation and conclude that only two sites had been previously reported in the vicinity: the OR&L alignment (SIHP 50-80-12-9714) well to the south of the current project area and the *heiau* and large rock shelter recorded by McAllister (1933) on Pu'uokapolei (SIHP 50-80-12-138). Pu'uokapolei was outside of the Haun study area and was not checked by him during his field survey. Haun identified two sites within the current project area: an irrigation ditch (a portion of the same SIHP 50-80-12-4341 identified during the 200-acre survey), and a rock wall that paralleled the irrigation ditch. This wall was later designated Site 50-80-12-4314. Both of these historic properties were later addressed by Hammatt et al. (1991) and found to be non-significant.

Archaeological inventory survey of the Makakilo D and D-1 Development Parcels included lands on the southern and western slopes of Pu'u Makakilo, adjacent to the golf course property. A single historic property, a cement irrigation flume (SIHP # 50-80-12-4664), was located in the southern portion of the project area near the H-1 Freeway (Nakamura et al. 1993).

Tulchin and Hammatt (2004a) conducted an inventory survey of the approximately 86-acre proposed Pālehua Community Association (PCA) Common Areas on the northwestern side of Makakilo. The elevation of that project area (approximately 400-1100 ft) makes it comparable to the present project area. Historic sites located during the inventory survey included: a complex of concrete and iron structures associated with industrial rock quarry operations (SIHP # 50-80-12-6680); three boulder mounds believed to be related to land clearing or ditch construction by the O'ahu Sugar Co. (SIHP # 50-80-12-6681); a small terrace believed to function as an historic water diversion feature (SIHP # 50-80-12-6682); and a remnant portion of the Waiāhole Ditch (SIHP # 50-80-09-2268). No prehistoric historic properties were identified.

A parcel of land adjacent to the Kahe Power Plant was the subject of an archaeological inventory survey (Tulchin and Hammat 2004b). Four historic properties were identified. The first (SIHP # 50-80-12-6647), consists of a ranch-related stacked limestone slab wall, an agricultural terrace, and a possible fishing shrine. The second (SIHP # 50-80-12-6648) includes three cement, brick and dressed basalt boulder ruins related to an historic structure. The third (SIHP # 50-80-12-6649) is an historic water diversion wall. The fourth (SIHP # 50-80-12-6650) comprises a collection of predominantly limestone boulder and cobble agricultural mounds and platforms.

An additional 30 acres adjacent to the Kahe Power Plant were the subject of an archaeological assessment (Hoffman et al. 2004). No historic properties were discovered.

Tulchin and Hammatt (2004) undertook a field inspection of four locations to the north of Waimanalo Gulch. Three small stone features were identified: an *ahu*, a stone terrace, and a small C-shape. An archaeological inventory survey was recommended should any construction activities be proposed for those parcels of land.

Tulchin and Hammat (2005) conducted an additional inventory of a 71-acre parcel adjoining the PCA which had been previously surveyed. Three historic properties were identified. SIHP # 50-80-12-6666 is a prehistoric agricultural alignment and mound. SIHP # 50-80-12-6667 consists of plantation-era stacked basalt boulder walls and a ditch. SIHP # 50-80-12-6668 is made up of two features: a single alignment of upright basalt boulders and a small, low terrace. Both features were thought to be prehistoric agricultural features.

3.1 Archaeological Inventory Survey of the Makaīwa Hills Project Area

In 1990 Cultural Surveys Hawaii was requested by William E. Wanket Inc., Land Use Consultant for the Estate of James Campbell, to undertake an archaeological inventory survey for the approximately 1,780.705-acre proposed Makaīwa Hills development project (TMK 9-1-15: 5, 11, 17; 9-1-16: Portion 9; 9-2-03: Portion 2) located in the *ahupua'a* of Honouliuli, 'Ewa, Island of O'ahu. The archaeological inventory survey (Hammatt et al. 1991) was reviewed and approved by the State Historic Preservation Division.

The survey and limited testing were conducted between September 24 and late October, 1990. During the fieldwork, 34 historic properties were located, including habitation structures (permanent and temporary), agricultural features (terrace and mounds), rock shelters, a possible rock shelter quarry, petroglyphs, *ahu*(s) and various other structures associated with sugarcane cultivation attributable to the 'Ewa Plantation Company.

Eighteen of the 34 recorded historic properties were considered "likely to yield information important to prehistory and history". Of these 18 historic properties, four were also evaluated as an excellent example of a site type. Thus, it was recommended that all of the 17 historic properties that were considered significant be subjected to a program of subsurface testing followed by intensive excavation of selected sites to address scientific/informational significance preceding developmental impact and removal of sites. It was additionally recommended that the four sites evaluated as excellent site types be considered for preservation pending results of subsurface testing. SIHP # 50-80-12-2893, already recommended for preservation, is no longer in the project current area.

Of the 34 historic properties, sixteen, including structures associated with the Ewa Plantation Company, historic cattle walls and various other amorphous and disturbed mounds and *ahu*(s), were considered to be no longer significant and were not recommended for further work. Detailed data recovery and preservation plans were called for to be prepared and submitted to the State Historic Preservation Office (DLNR) for review and approval.

Surface collection took place in only a handful or historic properties. Only two 50 cm square test units were excavated and no radiocarbon samples were submitted for dating.

3.1.1 Summary of Site Types

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

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

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

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

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

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

3.1.2 Petroglyphs

Two sites contain petroglyph figures in association with habitation features.

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

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

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

Table 2. Site Summary with Recommendations and Significance (adapted from Hammatt et al. 1991)

State Site # (50-80-12)	Description/Function	Significance	Recommendations
4310	Enclosure/Historic hunting shelter	NLS	None
4311	Wall/Cattle wall	NLS	None
4312	C-Shape enclosure/Temporary habitation	D	Data Recovery
4313	Terrace/Agricultural	D	Data Recovery
4314	Wall/Associated w/sugarcane cultivation	NLS	None
4315	Terrace/Associated w/sugarcane cultivation	NLS	None
4316	Wall-alignment/Poss.cattle wall	NLS	None
4317	Circular enclosure; platform/Recurrent habitation	D	Data Recovery
4318	Circular enclosure/Temp. habitation-shelter	D	Data Recovery
4319	Rockshelter w/interior terrace/Perm. hab	C, D	Data Recovery, P+
4320	Retaining wall/Historic road	NLS	None
4321	Rockshelter w/interior terrace/habitation	C, D	Data Recovery, P+
4322	Rockshelter w/interior *ahu*/Quarry	D	Data Recovery, P+
4323	*Ahu*/Marker	NLS	None
4324	Mound; *ahu*/Agricultural	D	Data Recovery
4325	C-shape enclosure; *ahu*/Temp. Habitation	D	Data Recovery
4326	Enclosure/Temporary habitation	D	Data Recovery
4327	*Ahu*/Marker	NLS	None
4328	Rockshelter complex (3)/Permanent habitation	D	Data Recovery, P+
4329	Enclosure/Modern	NLS	None
4330	Platform/associated w/sugarcane cultivation	NLS	None
4331	L-shape enclosure/Temp. habitation	D	Data Recovery
4332	Circular enclosure/Temp. habitation	D	Data Recovery
4333	Wall Segment & bulldozed pile/Sugarcane cult.	NLS	None
4334	Circular enclosure/Temporary habitation	D	Data Recovery
4335	Mound/Disturbed clearing mound	NLS	None
4336	Rectangular enclosure/Recurrent habitation	D	Data Recovery
4337	Circular enclosure/Temp. habitation	D	Data Recovery
4338	Rockshelter complex/Permanent habitation	C, D	Data Recovery
4339	Platform/Associated w/sugarcane cultivation	NLS	None
4340	Circular enclosure/Sugarcane cult. pumphouse	NLS	None
4341	Ditch/Sugarcane irrigation	NLS	None
4342	Circular Structure/Sugarcane cult. reservoir	NLS	None

Key

C Site is an excellent example of a site type
D Site may be likely to yield information important in prehistory or history
NLS No Longer Significant
P+ Possible Preservation: Pending Data Recovery Results

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

3.1.3 Prehistoric Habitation Sites

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

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

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

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

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

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

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

3.1.4 Agricultural Sites

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

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

3.1.5 Walls

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

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

3.1.6 Ahu(s)

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

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

3.1.7 Sugarcane Cultivation Infrastructure

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

3.2 Summary of Site Distribution

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

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

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

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

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

Section 4 Community Contact Process

Throughout the course of this study, an effort was made to contact and consult with Hawaiian cultural organizations, government agencies, and individuals who might have knowledge of and/or concerns about traditional cultural practices specifically related to the project area. CSH made this effort by letter, e-mail, telephone, and in personal contact. In the majority of cases, a letter along with a TMK map and a USGS topographical map of the project area were mailed with the following text:

> In collaboration with Group 70 Cultural Surveys Hawai‘i (CSH) is conducting a Cultural Impact Assessment for the proposed Makaīwa Hills Project ‘Ewa District, Honouliuli Ahupua‘a, O‘ahu Island (TMK [1] 9-1-015: 005, 011 & 017; 9-1-016:9 por.; 9-2-003: 002 por) new TMK [1] 9-1-015:005 por. and 017; 9-2-003:002 por., 005 por., and 084 por. A map of the project area is enclosed for your reference.
>
> The purpose of this assessment is to identify any traditional cultural practices associated with the project area, past or present, pursuant to Hawaii revised Statutes 343. We are seeking your *kōkua* and guidance regarding the following aspects of our study:
>
> - **General history and present and past land use of the study area;**
> - **Knowledge of cultural sites that may be impacted by the project, for example historic sites, archaeological sites, and burials;**
> - **Knowledge of traditional gathering practices in the study area, both past and on-going;**
> - **Cultural associations with the study area through legends, traditional use or otherwise;**
> - **Referrals of *kūpuna* or anyone else who might be willing to share their general cultural knowledge of the study area; and,**
> - **Any other cultural concerns the community might have related to cultural practices in the Honouliuli area.**
>
> I invite you to contact me, Kēhaulani Souza at (808) 262-9972 or send me an e-mail at ksouza@culturalsurveys.com if you have any information you would like to share

The individuals, organizations, and agencies attempted to be contacted and the results of any consultations are presented in the table below

Table 3 Community Contacts and Comments

Name	Affiliation	Comments
Ailā , William	Hui Malama I Na Kupuna	Mr. Ailā feels it is very important to preserve the sites of this area. See Traditional Cultural Practices below for response.
Amaral, Annelle	‘Ahahui Siwila Hawaii O Kapolei Hawaiian Civic Club	Made referral to Shad Kane.
Cope, Aggie	Hale O Na‘auao Society	See Traditional Cultural Practices below for response.
Desoto, Frenchy	Wai‘anae Coast Archaeological Preservation Representative	Made referral to Gary Omori, William ‘Ailā .
Eaton, Arline	*Kupuna* at Iroquois Elementary School	See Traditional Cultural Practices below for response.
Enos, Eric	Cultural practitioner and director of Kalala Farms	Mr. Enos is concerned about the sites in the project area and feels the sites in Nānākuli Valley are related to the sites in the project area.
Flanders, Judith	Granddaughter of Alice Kamōkila and James Campbell	See Traditional Cultural Practices below for response.
Greenwood, Alice	O‘ahu Island Burial Council Member, Wai‘anae District	Aunty Alice spoke vaguely of a *mo‘olelo* (story) long ago about a village at Makaīwa-she recalls a story about the author of the *mo‘olelo* attending a ceremony in the area that mentioned possible burials. She remembers the *mo‘olelo* had the names of the unknown gulches. She also spoke about the *huakai‘pō* (procession of the night marchers) and *akua lele* (Flying god, usually a poison god sent to destroy, sometimes in the form of fireballs). See Traditional Cultural Practices below for response.
Johnson, Rubellite	Hawaiian scholar	Ms. Johnson recommended consulting people who are from the project area.
Josephides, Analu	O‘ahu Island Burial Council Member, Wai‘anae District	See Traditional Cultural Practices below for response.
Kanahele, Kamaki	President of Nānākuli Homestead	See Traditional Cultural Practices below for response.
Kane, Shad	Member of the Makakilo, Kapolei, Honokai Hale Neighborhood Board and ‘Ahahui Siwila Hawaii O Kapolei Hawaiian Civic Club	Mr. Kane made two site visits with CSH to the project area. Mr. Kane is very concerned about the cultural sites within the project area and wants to be involved in the preservation process. He is also concerned

Name	Affiliation	Comments
		about the view plane. See letter from ‘Ahahui Siwila Hawaii O Kapolei Hawaiian Civic Club in Appendix A.
Makaiwi, Martha	Makakilo, Kapolei, Honokai Hale Neighborhood Board No. 34	Made referral to Maeda Timson and Shad Kane.
McKeaque, Kawika	O‘ahu Island Burial Council	O‘ahu Island Burial Council
Nāmu‘o, Clyde	Administrator at Office of Hawaiian Affairs	See Appendix B for OHA letter.
Philpotts, McD	Campbell Estate heir and long time resident of the area	See Traditional Cultural Practices below for response.
Stone, Tom	Cultural Practitioner-Hōlua Expert	Mr. Stone made a site visit with CSH to the project area. Mr. Stone is concerned about human burials and cultural sites in the area.
Tiffany, Nettie	Kahu of Lanikūhonua and O‘ahu Island Burial Council, ‘Ewa District	See Traditional Cultural Practices below for response.
Timson, Maeda	Member of the Makakilo, Kapolei, Honokai Hale Neighborhood Board No. 34 and President of Ua Au O Kapolei	Mrs. Timson shared two stories told to her by her Tutu Defreitas, and the lady in white. Her *tutu* would bless the *hale* with *ti* leaf and Hawaiian salt because all the *keiki* would get *maka‘u* (scared). They also had *ti* leaf on all four corners of the house for protection.

Section 5 Cultural Resources and Practices

The areas of Makaīwa, Ko‘Ōlina, Lanikūhonua and the uplands of Pu‘uku‘ua are within the ‘Ili of Waimānalo of the Ahupua‘a of Honuliuli, ‘Ewa District (See Figure 11) ‘Ili is defined as “a land section, next in importance to *ahupua‘a* and usually a subdivision of an ahupua‘a” (Pukui 1971:91).

The current project area was a zone of less intensive land use between two resource rich areas of *mauka* and *makai* of the present project area. The *makai* area is rich in marine resources a canoe landing, a *ko‘a* (fishing grounds) and *lo‘i* (pondfield) that sustained a fishing village. The *mauka* area is considered a sacred place with its many heiau, myths and legends.

Although this area has been placed in the district of ‘Ewa and the Ahupua‘a of Honouliuli, some Wai‘anae district community members feel a strong connection to this area as many traverse this area every day to get in and out of Wai‘anae. Participants also mentioned the many (past) natural and cultural resources of the region.

Discussions of specific aspects of traditional Hawaiian culture during information gathering interviews and “talk story” sessions are incorporated throughout this section as they may relate to the proposed project area. Some of the interviews provided below are excerpted from past cultural impact assessments conducted by CSH. Interviewees for the current project gave their permission for past interviews to be included in this report.

5.1 Traditional Hawaiian Beliefs

A number of *kūpuna* and others in the community spoke of beliefs associated with the Waimānalo ‘Ili of Honouliuli area including Makaīwa. While these beliefs and traditions are interrelated, they are discussed below in terms of the presence of *‘uhane* (souls, spirits, ghosts), traditions of *huaka‘i pō* (procession of the night marchers), a legend of a slain girl, a legend of two giants, and a tradition of owl *‘aumakua* (ancestor gods), in addition to accounts of other mysterious and strange incidents.

Association with *‘Uhane* (Spirits)

Several people familiar with the area mentioned that Waimānalo Gulch and Makaīwa Gulch are associated with *‘uhane*. In Nānā i Ke Kumu, a source book on Hawaiian cultural practices, concepts and beliefs, *‘uhane* are introduced as follows:

> Says Mary Kawena Pukui of certain of her ancestral beliefs, “Some things are *‘e‘epa.* Unexplainable. ”Accept that, and it becomes easier to know about *‘uhane.* For in Hawai‘i’s religious mystic tenets, *‘uhane* was:
>
> The animating force which, present in the body, distinguished the quick from the dead. And so *‘uhane* can be called “spirit.”
>
> The vital spark, that departed from the flesh, lived on through eternity, rewarded for virtue or punished for transgressions in life. Thus *‘uhane* is “spirit” in the immortal sense, and the “soul” of Christian concept.
>
> Or, as immortal spirit or soul, the *‘uhane* might return to visit the living and so be termed a “ghost”. (Pukui et al. Vol. I, 1972:193)

The presence of ‘*uhane* at Honouliuli’s Waimānalo Gulch was mentioned previously in a Cultural Impact Assessment for Waimānalo Gulch Landfill by: Black Ho‘ohuli, who is a cultural practitioner and Nānākuli Hawaiian Homestead resource person and by; Gary Omori, who was the consultant for Ko‘Ōlina Resort at the time the Waimānalo Gulch landfill was proposed; Maylene Keamo, who is the Wai‘anae Ahupua‘a Council President; and by Alice Greenwood a *kupuna* in the Wai‘anae area (Souza 2002).

Often the perception seems to be more a matter of the person feeling the presence of the *‘uhane* in the area rather than knowledge of transmitted lore. Mrs. Keamo also talked about the wandering spirits.

Wandering *(‘auana*) spirits were particularly associated with desolate places in ‘Ewa District. Samuel Kamakau (Mo‘olelo Hawai‘i, Vol. II, Chap. 12, p 23) associates them with the plain of Kama‘oma‘o, the rough country of Kaupe‘a and Leilono - all in ‘Ewa District. The belief was that these wandering souls were friendless and wandered in desolate places like the plain of Kaupe‘a catching night moths (*pulelehua*) and spiders (*nanana*) for food (*Ke Au Hou*, July 12, 1911; *Ka Po‘e Kahiko* 1964:49).

5.1.1 Huaka‘i Pō or ‘Oi‘o (Procession of the Night Marchers)

There are Hawaiian beliefs regarding the presence of what are popularly known as “night marchers” and the *huaka‘i pō* or the, “night procession or parade, especially the night procession of ghosts that is sometimes called *‘oi‘o*” (Pukui and Elbert 1986:84). According to Hawaiian tradition, the night marchers are the souls of those who have passed on. An *`ōlelo no`eau* (proverb) makes reference to this tradition: “*He pō Kāne kēia, he mā`au nei nā `e`epa o ka pō.”* (This is the night of Kāne, for supernatural beings are wandering about in the night) (Pukui 1983:98; O.N. #908).

> Family ties in the afterworld remain unbroken, and all Hawaiians believe in the power of sprits to return to the scenes they know on earth in the form in which they appeared while they were alive. Especially is this true of the processions of gods and spirits who come on certain sacred nights to visit the sacred places, or to welcome a dying relative and co0nduct him to the aumakua world. “Marchers of the night” (Hauaka‘ipo) or “Spirit ranks” (Oi‘o) they are called. Many Hawaiians and even some person of foreign blood have seen this spirit march or heard the “chanting voices, the high notes of the flute, and drummi8ng so loud as to seem beaten upon the side of the house.” Always, if seen, the marchers are dressed according to ancient usage in the costume of chiefs or of gods. If the procession is one of gods, the marchers move five abreast, with five torches burning red between the ranks, and without music save that of the voice raised in chant. Processions of chiefs are accompanied by aumakua and march in silence, or to the accompaniment of drum, nose-flute, and chanting. They are seen on the sacred nights of Ku, Lono, Kane, or Kanaloa, or they may be seen by day if it is a procession to welcome the soul of a dying relative. To meet such a procession is very dangerous. “O-ia” (Let him be pierced) is the cry of the leader and if no relative among the dead or none of his aumakua is present to protect him, a ghostly spearsman will strike him dead. The wise thing to do is to “remove all clotting and turn face up and feign sleep.” (Beckwith 1970:164).

Several of the participants in this cultural study talked about night marchers. Aunty Arline Eaton commented that there is a pathway for the night marchers that travel from the *mauka* area of Waimānalo 'Ili down to the special place of Lanikūhonua. She feels strongly that this pathway must be kept clear for them to continue their traditional passage.

Aunty Aggie Cope and Kamaki Kanahele both mentioned that the 'Ili of Waimānalo was well known for the pathway of the night marchers and they both feel it is of great importance to keep that pathway clear of visual impact.

Judith Flanders mentioned that her grandmother Kamōkila Campbell spoke about the night marchers trail that came from the uplands to the ponds at Lanikūhonua.

Mrs. Nettie Armitage-Lapilio related a tradition that at certain times of the year night marchers would come down from the uplands to the vicinity of Kamōkila Campbell's place on the coast (Lanikūhonua). The procession route indicated was on the east ridge of Waimānalo Gulch which is the west ridge of Makaīwa Gulch (Souza 2002).

Analu Josephides recalls *mo'oleo* told to him by his *kūpuna*:

> I grew up knowing about the land area known as Makaiwa. My mother, my Tutu Wahine, as well as, *kūpuna* within my*'ohana* had shared various stories about this area. One of the many stories shared and landscapes pointed out is both the path of the night marchers and of the night marchers themselves. One of the stories that Tutu Wahine related was that in the old days no homes were built in this particular area except for the *mauka* area of Makaiwa to the west, the *mauka* area to the east known as Makakilo, and the *makai* area below where in ancient time was the dwelling place of the Kamapua'a *'ohana* .
>
> We were told as children that one of the reasons that homes were not built on the path of the night marchers were that the night marchers and those who leaped from this world and taken to be with these clans were said to carry the burning *kapu* of Pihenakalani. This was a *kapu* that descends from Kaua'i from the ancient days of the Mu and the Menehune people. It was also known as the prostrating *kapu* of Kalanikauleleiaiwi.
>
> *Tutu* went on to state that if a *hale* was built upon the path of the night marchers that it would be destroyed by fire. A similar life story occurred in Opihali, South Kona, Hawaii where a grand-uncle of my *Tutu* Wahine named Ioane Kuahiwinui was said to have warned his brother not to build his home in a certain area in Opihali or else the night marchers would take it; and sure enough when the *hale* was finished, on the night of the night marchers, the new *hale* was burned to the ground. Not long after this home was built and burned did they build another home in a location off and away from the path of the marchers and till today that home is standing, *makai* of Mamalahoa highway near the 95 mile marker.
>
> *Tutu* spoke of how nothing should be on the path of the night marchers as when they came through they would destroy anything and everything in their way. It is also believed that if a person was on the path of the night marchers they would prostrate themselves and keep their face hidden lest they are succumbed to

> the marchers and join them in their realm. The story continues, that if the night marcher came upon you and you were not family nor the chief of the particular area they would take your soul and you would continue your spiritual life marching with them forever. It is believed that in this particular area called Makaiwa that Hiiakaikapoliopele, the sister of Pele would be the last one in the night marchers' line because of her back having been placed under *kapu;* therefore no one was allowed to walk behind her.
>
> For these historical reasons the path of the night marchers should be preserved so that the marchers who are the ancestors of many of our *Kanaka Maoli* [native born] can continue to travel.

Mrs. Nettie Tiffany discussed her childhood memories about what her aunty called the "bird catchers". They would come down from the Waimānalo and Makaīwa Gulch area through a trail that was marked by a large *pōhaku* (stone). The bird catchers would come down from the gulch to take a bath in the waters fronting Lanikūhonua.

The following is an insert regarding night marchers from the 'Ahahui Siwila Hawaii O Kapolei (Appendix A):

> There were many stories associated with night marchers walking from the area of Lanikuhonua mauka crossing Farrington Hwy in the area makai of Honokai Hale and walking mauka by way of Makaiwa Gulch. When Kamōkila Campbell lived at Lanikuhonua she had always left an opening in the Naupaka hedge that separated the beach from her property. This opening in the hedge was cut to allow night marchers to pass through the area on their way mauka. Members of the Campbell family have shared this story. There are many unexplained accidents that have occurred on Farrington Hwy between Honokai Hale and the entrance to Ko Olina when drivers turned off the road in an effort to avoid something that they saw, or thought they saw, ahead of them.

5.1.2 Legend of Two Giants

A legend told by Mrs. Alice Greenwood (Aunty Alice) tells of two giants who live in the Waimānalo and Makaīwa area. The legend indicates that when one giant opens his eyes it means the giant will take someone's life. There is concern that these legends may be connected with unexplained car accidents that have occurred on Farrington Highway in front of the two gulches. Few details of this legend were provided.

There are also several accounts of giants in the vicinity. The Hawaiian gods Kāne and Kanaloa, who are sometimes understood to have the capacity of supernatural size, are associated with the area of Piliokahe where stones they hurled from red hill landed (Simeon Nawa`a, 1954 in Sterling and Summers 1978:1). Simeon Nawa'a related another account of Piliokahe associating two hills with a male and a female - seemingly of fabulous size. The demi-god Maui is associated with the southern Wai'anae area (particularly Lualualei) and is often thought of as a giant in his superhuman efforts to snare the sun, etc.

5.1.3 Legend of the Slain Girl

These '*uhane* may be explained by a few legends concerning the Waimānalo Gulch area. Mr. Omori tells about one legend of two lovers:

> …the girl is hunted down and killed in the Waimānalo Gulch. People say that the girl's *'uhane* lingers in this gulch and an image of a white lady appears at times and strange things happen in the area. For example, unexplained car accidents happen on Farrington Highway.

This account has strong similarities to the famous legend of Kahalaopuna, the young woman of Mānoa who is murdered repeatedly (she revives repeatedly) by Kauhi, her jealous lover from Ko'olau. Enraged at accounts of her sleeping with various lovers, Kauhi leads Kahalaopuna through the uplands of south O'ahu traveling west from Mānoa Valley (with Kahala being slain repeatedly). While the many accounts differ in detail a common setting for the last of the beatings is Pōhākea Pass in Honouliuli north of the project area. After being put to death, her *'uhane* flies up into an *'ōhia lehua* tree and calls out to travelers passing along the road asking them to inform her parents of her death. An interesting aspect of the story is:

> *Kū iho lā ka huakai e ho'olohe, i kēia leo,*
>
> *e kanaka paha, he makani paha,*
>
> *he 'uwī lā'au paha.*
>
> *'Elua oli ana o Kahalaopuna, maopopo ia lākou, he 'uhane ua make*
>
> The travelers stood and listened, to this voice
>
> Was it a person or perhaps the wind
>
> Or the rubbing together of trees.
>
> The travelers are at first uncertain but when she cries a second time they know it is a spirit that has died. (Fornander 1919: Vol. V 192-193)

While it is certainly possible that Mr. Omori's account is unrelated, similarities include: a woman who is slain by her lover in the uplands of Honouliuli, that the slain woman's spirit lingers in the vicinity of her death, and that the spirit causes unexpected events to travelers. The nature of the legend of Kahalaopuna, with events happening in many different places, lends itself to becoming incorporated in other settings - particularly desolate areas in which the sound of the wind or creaking trees might sound like a human voice.

5.1.4 'Aumakua *Pueo* of the 'Ili of Waimānalo

Many people consulted for this project mentioned the frequent sighting of *pueo* (owl) in the area. Gary Omori and William 'Ailā mention that the *pueo* was the *'aumakua* of the *'ohana* in the area (Souza 2002). In Nānā i Ke Kumu, a source book on Hawaiian cultural practices, concepts and beliefs, the concept of *'aumakua* (plural *'aumākua*) is introduced as: "ancestor gods; the god spirits of those who were in life forebears of those now living; spiritual ancestors" (Vol. I, 1972:35). *'Aumākua* fall into the English category of totems and were typically animal or plant species. *'Aumākua* could be inherited bilaterally, from both the father's and mother's kin groups (*'ohana*). Each individual had the opportunity to retain multiple *'aumākua.* Mary

Kawena Pukui's childhood education included memorizing the names of fifty of her family *'aumākua* (Nānā i Ke Kumu Vol. I, 1972:356). Aunty Aggie Cope mentioned that there was a rock in Waimānalo Gulch that resembles a *pueo.* The presence of the Pueo Rock connects the traditions and beliefs directly to this area. *Pueo* are often seen hunting in grasslands. The Waimānalo and Makaīwa Gulches are typical habitat for *pueo*, and *pueo* are *'aumākua* for Hawaiian families living near open grassland areas. Many people who currently live in this area frequently see the *pueo*.

5.2 Burials

Most Hawaiians in the pre-contact period belonged to the *maka`āinana* or commoner class and their bones were usually buried in no other area than their particular *`ili*. Burials are commonly reported from clean, consolidated sand deposits, which was clearly a common method of internment practiced by Hawaiians (Cleghorn 1987:42).

Commenting on the nature of burial areas and body positions used in burial, William Ellis (1827: 361-363) says: "The common people committed their dead to the earth in a most singular manner." The body was flexed, bound with cord, wrapped in a coarse mat, and buried one or two days after death. Graves were ". . . either simply pits dug in the earth, or large enclosures . . Occasionally they buried their dead in sequestered places at a short distance from their habitations, but frequently in their gardens and sometimes in their houses. Their graves were not deep and the bodies were usually placed in them in a sitting posture" (*Ibid*.). Hawaiians placed significance on the *iwi* that were regarded as a lasting physical manifestation of the departed person and spirit. "The bones of the dead were guarded, respected, treasured, venerated, loved or even deified by relatives; coveted and despoiled by enemies" (Pukui *et al*., 1972:107).

It seems likely that the remains thus far documented in the vicinity of the project area relate to common traditional mortuary practices. The burials discovered in the vicinity of the project area are likely to be related to normal population demographics than battle deaths or human sacrifices. There were no burials reported in the project area and the closest known burials were found in the Ko'Ōlina and Lanikūhonua in caves, sand dunes and sink holes. Additionally, in the past there has been some reinterment of *iwi* in the mauka portion northwest of the project area.

Mrs. Nettie Tiffany urged caution in regards to burials in the project area, she feels although the land has been heavily altered by ranching and other activities there is still a possibility of finding *iwi kūpuna.* She also strongly suggests that there be a plan of action if there are burials found during the project.

The Office Of Hawaiian Affairs urges caution although the area has been altered in the past:

> Native Hawaiian burials sites have been found just on and under the surface to depts. of eight or nine feet depending upon the nature of the terrain. Furthermore, the nature of documented interments in the 'Ewa area (stone pits, sink holes, crypts, etc.) could lead to the survival of these sites despite intensive agricultural activities on the surface….if any significant cultural deposits or human skeletal remain area encountered, work shall stop in the immediate vicinity and the State Historic Preservation Division (SHPD/DLNR) shall be contacted. (See Appendix B)

Aunty Arline also commented if people lived in the area there might be a possibility of burials:

> My only thought is that for every person that lives in that area, that's where they bury their people… We never said anything if people died, we'd go over there and they'd bury them right there where the house is. We'd never go four-hundred-million-miles away, it's right there. All your *'ohana* stay right in the same area. We never went afar, not in the rural areas.

5.3 Trails

Trails served to connect the various settlements throughout the District of ‘Ewa. Based on nineteenth and twentieth century maps the primary transportation routes *mauka/makai* correlated closely to the existing major roadways. John Papa ‘I‘ī describes a network of Leeward O‘ahu trails that in later historic times encircled and crossed the Wai‘anae Range, allowing passage from West Loch to the Honouliuli lowlands, past Pu`uokapolei and Waimānalo Gulch to the Wai‘anae coast and onward, circumscribing the shoreline of O‘ahu (‘Ī‘ī 1959:96-98). Following ‘I‘ī's description, a portion of this trail network would have passed close to the presently existing Farrington Highway.

It seems clear that a major east/west artery from ‘Ewa and Kona O‘ahu to Wai‘anae ran just south of Makaīwa Gulch roughly along the Farrington Highway alignment (See Figure 5). “As mentioned before, there were three trails to Waianae, one by way of Pu‘u o Kapolei, another by way of Pohakea, and the third by way of Kolekole” [‘Ī‘ī 1959:97].

‘Ī‘ī, who was born about 1800, also recounts an incident at Waimānalo that occurred when he was eight or nine years old. While the young ‘Ī‘ī was staying at Nānākuli, he learned:

> …of the burning of the houses in Waimanalo. The overseer in charge of the burning told [‘Ī‘ī and his relatives] that it was so ordered by the royal court because the people there had given shelter to the chiefess, Kuwahine, who ran away from her husband Kalanimoku after associating wrongfully with someone. Kuwahine was the daughter of the Kaikioewa who reared Kamehameha III in his infancy. She had run away because she had been beaten for her offense and for other reasons, too, perhaps. She had remained hidden for about four or five days before she was found. Here we see the sadness that befell the people through the fault of the chiefs. The punishment fell on others, though they were not to blame. (‘Ī‘ī 1959:29).

Ī‘ī's sad account reveals that the coastal Waimānalo portion of Honouliuli Ahupua‘a continued to be inhabited into the early 19th century.

The following is an insert regarding ancient trails (Appendix A) from the ‘Ahahui Siwila Hawaii O Kapolei letter:

> There may have once existed an intersection of 2 trails in the approximate location where the present entrance to Ko Olina exist today. In ancient times there were 3 ways to get to Wai‘anae. One was by way of Kolekole, one was by way of Pohakea and the 3rd was by way of Pu‘uokapolei. Farrington Highway follows the path of the ancient trail that passed Pu‘uokapolei.

> Generally, petroglyphs are found on the high ground between Waimanalo and Makaiwa Gulches indicating that a trail may have once existed in this area, again confirming a mauka-makai path. The existence of this trail is supported by numerous amounts of cultural resources and structures built along this lineal mauka-makai relationship that follows the path of Waimanalo and Makaiwa Gulches.

The petroglyph site mentioned above (SIHP 50-80-12-2893) is located outside the southwest corner of the current project area (see previous archaeology section). The mauka/makai trail mentioned above is probably the one depicted on the 1914 fire Control Map (See Figure 7). The trail starts at the area of the petroglyphs (SIHP# 2893) and goes up between the east end of Waimānalo Gulch and the west end of Makaīwa Gulch. This trail is most likely a pathway to the former village of Pu‘u Ku‘ua and the heiau in this mauka region of Honuliuli. This mauka/makai trail would have also intersect with the well known trails of upper Honouliuli, Pohakea Pass, Kolekole and Palikea which all lead to Kūkaniloko, the center or the piko of the Island of O‘ahu.

Another mauka/makai trail is depicted on the 1873 Alexander map (See Figure 8) of Honouliuli. The trail went from the uplands of Pu‘umanawahua, Palikea (shown on map as “wooded hill”), Kapuai and Pu‘ukuua passing Pu‘umakakilo straight to Pu‘uPālailai, then to the coast of Ko‘Ōlina where there was once a village.

On a site visit with Shad Kane a paved road was found in the project area, this is most likely historic in nature and will be discussed in the Inventory Survey Report (O'Leary 2006).

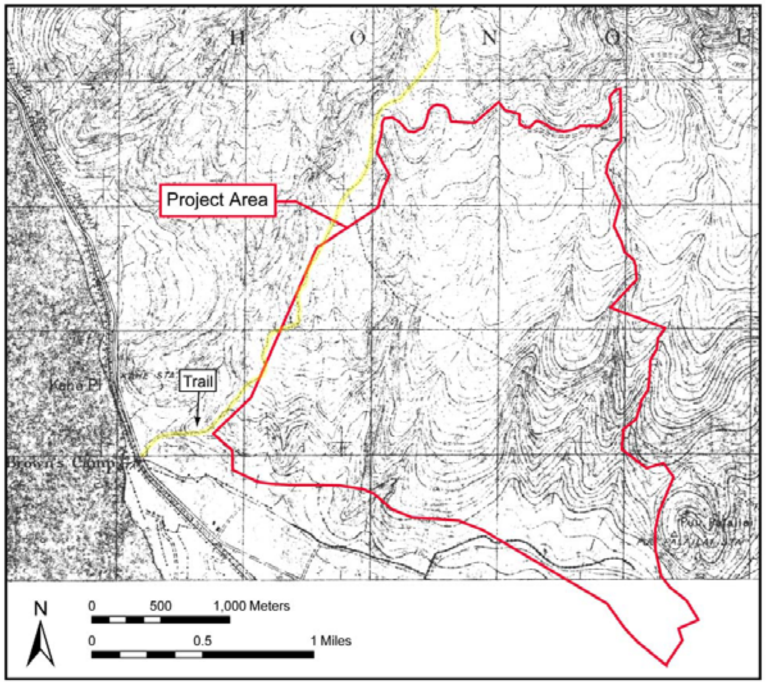


Figure 7. 1914 Fire control map showing mauka/makai trail west of the project area

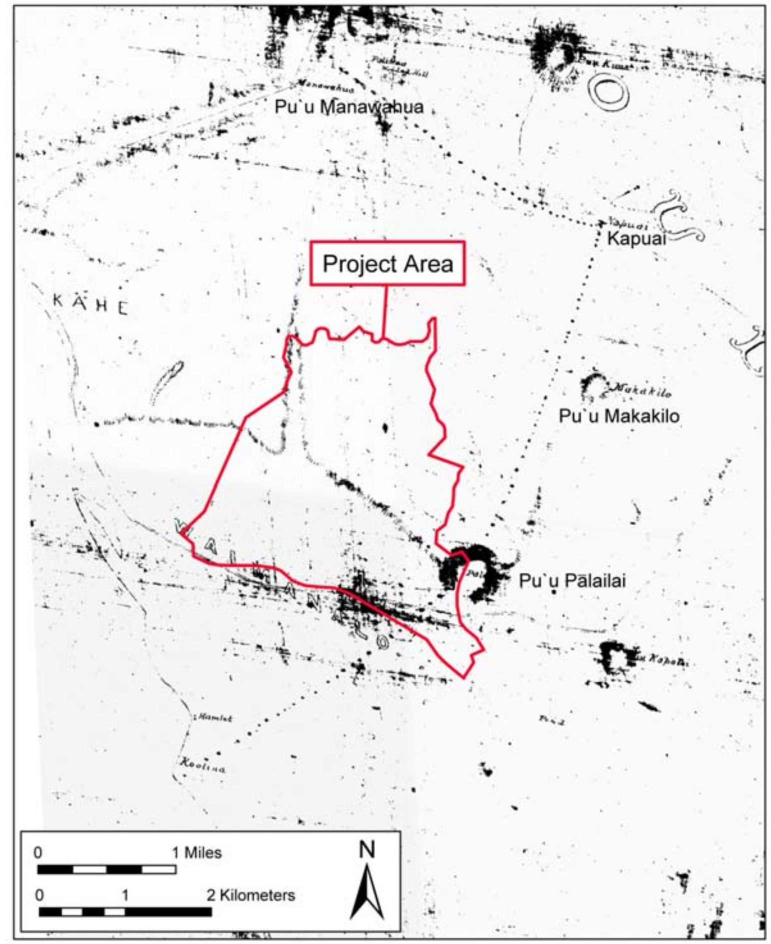


Figure 8. 1873 Alexander map showing mauka/makai trail from Ko'Ōlina to Pu'umanawahua and a Hamlet (village) where the trail ends at the coast Ko'Ōlina

5.4 Gathering of Plant Resources

Given the ecosystem diversity of coastal lowland, transition, and upland forest zones in Honouliuli Ahupua‘a, it is likely that one of the primary traditional cultural practices associated with the present project area would have been the gathering of native plant resources. Table 4 lists Honouliuli lowland plants and uses with columns for "common/Hawaiian name", "scientific name" and "use" based on research conducted by Barbara Frierson (1973) on native plant species present in Honouliuli before 1790, in addition to plant use recorded by Isabella Abbott (1992).

Table 4. Native Plants in Honouliuli

Hawaiian/Common Name	Scientific Name	Use
Hala, pandanus	*Pandanus odoratissimus*	Weaving
Hau, hibiscus	*Hibiscus tiliaceus*	Cordage
Milo	*Thespesia paradisiaca*	Wood used for bowls
Neneleau, Sumac	*Rhus sandwicensis* *Rhus chinensis*	Unknown
‘Ilima	*Sida cordifolia*	Leis, medicine
Kou	*Cordia subcordata*	Bowls
Makaloa, sedge	*Cyperus laevigatus*	Mats (Abbott)
Pili grass	*Heteropogon contortus*	Thatch
Kakonakona, grass	*Panicum torridum*	Unknown
Honohonowai	*Commelina nudiflora*	Unknown
Ma‘o, cotton	*Gossypium tomentosum* *Abutilon incanum*	Flowers used as dye for kapa (Abbott)
‘Ūlei	*Osteomeles anthyllidifolia*	Branches used for fishing nets (Abbott)
‘Uhaloa	*Waltheria americana*	Medicine (Abbott)
Koali‘ai	*Ipomoea cairica*	Cordage (Abbott)
Pā‘ū o Hiiaka	*Jacquemontia sandwicensis*	Unknown
Ko‘oko‘olau	*Bidens* sp.	Use as tea (Abbott)
‘Ulu, breadfruit	*Artocarpus incisus*	Food
Taro	*Colocasia esculenta*	Food
Niu, coconut	*Cocos nucifera*	Food, liquid

The accessibility of Honouliuli lands, including the present project area, to the Hawaiians for gathering or other cultural purposes would be radically curtailed during the second half of the nineteenth century. As noted above in this evaluation, by the 1870s, herds of cattle grazing across the ‘Ewa Plain likely denuded the landscape of much of the native vegetation. Subsequently, during the last decade of the nineteenth century, the traditional Hawaiian landscape was further distorted by the introduction and rapid development of commercial sugar cane cultivation. Throughout the twentieth century sugar cane cultivation was the dominating land use activity within the project area. Cane cultivation – and the sense that the project area was private property – restricted access inside the project area to employees of Ewa Plantation

5.5 Taro in Hawaiian Culture

In this section, the cultural connections of Hawaiians to taro will be discussed.

Taro cultivation was mentioned in two of the LCA testimonies for individual kuleana claims in the ‘Ili of Waimānalo of Honouliuli Ahupua‘a. The testimonies indicated that these LCA's contained at least two *lo‘i* as well as house lots, sweet potato, *kula*-at Pu‘ukuua, ponds, streams and fishery. The taro cultivation here was not as intensive as the well known "Honouliuli Taro Lands" near the mouth of Pear Harbor or the Honouliuli Stream. Apparently Waimānalo ‘Ili had sufficient water along with backshore swampy areas to provide personal *lo‘i* on a small scale. Although these claims were not awarded they provide a wealth of information. See Appendix C to view the two LCA claims.

The area of Lanikūhonua south of the project area was once a marshy wetland feed by a natural springs, this would have been ideal place to cultivate taro. Davis, Haun and Rosendahl conducted a study in 1986 and provided a map of the natural marshy area and spring that could have fed a *lo‘i* (See Figure 10). Many maps show water filtering down from the Waimānalo and Makaīwa Gulches as well as the unnamed gulches that also could have feed the *lo‘i* of this area (See Figure 12). There is no mention of taro grown in the project area but there were natural springs that could sustain a small patch and evidence of agriculture terraces. Aunty Nettie Tiffany and Aunty Arline Eaton both expressed that the area of Waimānalo, Makaīwa, and Lanikūhonua all had sources of fresh water.

Taro has an intimate connection to the Hawaiian culture. Taro (*kalo*; *Colocassia esculenta*) was probably brought to Hawai‘i by the earliest Polynesian voyagers and has been a staple crop on the islands ever since. Taro is intimately connected through myth to the origins of Hawaiians as a people. There are different versions of this myth, but all of them make the connection between the first-born Hawaiian and the taro plant, according to Mary Kawena Pukui:

> The first Hāloa, born to Wākea and Ho‘ohoku-ka-lani, became a taro plant. His younger brother, also named Hāloa, became the ancestor of the people. In this way, taro was the elder brother and man the younger-both being children of the same parents (Pukui in Handy and Handy 1972:80).

The physical attributes, the growth patterns, and the propagation of taro all reflect the structure of Hawaiian kinship and an obvious relationship to the human body. The main plant in the center is the *makua* (parent), the smaller plants budding out of the *makua* are the *‘ohā* (offspring). The center of the leaf where it connects to the stem is the growth center of the veins of the leaf and is called the *piko* (belly button). The stem is called *ha*, which is also a word for breath, the basis of life. The cycle of planting is a reflection of the human life cycle. When the taro is harvested the *kalo* (corm) is cut right below the green top, the cut top is called the *huli* (turning, returning or transforming). The *huli* is replanted and the family of taro once again continues its growth cycle. The generations of taro are thought of interchangeably with the generations of Hawaiians as reflected in the saying "*Kalo kanu o ka 'āina*"-literally "taro planted on the land" but figuratively referring to successive generations of natives (Pukui 1983:157). Both the *'ohā* and the *makua* can be used as *huli,* but as in a family, the '*oha* (child) must be separated to become independent of the parent and – to become a parent itself. If it is not, it remains a dependent attachment, overshadowed by the leaves of the *makua*. Another saying, *I makika'I kekalo I ka 'ohā*-"the goodness of the taro is judged by the young plant it produces" (Pukui 1983:133), is a metaphor for the parents being judged by the behavior of their children.

All parts of the taro plant are used for food: the corm is cooked and eaten as table taro or steamed and pounded into *poi*; the stem can be steamed and used in various soup and stew dishes; the young leaves are used for *laulau* and *lū'au* dishes mixed with fish, squid, pork, chicken or beef. Generally, the leaves are not harvested from the plants designated for corm production because continuous cutting makes the corms soft and tasteless (*loli*). Taro growers who grow leaf for home use or commercial purpose always have specially designated *lū'au* patches. It is traditional Hawaiian practice to use all the coarse green cuttings that are the by-product of the harvesting of the corns as food for the pigs. This green material, when cooked and fed to the animals, is highly nutritious. For this reason, raising pigs is traditionally is symbiotic relationship to taro production. In a traditional taro field, no space is wasted. The *lo'i* are used for the taro and any extra space on the banks is used for subsistence, utilitarian and medicinal plants, such as bananas, *noni*, and *ti*.

The practice of taro cultivation most resembles gardening in its scale and methods. Much of the work is undertaken by an individual or family, and is performed by hand. The *lo'i* and banks are beautifully manicured, ostensibly for weed control but the result is aesthetically like a garden. Yet, taro production remains viable even on this small scale because of its high per-acre productivity.

Nowhere else in the world was taro cultivation more developed than in Hawai'i (Kirch 1985:215). It was the staple for the hundreds of thousands of Hawaiians before European contact. It was grown in areas with sufficient rainfall (above 30-50 inches per annum) or under dryland management. In areas of suitable water sources extensive and sophisticated irrigated systems were developed for its cultivation. The social requirement for the planning, development, and maintenance of theses irrigated systems was a stable political system and community cooperation. Although the cultivation and maintenance of individual fields could be the purview of single families or individuals, the maintenance of the water supply system, on which the entire system depended, had to be organized on a community level.

Although less than 100 varieties of taro survive today, there may have been, at one time, as many as 300 varieties in the islands, distinguished by leaf shape, corm, morphology, color and use. The labels of wetland and dryland taro do not refer to different taro varieties, but only to different cultivation practices. All varieties of taro can be grown in dryland fields and all but a few in *lo'i* (flooded fields). Today there are only a few widely-grown commercial varieties. Mechanical devices are used, such as tillers and small tractors; in some cases PVC pipes have replaced earthen or stone lined '*auwai* or waterways, and commercial fertilizers are routinely

used. A typical taro crop will take from 10 to 14 months to mature. With modern farming methods taro is one of the most productive per-acre staple crops in the world. However, in spite of these modern overlays, the bulk of the labor is done by hand in the context of the family and the essence of a traditional taro growing community. Cooperation in management of water and land resources remains an integral part of this lifestyle.

In pre-contact Hawaii, during the late prehistoric era, as documented by archaeological studies, taro cultivation was practiced in virtually every suitable locality, including floodplains in windward valleys with perennial streams, open lava and beach flats near stream systems, and moist leeward slopes. Taro was such an important crop it was even grown in artificial microenvironments created by mulching pits in lava fields.

Since European contact there has been a slow but steady decline in taro cultivation. In the late nineteenth and early twentieth centuries, many of the large taro growing areas were given over to rice planting. Taro cultivation returned on a smaller scale to these areas after development of the California rice industry. Today, commercial Hawaiian taro cultivation is confined to a few areas in the islands: Hānalei/Waioli, Hanapēpē and Waimea on Kaua'i, Waikāne/Waiāhole and Haleiwa on O'ahu, Honokohau, Ke'anae/Wailuanui on Maui, and Waipi'o Valley on the island of Hawai'i. Although taro is not grown anymore near the project area there is documents that prove there once was taro cultivation west of Honouliuli.

'Ewa was well known for its rare *kai* variety of taro that was very flavorful as well as the ability to reproduce itself over a ten year span. The Kai O *'Ewa* was grown in mounds in marshy locations. The cultivation of this prized and delicious taro led to the saying:

> *Ua 'ai i ke kāī-koi o 'Ewa.*
>
> He has eaten the Kāī-koi taro of 'Ewa.
>
> Kāī is O'ahu's best eating taro; one who has eaten it will always like it. Said of a youth of a maiden of 'Ewa, who, like the Kāī taro, is not easily forgotten (Pukui 1983:#2770).

The taro of 'Ewa was poetically referred to a man's love for a 'Ewa women that was so strong he would never leave:

> The *kai* was native to 'Ewa and was often referred to as Kai o 'Ewa. . . . An 'Ewa *kama'āina* described this in 1899: When planted, it sends up shoots, more shoots and still more shoots. Again and again it will send up new shoots, filling the mounds until they mixed with the taro of other mounds. . . . This description (*Ka Loea Kalani'āina*), June 3, 1899) indicates that in the flat, wet lowlands of 'Ewa this famous taro was grown in mounds (*pu'epu'e*) as in marshy localities. The article quoted above says that '*Kai koi* multiplies itself over and over with one planting and often last as long as ten years. No other variety or locality can equal this. This fragrant taro was likened to a woman with whom a man falls in love, and it was said that anyone who married a native of 'Ewa would come and settle there and would never leave, because of the *kai koi* of 'Ewa. Our Hawaiian writer describes two other varieties of *kai: Kai 'ele'ele*, black *kai*, has a black stalk, with dark skin on stems and leaves; its corm was tough and hard to pound. *Kai kea*, white *kai*, had a light-colored stem and leaves; the skin (of the corm) was

red, but the flesh was dark like that of black *kai*, the corm likewise tough. In 1931 we collected four varieties of *kai: kai koi*, whose corm was white, vase of stalk pink, petiole pink, with a pink edge on the leaf; *kai kea* or *keokeo* with white corm, white base, whitish stalk with red margin, and a leaf with white edge and white center and pinkish veins; *kai ‘ula‘ula* (red *kai*) with corm flesh purplish white, and cortex of corm reddish purple, base red, stalk green with black streaks becoming light green and pink above, and finally, *kai-uliuli* (dark-*kai)* with white corm and lavender cortex, red to pink base, whitish and dusky green petiole with red and white margin, and leaf with a slightly reddish center. It was the *kai keokeo* which was described as being fragrant *(‘ala*). From this was made the *poi* reserved for the chiefs (*poi ali‘i)* (Handy and Handy 1972:471)

5.6 Significant Cultural Sites

CSH previously performed an Inventory Survey of the Project Area in 1991 (Hammatt, *et al.* 1991) and an additional assessment was conducted in 2006 (O’Leary 2006). During the previous surveys CSH identified five sites for preservation (See Figure 9), and 17 sites for data recovery, (for more information on these sites see Hammatt, *et al.* 1991, O’Hare 2006, O’Leary 2006,):

50-80-12-2893 Rockshelter and petroglyphs-this site was previously found.

50-80-12-4319 Rockshelter with interior terrace

50-80-12-4321 Rockshelter with interior terrace

50-80-12-4322 Rockshelter with interior *ahu*

50-80-12-4328 Rockshelter complex (3) and petroglyph

50-80-12-4338 Rockshelter complex (3)

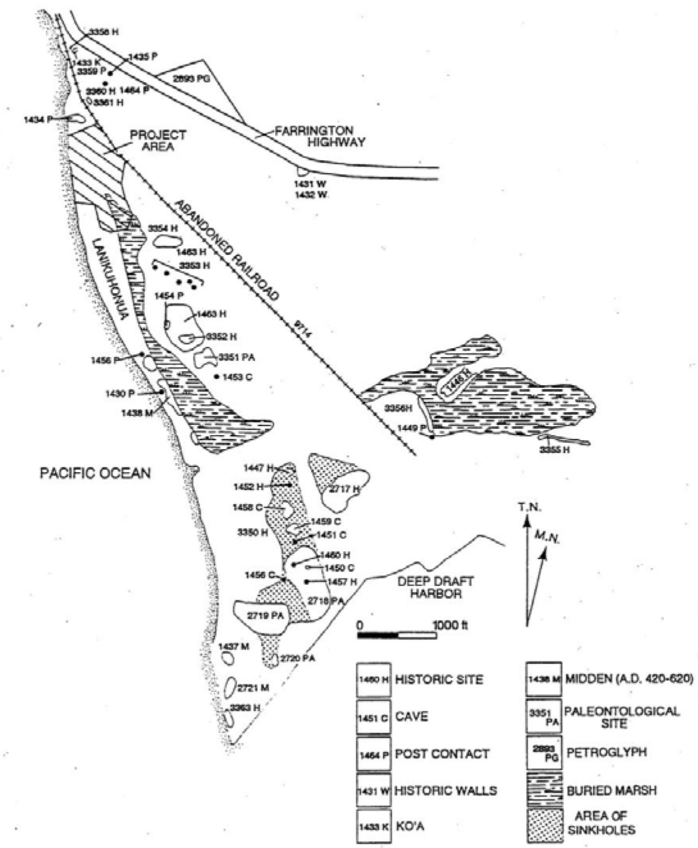


Figure 9. Pre-and Post-Contact Archaeological Sites Previously Identified in Davis, Haun, and Rosendahl, 1986 this area is south of the current project area. (Lanikūhonua-Ko‘Ōlina-Waimānalo-Paradise cove.

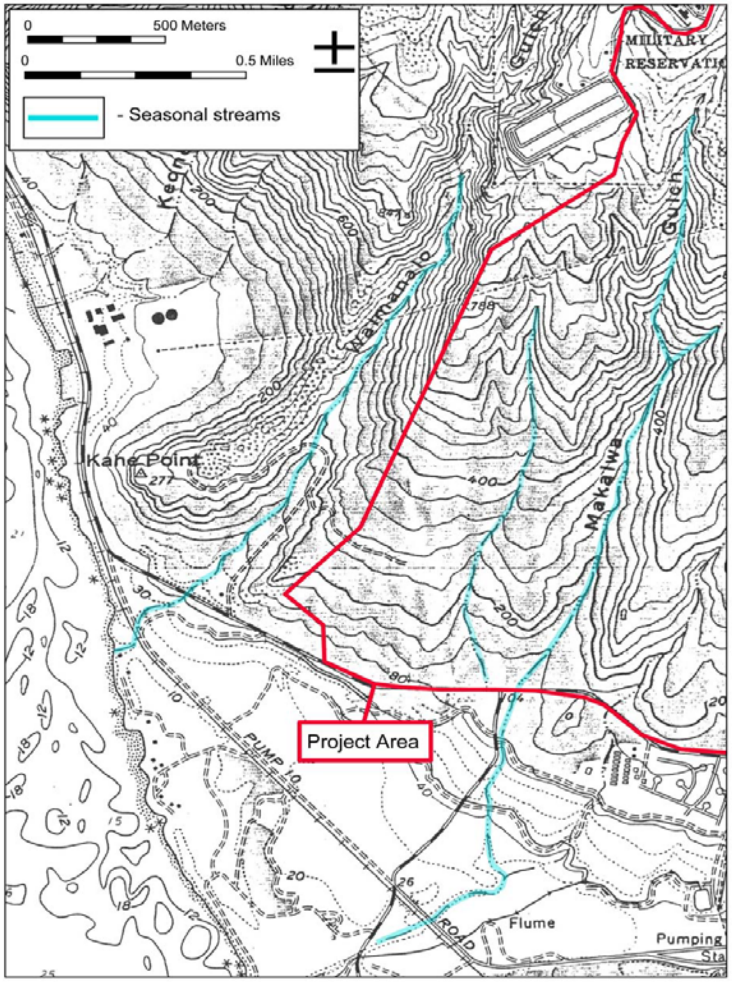


Figure 10. 1962 USGS Map showing seasonal streams

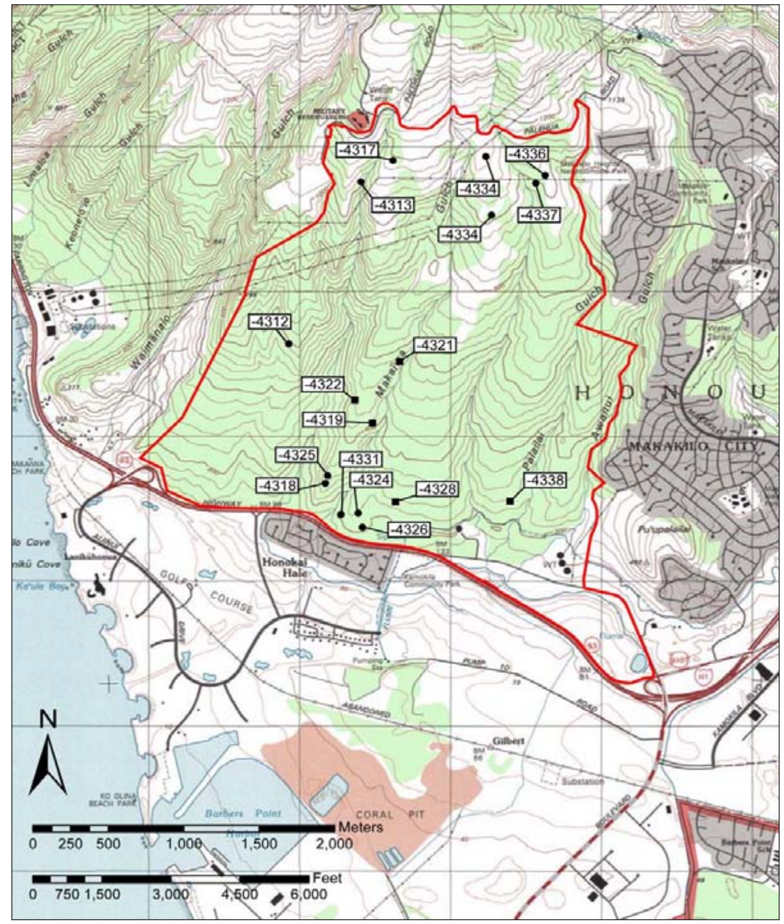


Figure 11. USGS Map showing locations of sites recommended for preservation depicted with a square and sites planed for data recovery depicted by circles.

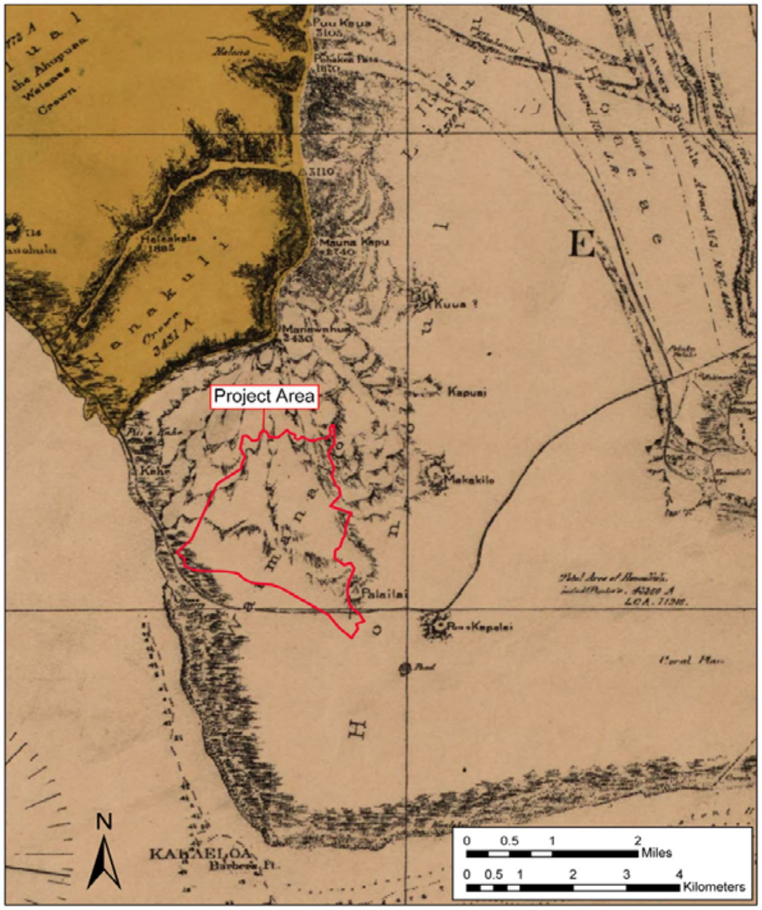


Figure 12. 1881 Hawaii Government Survey Map showing project area and the ʻIli of Waimānalo. KoʻŌlina is depicted south of the project area as well as a quarry. Also showing east/west trail

5.7 Marine Resources

The sea is a rich resource and the Hawaiian people were traditionally expert fishermen. Fish of all types supplied the Hawaiian diet with a rich source of protein. This source of food is a supplement to the things grown in the uplands. The LCA documents provide information that the people of Waimānalo area were utilizing the ocean resources as a fishery as well as the upland forest area for subsistence. This is a good example of the *ahupuaʻa* system that was once used.

Through this process a people mentioned a *koʻa* (See Figure 10) when asked about fishing south of the project area at Lanikūhonua. A *koʻa* is defined as "Fishing grounds, usually identified by lining up with marks on shore or shrine, often consisting of circular piles of coral or stone, built along the shore or by ponds or streams" (Pukui and Elbert 1971:144). Kamaki Kanahele is a Kamaʻāina to the area and recalls his childhood memories of fishing the Waiʻanae coast and using the many koʻa in the area to line up the fishing spots. Eddie Kaʻanana was an avid fisherman and did *ʻōpelu* fishing on the Waiʻanae coast. He mentioned that he did fish the traditional style on a canoe for *ʻōpelu* as well as on a boat. Other types of fish that were caught were *uʻu, akule*, and mullet. When asked about a *koʻa* he said that he is aware of *koʻa* along the Waiʻanae coast and there was abundant fish in that area, suggesting that maybe there was a *koʻa* near by (Souza 2002). William Ailā also mentioned a *koʻa* and great *akule* fishing offshore fronting the project area. Nettie Tiffany recalls her childhood memories of the shore fronting Lanikūhonua as always having abundant fish such as mullet and other reef fish. She also mentioned the *koʻa*.

Mr. George Kaʻeliwai mentioned in a telephone interview:

> We all knew how to survive through our culture by the age of thirteen. The older boys would go up mountain and I had to know how to make the *palu* (bait) for fishing. You are not aloud to talk about fishing. You just get up early and go. I knew *Tūtū* (grandmother) Campbell on the ranch. She liked me and favored me. She gave me fishing rights as long as I gave her some fish.

Additionally Mr. Kaʻeliwai confirms that there were activities related to early Hawaiian gathering practices from rich marine resources at Lanikūhonua. Mr. Kaʻeiliwai spoke about the different types of fish that he and his uncle would gather; *manini, aweoweo, uhu*, and *menpachi.* The area was a great place for diving and throw net fishing.

McD Philpotts mentioned the plentiful marine resources at Lanikūhonua where he once lived, fished and often went thro net fishing. He mentioned that Lanikūhonua was once a thriving fishing village, with a canoe landing and a fishing shrine.

Hawaiians were very conservative when it came to marine resources they set *kapu* on certain fish during their time of spawning. Here is a passage from Hawaiian Fishing Traditions that talks about the *kapu* on ʻ*ōpelu*:

> An important fishing *kapu* concerned the ʻōpelu (mackerel) and the aku (bonito), two highly prized fish caught in great numbers in Hawaiian waters. ʻŌpelu was netted from July through January. Walter Paulo and Eddie Kaʻanana, two ōpelu fishermen from Miloliʻi, told me the best time for catching this fish is in October. ʻŌpelu was placed under *kapu* in February, until the end its spawning season, around July (Moku Manu and Others 1992:xii).

5.8 *Wahi Pana* (Storied Places)

The concept of *wahi pana* (a place with a story or legend attached to it) is very important in the Hawaiian culture because it is a connection to the past and, therefore, the ancestors. From the name of a place one can know intimate details about the people who lived there, the environment, cultural practices, and historical events that took place. In Hawaiian culture, if a particular spot is given a name, it is because an event occurred there that has meaning for the people of that time. Because Hawaiian culture was based on oral traditions, place names and their stories were an important way of remembering these traditions and ensuring these stories would be passed on to future generations. In Hawaiian thinking, the fact that a place has a name deems it important. Often, spiritual power or *mana* is attached to a place, which increases its importance. On the subject of *wahi pana*, Edward Kanahele writes:

> As a native Hawaiian, a place tells me who I am and who my extended family is. A place gives me my history, the history of my clan, and the history of my people. I am able to look at a place and tie in human events that affect me and my loved ones. A place gives me a feeling of stability and of belonging to my family, those living and dead. A place gives me a sense of well-being and of acceptance of all who have experienced that place (Kanahele in James 1995:6).

Analu Josephides mentions a *mo'olelo* passed down to him by his *kūpuna* regarding some names of the Waimānalo 'Ili. The area was referred to as five brothers who protected and cared for the Island of O'ahu, they were the "Eye's" of O'ahu:

> Another concern that I may have is the place names of this particular area. A story that has been passed down to me from my Kupuna is that there were five brothers who were the watchers. Their names were Makaiwa, Makaike, Makaloa, Maka-Io, and Makakilo. It was known that Makaiwa was to the farthest west and that Makakilo was to the farthest east. That these five brothers were the eyes of the Oahu people and were their protectors. They would watch for enemy intruders and relay messages to their makulu (runners). If enemy canoes were seen the makulu would run to the various districts and warn the chief and his/her people. This is why Oahu was a hard island to conquer in the ancient times. By the time the war canoes of the enemies would reach the shores they would be greeted by the warriors of Oahu, thus the enemies were never allowed to land upon the shores of Oahu.

Below Kawika McKeaque, a member of the O'ahu Island Burial Council, sheds light and on the meaning of *wahi pana* and how Hawaiian culture is strongly rooted to the ancestors and the *'āina.* Mr. McKeaque feels that these connections need to be considered and incorporated into the project design:

> 1) Spiritual transcendence imbued into physical landscape- there is a fine line of existence and being within the worlds of the ethereal and "reality" within the entire Honouliuli Ahupua'a. This fine line between two worlds of knowing, perceiving, and attaining life essence creates a cultural/spiritual foundation for this area to provide the means for moments of revelation through various sensories. These *ho'ike* reveal themselves through *'ike papalua*, secondary sight/knowledge, *hihi'o, akaku*, and *ho'ike na ka po.*

> Even the name of *the ahupua'a* is suggestive of the deep well of knowledge and understanding that comes from the time of Po. Some of the supporting elements to this line of thought of extrasensory "enlightenment" to delve into different plains of being and existence include:
>
> a) Kapo'ulakina'u- (Kapo of the red streaked with dark) the female *akua* that provides inspiration and insight only through one's dreams- her presence demarked by the *ula* rays of the setting sun, which also belongs to Hina/Papa/Haumea;
>
> b) The area of Kaupe'a- the plains of the *ao auana*, where unsettled souls wander and dwell.
>
> c) Hoakalei- area near White Plains Beach- where it is said that Hi'iaka receives vision of the death of Hopoe and the burning groves of *lehua* on Hawai'i island.
>
> d) Pu'uomakakilo- any term with *kilo-* indicative of being able to read *ho'ailona*, second sighters, if you will
>
> e) Mo'olelo of Kamapua'a- foretells or gives Kamaunaaniho the *ho'ailona* that will reveal his death at Pu'uokapolei- the smelling burning bristles.
>
> 2) Sensory exploits of the female persona- you look at the natural landscape and you begin to understand some of the place names are related to physical, emotional, and spiritual cycles that are a natural part of a wahine's passage through and during childbirth. There's multiple loaded *kaona* in these place names but there is commonality again in sensory experiences that sustain the cyclic nature between life and death, ignorance and enlightenment, po to ao-
>
> a) Pu'umanawahua- discomfort of the stomach, nausea; to suffer great grief; also jealousy
>
> b) Pu'ukapua'i- to cause to flow, to bubble, gurgle; to vomit; to appear, as a color; variation on the word *kapua'i* also means to tread
>
> c) Pu'umo'opuna- grandchild; offspring; relative or descendant two generations later
>
> d) Puuku'ua- to release; let go; discharge
>
> e) Pu'upoulihale- again the reference to *uli-* any dark color, richness of vegetation, of seed banks; also female akua of certain sorcery; short for *'ouli-* study of omens; also the name for the developmental stage of a fetus, as the body begins to form. *Pouli* can mean darkness, sometimes ignorance (modern mental ascription to the night but a more traditional line of thinking could be that of Po, of knowledge beyond the sensory experiences of ao, of being awake, in the light; the knowledge that stems from such a time of antiquity.
>
> f) Akupu- to sprout; germinate; supernatural

g) Awanui Gulch- could reference the "large passage", indicative of birthing passage or "outburst" (alluding to Papahanaumoku/Haumea's birth of the island- geologically one of the main outvents of Wai'anae volcanic eruption);

h) Pohakea- where Pele receives the cloud omens; where Kauhi kills Kahalaopuna who is resuscitated by her *pueo* 'aumakua. I've been taught that name ascribed is Poha a Kea- the bursting forth (as thunder) of Kea (or Wakea)- presence of all the childbearing qualities and emotions; the ability of a woman to bring life into the world; of Papa to give birth to the islands, Wakea's presence must be the balance. However, some traditions cite that Papa and Lua mated to birth O'ahu in Papa's jealousy of Wakea and Ho'ohokukalani's relationship. In Pele and Hi'iaka epic, Hi'iaka undergoes a long period of visions *and mo'olelo/oli* are iterated (so much so Emerson's says there's too much going on that he purposefully does not include it in his account).

i) Palehua- I disagree with Pukui; I don't believe it's only meaning is the *lehua* enclosure; I see two other words prominent- pale and hua, the idea that this place is where the hua is protected or perhaps in another meaning one is protected by *hua*, by jealousy

j) Palikea- the cliff of Kea (Wakea)- he is detached from the processes of the childbearing activities that are evident with the form of these *pu‘u*- this distinguished "setting aside" of place for Kea further support that the mountainscape down to Pu'uokapolei is female, is lifebearing, is transcending between this life and others yet to be or that have passed before.

k) Palailai- I disagree with Pukui; I don't believe it's the "young of the lai fish"- my *hale* is on the northeast corner of its *kahua*- I believe it's to "experience or be in a state of being calm and clear"- again sensory; having clear vision or thought as something is born in thought through experience

l) Mauna Kapu- I know some say this is regards to Kakuhihewa's *kapu*. Could be- my *mana‘o* is that this point clearly defines what is Wakea and what is Papa, my *mana‘o* only...Papa giving birth- woman giving birth-probably the strongest period where Haumea thrives and is more "powerful" or omniscient than Wakea- kapu had to be established to protect both male/female sources of identity.

m) Makaiwa- I think it's a shortened version of-Maka a aiwa, as in the face (essence) of complete mystery, incomprehensible (as in caught in a wake between two worlds- again transitional, balancing between two worlds).

Understanding the meanings of these traditional place names is important to the consciousness of the Hawaiian people and the culture, it gives light to what was going on in this area in regards to the spiritual and physical nature of the whole ahupua‘a. It is imperative to keep this mana‘o alive in the sustaining of the original names of these special places.

Section 6 Summary and Recommendations

6.1 Summary

Cultural Surveys Hawai‘i, Inc. (CSH) completed this cultural impact assessment at the request of Group 70 International, Inc., for the proposed Makaīwa Hills Project Honouliuli Ahupua‘a, ‘Ewa District, O‘ahu TMK: [1] 9-1-015:005 por. and 017; 9-2-003:002 por., 005 por., and 084 por.

Honouliuli is associated with a number of legendary accounts. Many of these concern the actions of gods or demi-gods such as Kāne, Kanaloa, Māui, Kamapua‘a, the reptile deity (*mo‘o*) Maunauna, the shark deity Ka‘ahupāhau, and the demi-god hero Palila.

Hawaiian organizations, government agencies, community members, and cultural and lineal descendants with ties to Honouliuli were contacted to: (1) identify potentially knowledgeable individuals with cultural expertise and knowledge of the project area and its surroundings, and (2) identify cultural concerns and potential impacts within the project area. An effort was made to locate people with ties to Honouliuli and neighboring *ahupua‘a* who live or had lived in the region or who, in the past, used the area for traditional and cultural purposes. Nettie Tiffany, Arline Eaton, Rubellite Johnson, Aggie Cope, Kamaki Kanahele and other *kūpuna* as well as community members such as Analu Josephides, Kawika McKeaque and Shad Kane were interviewed for this assessment.

The accessibility of Honouliuli lands, including the present project area, to the Hawaiians for gathering or other cultural purposes would be radically curtailed during the second half of the nineteenth century. As noted above in this evaluation, by the 1870s, herds of cattle grazing across the ‘Ewa Plain likely denuded the landscape of much of the native vegetation. Subsequently, during the last decade of the nineteenth century, the traditional Hawaiian landscape was further distorted by the introduction and rapid development of commercial sugar cane cultivation. Throughout the twentieth century sugar cane cultivation was the dominating land use activity within the project area. Cane cultivation – and the sense that the project area was private property – restricted access inside the project area to employees of Ewa Plantation

The ‘Ili of Waimānalo including (Makaīwa, Lanikūhonua, Ko‘Ōlina, and the uplands) has been described by community participants in this assessment process as a sacred area of great cultural importance. Many of the individuals contacted or interviewed for this study have expressed concerns about cultural impacts within and beyond the boundaries of the proposed project area. These concerns are based on a traditional view of the Hawaiian landscape as a continuum, in which the ‘Ili of Waimānalo is perceived in unbroken relationship bewteem *mauka* and *makai* lands and to the ocean beyond. This relationship is reflected in the oral traditions mentioned by the people of this land, the many sites documented within the project area, as well as the many sites *mauka* and *makai*. The current project area was a zone of less intensive land use between two resource rich areas *mauka* and *makai* of the proposed project area. The *makai* area was rich in estuarine and marine resources including a canoe landing, a *ko‘a* and a *lo‘i* that sustained a fishing village.

Although community members contacted for this assessment did not comment on current or ongoing cultural practices in the proposed project area, it should be noted that several of the study participants emphasized the cultural importance of the area as a *wahi pana* (storied place), with emphasis on the significance of the *huaka‘i pō* (procession of the night marchers).

6.2 Recommendations

Hammatt et al. (1991) conducted an archaeological inventory survey of the entire 1,780.705-acre project area. The report concluded that 18 historic properties within the project area were eligible for inclusion on the Hawai‘i Register of Historic Places. Five of these were recommended for permanent preservation. The archaeological preservation plan (O'Leary 2006), being completed concurrently with this cultural impact assessment, includes the following statement:

> A total of 34 sites of varied archaeological significance were identified within the project area. Sixteen of these sites are evaluated as no longer significant because of bulldozing disturbance or lack of cultural or scientific interest beyond their plotted distribution.
>
> Eighteen of the 34 recorded sites are considered "likely to yield information important to prehistory and history". Of these 18 sites, four are also evaluated as an excellent example of a site type. Thus, it is recommended that all of the 18 sites that are considered significant be subjected to a program of subsurface testing followed by intensive excavation of selected sites to address scientific/informational significance preceding developmental impact and removal of sites. It is additionally recommended that the four sites evaluated as excellent site types be considered for preservation pending results of subsurface testing. Data recovery and preservation will be implemented through plans submitted to DLNR for review and approval.
>
> Site 50-80-12-2893 has been the subject of previous research and as a result has already been recommended for preservation. Based on the present condition of this site, it is strongly urged that the necessary preservation plans be carried out forthwith to avoid any future damage to the site. The petroglyphs are of particular concern. They should be systematically recorded and duplicated with latex casts. Preservation plans should include an interpretive program. The rock shelters (4319, 4321, and 4338), if they are to be preserved following testing and/or excavation, should have restricted access by means of a fence or other barrier to prevent vandalism. A detailed and explicit data recovery plan and preservation plan will be prepared for the sites in the project area. These plans will be submitted to DLNR for review and approval. Only the broad concepts and general recommendations are presented here in anticipation of the preparation of these plans.

Following is a list of community concerns and recommendations based on the community consultation process for this cultural impact assessment for the proposed Makaīwa Hills project residential development:

- The *huaka‘i pō* (procession of the night marchers) should be taken into account in the housing development design plans. Several community participants in this study stated that it is very important to keep the pathway clear of visual and structural blockage from *mauka* to *makai* on the east ridge of Waimānalo Gulch, west ridge of Makaīwa Gulch, to allow the *huaka‘i pō* to continue.

- Although the land has been dramatically altered, there remains a possibility that burials and other archeological sites may be present in and around the proposed project area.
- It was also strongly recommended that the project should incorporate the traditional place names of the surrounding area into the proposed development to sustain a connection to the past.

Cultural Surveys Hawai‘i Inc. recommends that community members be further consulted about these and other concerns throughout the planning process. Specific to the first concern, please note that the night marchers' procession is not a well-defined corridor. Alignment and buffer zone/s of the *huaka‘i pō* is a key conscern of community participants in this study and should be addressed in greater detail through further consultaion with the community as part of a mitigation plan. CSH can assist with the mitigation plan as required. Addressing these cultural concerns will minimize the impact of the project on Hawaiian culture, its practices and traditions.

Section 7 References Cited

Abbott, Isabella A.
1992 Lā'au Hawai'i: Traditional Hawaiian Uses of Plants. Bishop Museum Press, Honolulu, HI.

Ahlo, Hamilton M., Jr., and Robert J. Hommon
1984 *Archaeological Test Excavations at the Site of the Proposed Solid Waste Processing and Resource Recovery Facility, Honouliuli, 'Ewa, O'ahu*, Prepared for: Belt Collins and Associates by Science Management, Inc., Honolulu

Ahlo, Hamilton M., Jr., and Robert J. Hommon
1983 *An Archaeological Reconnaissance Survey of the Site of the Proposed Solid Waste Processing and Resource Recovery Facility, Honouliuli, 'Ewa, O'ahu,* Prepared for: Belt Collins and Associates by Science Management, Inc., Honolulu, June.

Athens, J. Stephen, Jerome V. Ward, H. D. Tuggle and David J. Welch
1997 *Environment Vegetation Change and Early Human Settlement on the 'Ewa Plain: A Cultural Resource Inventory of Naval Air Station, Barbers Point, O'ahu Hawai'i, Part III: Paleoenvironmental Investigations* IARII, Honolulu

Barrera, William M., Jr.
1986 *West Beach, O'ahu Archaeological Investigations*, Prepared for West Beach Estates by Chiniago Inc., Honolulu.

Barrera, William M., Jr.
1979 *Archaeological and Historic Reconnaissance of Alternate Sites for the Honolulu Program of Waste Energy Recovery*. Prepared for: City and County of Honolulu by Chiniago Inc., Honolulu.

Barrera, William M., Jr.
1979 *West Beach, Oahu: An Archaeological Survey*. Prepared for: West Beach Associates by Chiniago Inc., Honolulu.

Barrera, William M., Jr.
1975 *A Report on the Archaeological Reconnaissance Survey of the Proposed Barbers Point Harbor Area*. Prepared for: U.S. Army Corps of Engineers, Pacific Ocean Division by BPBM Department of Anthropology, Honolulu. November.

Bath, Joyce
1989 *Waimānalo Gulch Petroglyphs 80-12-4110, Waimānalo Gulch, Honouliuli, 'Ewa, O'ahu* SHPD File # O-561

Beckwith, Martha W.
1970 *Hawaiian Mythology,* University of Hawaii Press, Honolulu, HI.

Bennett, Wendell C.
1930 *Hawaiian Heiau*, Ph.D. Dissertation, Univ. of Chicago, Chicago, IL.

Bordner, Richard M.
1977 *Archaeological Reconnaissance of the Proposed Kalo'i Gulch Landfill Site, 'Ewa O'ahu Island* Archaeological Research Center Hawai`i, Inc.

Bordner, Richard M. and Carol Silva
1983 *Archaeological Reconnaissance and Historical Documentation: Waimanalo Gulch, Oahu, TMK:9-2-03:2,40,13 (por).*

Burgett, Berdena D. and Paul H. Rosendahl
1992 *Archaeological Inventory Survey, Contaminated Soil Stockpile/Remediation Facility* PHRI, Hilo, HI.

Carlson, Arne K. and Paul H. Rosendahl
1990 *Archaeological Inventory Survey, Campbell Industrial Park - Kaomi Loop Subdivision*, PHRI, Hilo, HI.

Charvet-Pond, Ann and Bertel D. Davis
1992 *West Beach Data Recovery Program Phase 4, Archaeology and Paleontological Excavations*, PHRI Hilo

Christensen, Carl C. and Patrick V. Kirch
1981 "Landsnails and Environmental Change at Barbers Point, Oahu, Hawaii," *Bulletin of the American Malacological Union* 1981:31. Honolulu.

Clark, Stephan D.
1979 *Archaeological Reconnaissance Survey for Barbers Point Beach Park Improvements, Ewa, Oahu (TMK: 9-1-26:27)*. Prepared for: City and County of Honolulu, Department of Parks and Recreation by Kualoa Archaeological Research Project, Honolulu.

Clark, Stephan D. and Robert D. Connolly, III.
1975 *Archaeological Reconnaissance Survey for Honouliuli Sewage Treatment Plant and Barbers Point Outfall*. Prepared for: City and County of Honolulu, Department of Public Works by Kualoa Archaeological Research Project, Honolulu, February.

Clark, Stephan D. and Robert D. Connolly, III.
1975 *Archaeological Reconnaissance Survey for Honouliuli Sewage Treatment Plant and Barbers Point Outfall*. Prepared for: City and County of Honolulu, Department of Public Works by Kualoa Archaeological Research Project, Honolulu, February.

Cleghorn, Paul L.
1979 *Archaeological Reconnaissance Survey of Water Systems Improvement Area, Park I, James Campbell Industrial Park, Oahu, Hawaii (TMK: 9-1-18).* Prepared for: M & E Pacific Inc. by BPBM Department of Anthropology., Honolulu, June.

Cleghorn, Paul L. and Bertell D. Davis
1990 *Archaeological Paleontological Investigations at the Barbers Point Deep Draft Harbor, 'Ewa, O'ahu*, Applied Research Group, Bishop Museum, HI.

Condé, Jesse C. and Gerald M. Best
1973 *Sugar Trains, Narrow Gauge Rails of Hawaii*, Glenwood Publishers, Felton, CA.

Davis, Bertell
1993 *Archaeological and Paleontological Investigations at Barbers Point at the Deep Draft Harbor*," BPBM Department of Anthropology, Honolulu ("Final Draft")

Davis, Bertell D.
1990 *Human Settlement in Pristine Insular Environments: A Hawaiian Case Study from Barbers Point, Southwestern O‘ahu*. Ph.D. Dissertation, University of Hawai‘i, Honolulu.

Davis, Bertell D.
1990 *Archaeological and Paleontological Investigations at the Proposed HECO Barbers Point Generating Station, Honouliuli, ‘Ewa, O‘ahu* Applied Research Group, Bishop Museum Honolulu.

Davis, Bertell D.
1982 "Horticultural Adaption and Ecological Change in Southwestern O`ahu: Preliminary Evidence from Barbers Point," pp. 51-59 in *Proceedings, Fourth Conference in Natural Sciences, Hawaii Volcanoes National Park*, Cooperative National Park Resources Study Unit, UH Mānoa and National Park Resources Study Unit, UH Mānoa and National Park Service.

Davis, Bertell D.
1980 "A Research Design for the Study of Human Settlement and Environmental Change in southwestern O‘ahu: Re-evaluation of the Strategy Based on New Work," pp. 77-86 in C.W. Smith (ed.), *Proceedings Third Conference in Natural Sciences, Hawaii Volcanoes National Park*, Cooperative National Park Resources Study Unit, UH Manoa and National Park Service.

Davis, Bertell D.
1979 Progress Report on Emergency Excavations at Barbers Point, O‘ahu: First Quarter (January-March), 1979. UH Manoa, Department of Anthropology, Honolulu, March.

Davis, Bertell D.
1979 Report on Archaeological Survey of the Proposed Ewa-Marine Community Development, Ewa Beach, Oahu Island, UH Mānoa, Department of Anthropology, Honolulu.

Davis, Bertell D.
1979 Progress Report on Emergency Excavations at Barbers Point, O‘ahu: Second Quarter (April- June) 1979. UH Mānoa, Department of Anthropology, Honolulu, June.

Davis, Bertell D.
1979 Progress Report on Emergency Excavations at Barbers Point, O‘ahu: Third Quarter (July-August) 1979. UH Manoa, Department of Anthropology, Honolulu, August.

Davis, Bertell D.
1978 “Human Settlement and Environmental Change at Barbers Point, O`ahu," pp. 87-97 in C.W. Smith (ed.) *Proceedings, Second Conference in Natural Sciences Hawaii Volcanoes National Park.* Cooperative National Park Resources Study Unit, UH Manoa and National Park Service, Honolulu.

Davis, Bertell D. and P. Bion Griffin (eds.)
1978 *Studies in Natural History and Human Settlement at Barbers Point, O‘ahu*. Prepared for: U.S. Army Corps of Engineers by Archaeological Research Center Hawaii (ARCH). Lawai, Kauai.

Davis, Bertell D. and Alan E. Haun
1987 *Interim Report: Phase 2) Intensive Survey and Test Excavations West Beach Data Recovery Program, Honouliuli, Ewa, Island of Oahu,* PHRI Inc.

Davis, Bertell D., A.E. Haun and P.H. Rosendahl
1986 *Phase 1) Research Design for Intensive Survey and Test Excavations, West Beach Data Recovery Program, West Beach Resort, Honouliuli, ‘Ewa, O‘ahu*, Paul H. Rosendahl, Ph.D., Inc.

Davis, Bertell D. and A. E. Haun
1986 *Preliminary Report Upon Completion of Field Work: Phase 2 - Intensive Survey and Test Excavations, West Beach Data Recovery Program, West Beach Resort, Honouliuli, 'Ewa, O'ahu,* Paul H. Rosendahl, Ph.D., Inc.

Davis, Bertell D., A.E. Haun and P.H. Rosendahl
1986 *Phase 3) Data Recovery Plan for Archaeological and Paleontological Excavations, West Beach Data Recovery Program, West Beach Resort, Honouliuli, ‘Ewa, O‘ahu,* Paul H. Rosendahl, Ph.D., Inc.

Dicks, A. Merrill, Alan E. Haun and Paul H. Rosendahl
1987 *Archaeological Reconnaissance Survey for Environmental Impact Statement, West Loch Estates Golf Course and Parks, Honouliuli, ‘Ewa, O‘ahu*, Paul H. Rosendahl, Ph.D., Inc.

Frierson, Barbara
1972 *A Study of Land Use and Vegetation Change: Honouliuli, 1790-1925*, Manuscript prepared for Graduate Seminar in Geography (750), University of Hawai‘i, Honolulu.

Glidden, Catherine, Maurice Major and Boyd Dixon
1993 *Results of Subsurface Data Recovery in Selected Areas of Paradise Cove, Honouliuli, ‘Ewa, O‘ahu*, Anthropology Department, Bishop Museum, Honolulu, HI.

Hammatt, Hallett H.
1984 *Archaeological Reconnaissance at HECO Kahe Point Power Plant* (Letter Report to Dames & Moore), Cultural Surveys Hawaii, Kailua, HI.

Hammatt, Hallett H. and William H. Folk
1992 *Archaeological Subsurface Testing of a Beach Berm Within the Proposed Barbers Point Drainage Channel* Cultural Surveys Hawai‘i, Inc.

Hammatt, Hallett H. and William H. Folk
1981 *Archaeological and Paleontological Investigation at Kalaeloa (Barbers Point), Honouliuli, ‘Ewa, O‘ahu, Federal Study Areas 1a and 1b, and State of Hawai'i Optional Area 1,* ARCH 14-115.

Hammatt, Hallett H., Jennifer Robins, Mark Stride and Matthew McDermott
1990 *An Archaeological Inventory Survey for the Makaiwa Hills Project Site, Honouliuli, ‘Ewa, O‘ahu,* Cultural Surveys Hawai‘i, Kailua.

Hammatt, Hallett H. and David W. Shideler
1994 *An Archaeological Assessment for the Proposed Barbers Point Harbor Expansion (84 acres), Honouiuli, ‘Ewa, O‘ahu, (revised),* Cultural Surveys Hawai‘i, Kailua, HI.

Hammatt, Hallett H. and David W. Shideler
1991 *An Archaeological Assessment for the Proposed Barbers Point Harbor Expansion, (140.4 acres), Honouliuli, ‘Ewa, O‘ahu*, Cultural Surveys Hawai‘i.

Hammatt, Hallett H. and David W. Shideler
1990 *Archaeological Inventory Survey of the West Loch Bluffs Project Site, Honouliuli, ‘Ewa, O‘ahu*, Cultural Surveys Hawai‘i, Kailua, HI.

Hammatt, Hallett H., and David W. Shideler
1989 *An Archaeological Assessment for the Proposed Kapolei Business/Industrial Park, Honouliuli, ‘Ewa, O‘ahu*, Cultural Surveys Hawai‘i.

Hammatt, Hallett H. and David W. Shideler
1989 *Archaeological Reconnaissance of the Six-Acre Proposed HECO Kahe Training Facility (T.M.K. 9-1-3:27), Honouliuli, ‘Ewa, O‘ahu*, Prepared for M and E Pacific, Inc., Cultural Surveys Hawai‘i, Kailua, HI.

Hammatt, Hallett H., David W. Shideler, Melody Heidel and Mark Stride
1994 *Archaeological Inventory Survey of the Proposed Barbers Point Harbor Expansion (TMK 9-1-14:02)*, Revised Sept. 1994, Cultural Surveys Hawai‘i, Kailua, HI.

Handy, E.S. Craighill and Elizabeth G. Handy
1972 *Native Planters in Old Hawaii: Their Life, Lore, and Environment*, Bishop Museum Bulletin 233, Honolulu.

Haun, Alan E.
1991 *An Archaeological Survey of the Naval Magazine & Naval Communications Area Transmission Facility, Lualualei, O‘ahu, Hawai‘i,* Ms. 100191, B.P. B.P. Bishop Museum, Honolulu, HI.

Haun, Alan E.
1986 *Preliminary Archaeological Reconnaissance Survey for Environmental Assessment (EA) Ewa Town Center/Secondary Urban Center Land of Honouliuli, ‘Ewa, Island of O‘ahu, (TMK 9-1-15 and 9-1-16),* PHRI, Hilo, HI.

Haun, Alan E.
1986 *Preliminary Archaeological Reconnaissance Survey for Environmental Assessment (EA) Ewa Town Center/Secondary Urban Center Land of Honouliuli, Ewa, Island of Oahu, (TMK 9-1-15:Por. 5, 17: 9-1-16:Por. 9)*, PHRI, Hilo, HI.

Haun, Alan E.
1985 *An Archaeological Survey of the Naval Magazine and Naval Communications Area Transmission Facility, Lualualei, O‘ahu, Hawai‘i*. Dept. of Anthropology, Bishop Museum, Honolulu.

Haun, Alan E. and Marion Kelly
1984 *Research Design for an Archaeological Survey of Naval Communication Area Radio Transmission Facility, Lualualei; and Naval Air Station, Barbers Point, Oahu, Hawaii,* Dept. of Anthropology, Bishop Museum, Honolulu.

Hawaii Marine Research Inc.
1978 "Appendix I: Geoarchaeological Reconnaissance of Barbers Point," in Akihiko Sinoto, *Archaeological and Paleontological Salvage at Barbers Point, O`ahu*. Prepared for: U.S. Army Engineer District by BPBM Department of Anthropology., Honolulu, March.

Hommon, Robert J., Timothy K. Earle and Eliza Earle
1973 *Archaeological Survey and excavations in Honouliuli, O‘ahu*, Prepared for: BPBM Department of Anthropology, Honolulu.

Hommon, Robert J. and Hamilton M. Ahlo, Jr.
1984 *Archaeological Test Excavations at the Site of the Proposed Solid Waste Processing and Resource Recovery Facility, Honouliuli, Ewa, O‘ahu*. Prepared for: Belt Collins and Associates by Science Management Inc., Honolulu, January.

‘Ī‘ī, John Papa
1959 *Fragments of Hawaiian History* (Pukui translation), Bishop Museum Press, Honolulu.

James, Van
1995 *Ancient Sites of Hawaii, Archeaological Places of Interest on the Hawaiian Islands.* Mutual Publishing, Honolulu, HI.

Jones, Anthony
1993 *Elevated Fossil Coral Deposits in the Hawaiian Islands: A Measure of Island Uplift in the Quaternary* Ph.D. dissertation, Department of Oceanography, University of Hawai‘i at Mānoa

Jourdane, Muffet (Elaine)
1995 *Inadvertent Discovery of Human Remains at Paradise Cove, Honouliuli, ‘Ewa, O‘ahu, State Site No. 50-80-12-4968,* SHPD #762, SHPD, Honolulu, HI.

Juvik, Sonia P. and James O. Juvik, Editors, Chief Cartographer, Thomas R. Paradise
1998 *Atlas of Hawai‘i*, Third Edition, University of Hawaii Press, Honolulu, HI.

Kelly, Marion
1979 "Appendix B: Notes on Honouliuli History," pp. 9-17, in Elaine Rogers-Jourdane, *Archaeological Reconnaissance Survey of Proposed Ewa Marine Community, Campbell Estate Properties, One‘ula, Honouliuli, O‘ahu, Hawai‘i.* Prepared for: Pearson and Wuesthoff and Associates by BPBM Department of Anthropology, Honolulu, March.

Kennedy, Joseph
1991 *Subsurface Testing at the Proposed Kapolei Park/Fort Barrette, Pu‘u Kapolei, Island of O‘ahu,* TMK:9-1-16:2,

Kikuchi, William K.
1959 *Standard Oil Refinery Site Letter Report*, plus maps and field notes on file, BPBM, Honolulu, HI.

Kirch, Patrick V.
1978 "Appendix II, Report on Recent and Subfossil Land Mollusca From Barbers Point, Oahu," in Akihiko Sinoto (March, 1978), *Archaeological and Paleontological Salvage at Barbers Point, O‘ahu,* Prepared for: U.S. Army Engineer District, Pacific Ocean Division by BPBM Department of Anthropology, Honolulu, March.

Kirch, Patrick V. and Carl C. Christensen
1980 *Nonmarine Molluscs and Paleoecology at Barbers Point, O‘ahu*, Prepared for: Archaeological Research Center Hawaii by BPBM Department of Anthropology, Honolulu, July.

Kolb, Michael John
1991 *Social Power, Chiefly Authority and Ceremonial Architecture, In an Island Polity, Maui, Hawai‘i,* Diss. UCLA, Los Angeles, CA, CA.

Komori, Eric K. and Thomas Dye
1979 *Archaeological Testing at Lanikuhonua, West Beach, Ewa, Oahu, Hawaii, (TMK 9-1-13:por.10)*, Bishop Museum, Honolulu, HI.

Landrum, Jim
1993 *Archaeological Reconnaissance and Limited Subsurface Testing at the Proposed Family Housing Construction Area Project No. 34863, Barbers Point Naval Air Station, Honouiliuli Ahupua‘a, ‘Ewa District, O‘ahu Island* Ogden

Lewis, Ernest
1970 "The Campbell Project: A Preliminary Report. University of Hawaii," Appendix C, in W. Barrera (1975), *A Report on the Archaeological Reconnaissance Survey of the Proposed Barbers Point Harbor Area*. Prepared for: U.S. Army Corps of Engineers, Pacific Ocean Division by BPBM Department of Anthropology, Honolulu, May.

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

McCoy, Patrick C., Carl Christensen, and Bertell Davis
1982 *A Proposal for Archaeological and Paleontological Investigations in Stockpile Area III at Barbers Point, Southwestern O‘ahu; Phase 1: Data Recovery and Preliminary Analysis, and Phase 2: Detailed Data Analysis*, Pending, Honolulu,

McDermott, Matthew, David Shideler, John Winieski and Hallett H. Hammatt
2000 *Archaeological Data Recovery Report for the Archaeological sites in the Proposed Barbers Point Harbor Expansion Area, Kalaeloa, Ahupua‘a of Honouliuli, District of ‘Ewa, Island of O‘ahu (TMK 9-1-14:2),* Cultural Surveys Hawai‘i, Kailua, HI.

Miller, Lynn
1993 *Archaeological Data Recovery of State Sites 50-80-12-2710 and 50-80-12-2711 at Barbers Point, Honouliuli Ahupua‘a, ‘Ewa District, O‘ahu Island*, Bernice Pauahi Bishop Museum, Honolulu.

Nakuina, Emma M.
Hawaii – Its People and Their Legends, Honolulu, HI.

Nakuina, Moses K.
1992 The Wind Gourd of La‘amaomao, The Hawaiian Story of Pāka‘a and Kūapāka‘a, Personal Attendatns of Keawenuia‘umi, Ruling Chief of Hawaii and Descendants of La‘amaomao, Collected, edited, and expanded by Moses K. Nakuina, translated by Esterher T. Mookini and Sarah Nākoa, Kalamaku Press, Honolulu, HI.

Neller, Earl
1985 *A Preliminary Review and Evaluation of Archaeological Studies and Recommendations for the Proposed West Beach Estates at ‘Ewa, O‘ahu* State Historic Preservation Office

Neller, Earl
1982 *The Barbers Point Archaeological District, O‘ahu, Hawai‘i*, Committee on Public Archaeology (COPA) Communications 5(3): 19021. Society for American Archaeology.

O'Hare, Constance R. and Thomas R. Wolforth, and Paul H. Rosendahl
1996 *Phase II Intensive Survey and Testing, Naval Air Station, Barbers Point*, PHRI, Inc. Hilo, HI.

O’Leary, Owen L. and Hallet H. Hammatt
2006 *Preservation Plan for SIHP #s 50-80-12-4319, -4321, -4322, -4328 & -4338 at the Makaīwa Hills Project, Honouliuli Ahupua‘a, ‘Ewa District, O‘ahu.* Cultural Surveys Hawai‘i, Kailua, HI.

Oshima, Neal
1975 *Archaeological Reconnaissance Survey of Proposed Drainage Channel at the Campbell Industrial Park Complex, Ewa, Island of O‘ahu.* Prepared for: R.M. Towill Corporation by BPBM Department of Anthropology, Honolulu, June.

Pukui, Mary K. and Samuel H. Elbert
1986 *Hawaiian Dictionary, 2nd Edition,* University of Hawaii Press, Honolulu, HI.

Pukui, Mary K.
1983 *Ōlelo No‘eau: Hawaiian Proverbs and Poetical Sayings,* Bishop Museum Special Publication No. 71, Bishop Museum Press, Honolulu, HI.

Pukui, Mary K., E.W. Haertig, M.D., and Catherine A. Lee
1972 *Nānā I Ke Kumu (Look To The Source),* 2 v., Hui Hānai, Honolulu, HI.

Rosendahl, Paul H.
1990 Archaeological Survey Kapolei Golf Course Addition Honouliuli, ‘Ewa District Island of O‘ahu, PHRI, Hilo, HI.

Rosendahl, Paul H.
1987 Archaeological Reconnaissance Survey for Environmental Impact Statement: Kapolei Village Master Plan Project, Honouliuli, ‘Ewa District, Island of O‘ahu PHRI

Rosendahl, Paul H.
1987 *Archaeological Reconnaissance Survey Ko Olina Resort Phase II Development Site, Honouliuli, Ewa, District, Island of O‘ahu*, PHRI, Hilo, HI.

Sinoto, Akihiko
1989 *Letter to Mr. Walter Yoshimitsu*, Administrator, Estate of James Campbell, dated March 8, 1989.

Sinoto, Akihiko
1979 *Cultural Resources Survey at New Dredged Material Disposal Sites at Barbers Point, O‘ahu*. Prepared for: Prepared for: U.S. Army Corps of Engineers, Pacific Ocean Division by BPBM Department of Anthropology, Honolulu.

Sinoto, Akihiko
1978 *Archaeological and Paleontological Salvage at Barbers Point, O‘ahu*. Prepared for: U.S. Army Corps of Engineers, Pacific Ocean Division by BPBM Department of Anthropology, Honolulu, March.

Sinoto, Akihiko
1976 *A Report on Cultural Resources Survey at Barbers Point, Island of O‘ahu*. Prepared for: U.S. Army Corps of Engineers, Pacific Ocean Division by BPBM Department of Anthropology, Honolulu, December.

Stearns, Harold T.
1978 *Quaternary Shorelines in the Hawaiian Islands*, Bishop Museum Bulletin 237, Honolulu.

Sterling, Elspeth P. and Catherine C. Summers (comp.)
1978 *Sites of O‘ahu*, Dept. of Anthropology, B.P. Bishop Museum, Honolulu.

Thrum, Thomas G.
1906 "Heiaus and Heiau Sites Throughout the Hawaiian Islands, IN Thos. G. Thrum, compiler, *Hawaiian Almanac and Annual for 1907*, pp. 38-47, Honolulu, HI.

Tuggle, H. David
1997 "The ‘Ewa Plain", *Hawaiian Archaeology*, Volume 6:8-36, Journal of the Society for Hawaiian Archeology. Honolulu, HI.

Tuggle, H. David
1997 *Archaeological Inventory Survey for Construction Projects at Naval Air Station Barbers Point, O‘ahu, Hawai‘i* IARII, Honolulu, HI.

Tuggle, H. David
1984 *Report to File on Outlease Survey*, Pacific Division, Naval Facilities Engineering Command, Honolulu

Tuggle, H. David and M. J. Tomonari-Tuggle
1997 Synthesis of Cultural Resource Studies of the ‘Ewa Plain, Task 1a: Archaeological Research Services for the Proposed Cleanup, Disposal and Reuse of Naval Air Station Barbers Point, O‘ahu, Hawai‘i, IARII, Honolulu, HI.

Tuggle, H. David and M. J. Tomonari-Tuggle

1997 *A Cultural Resource Inventory of Naval Air Station Barbers Point, O‘ahu, Hawai‘i, Part I: Phase I Survey and Inventory Summary* IARII, Honolulu, HI.

Welch, David J.
1987 *Archaeological Reconnaissance of Former ‘Ewa Marine Corps Air Station, Barbers Point Naval Air Station, O‘ahu, Hawai‘i,* International Archaeological Research Institute, Inc. Honolulu

Wickler, Stephen and H. David Tuggle
1997 *A Cultural Resource Inventory of Naval Air Station Barbers Point, O‘ahu, Hawai‘i Part II: Phase II Inventory Survey of Selected Sites* IARI, Honolulu, HI.

Wulzen, Warren and Paul H. Rosendahl
1997 *Subsurface Testing and Data Recovery Excavations, Site 50-80-12-2220, Nimitz Beach, Naval Air Station Barbers Point* PHRI, Hilo, HI.

Appendix A 'Ahahui Siwila Hawaii O Kapolei

1

`Ahahui Siwila Hawaii O Kapolei

March 2, 2006

Kehaulani Souza
Cultural Surveys Hawaii, Inc.
P.O. Box 1114
Kailua, Hawaii 96734

Dear Ms. Souza:

Ahahui Siwila Hawaii O Kapolei (Ahahui) is one of fifty component clubs throughout the State of Hawaii and seven states on the continent, under the Association of Hawaiian Civic Clubs. The first civic club was founded in 1918 and, since then, the movement to preserve and protect all aspects of the native culture has continued to develop and expand.

Our Ahahui was established and chartered in Kapolei in 1993 and we have concentrated our efforts on the identification, preservation and restoration of historic sites in the ahupua`a of Honouliuli. This area includes the Ewa Plains, Kalaeloa, Ko Olina, Kapolei, Makakilo, Honokai Hale, Makaiwa, Waimanalo, Ka Lo`i and Palehua.

Although property identified as Makaiwa Hills have been private lands for well over 100 years it is important to understand that it was and continues to be a place of traditional and cultural practices guaranteed by the PASH decision of the Hawaii Supreme Court despite the common land-owner custom of fencing and exclusivity.

The properties identified as Makaiwa Hills have been, and continue to be, a cultural landscape of traditional and customary practices, as past telephonic conversations with Kehaulani Souza revealed that Cultural Survey conducted an archaeological survey and identified numerous cultural structures on the proposed project area.

General history of cultural sites and past land use of the project area.

It is important to understand that the oral nature of Hawaiian history can limit the discussion of, as well as Western comprehension, of the Hawaiian cosmic view, which would include understanding and interpretation of cultural sites, traditions and practices.

The decimation of native Hawaiians in a short period of time, between 1778 and 1917, and the resulting loss of language and oral history, exacerbated the situation and we struggle today to piece together the fragments.

History is the interaction of people and the course that interaction takes within a geographical region, with cultural sites and trails serving as evidence and support of that interaction and the relationship of the people with the place. Ancient Hawaiian people, as did other indigenous cultures, lived within a sustaining environment where rules and relationships identified the means of survival. It was this sustaining environment that determined whether it would be a cooperative one or one of conflict competing for resources.

Losing the resource results in losing the practice, making it of fundamental importance that cultural resources such as cultural sites be given the protection which can protect the practices. Both PASH and the Ka Paakai O Ka Aina Hawaii Supreme Court rulings confirmed that the State of Hawaii has an obligation to protect and preserve traditional and cultural practices and resources, and that the State Land Use and the County Planning Commissions do not have the right to regulate resources out of existence by changing land use zonings and determinations.

Knowledge of cultural sites which may be impacted by future development of the project area – for example, historic sites, archaeological sites and burials.

To avoid trespassing on private property, Ahahui Siwila Hawaii O Kapolei has been able to survey only segments of the cultural landscape of the Makaiwa Hills project. However, it is clear that even in those small areas we had an opportunity to inspect, a substantial number of significant sites have been re-discovered.

We can surmise, then, that there is a high probability of substantial cultural sites existing in the larger area occupied by the Makaiwa Hills project that we have not had an opportunity to visit. Provided under separate mailing will be photos as examples of some of the types of resources within your proposed project site. These photos include what we believe is a paved trail that may be the site of a Holua Slide, a stone image, mounds that may be burials, remnants of ahu or markers, heiau, platforms and cave burials. The photos are supported by GPS data.

Because Cultural Surveys did the archaeological survey, they should have knowledge of all these structures, so there is no need to provide specific data with respect to their location. It is enough to say that some of these structures are in areas defined as "urban" on the Makaiwa Hills Master Plan, and the Estate of James Campbell should be appropriately advised.

At this time, Ahahui Siwila Hawaii O Kapolei cannot agree to a determination of no impact to the cultural sites of the Makaiwa Hills project without an opportunity to visually inspect and evaluate all of the properties and conditions of cultural sites defined within the borders of your map. But it should be pointed out, that as with so many other areas, historic trails connecting mauka and makai access in Makaiwa have been obliterated by horizontal fencing to accommodate cattle ranching.

In a cursory assessment, it appears that some of the disturbance of the cultural sites in your project area identified as Makaiwa Hills has been done by the removal of stone by rock wall contractors. It is not clear whether this is being done with the permission of the land-owner or the lessee, however it seems that the cultural sites are being systematically diminished in proportion to the growth of Kapolei and in contravention to existing laws protecting historic sites.

Knowledge of historic and current gathering practices in the project area.

As stated earlier, cultural resources and native medicinal plants serve as evidence of traditional and customary gathering practices of native Hawaiians, past and present. Again let there be no mistake that traditional and customary practices and gathering rights of native Hawaiians are not extinguished by non-use.

Ahahui Siwila Hawaii O Kapolei has established a relationship with the Estate of James Campbell through lessee Judith Flanders by caring for the cultural landscape of her leased property. Significant cultural sites on her leased land and the surrounding landscape have been rediscovered in considerable numbers. The care of this cultural landscape involves clearing, cleanup, maintenance and reforestation of native plants and trees, as they once existed in the Palehua and Makaiwa landscape.

The sites include a large enclosure of approximately 90 to 100 feet on the side, smaller enclosures, numerous cultural mounds ("Probable burials": State Archaeologist David Brown), stone images, elevated platforms, house sites, cultural pits and map stones, and wahine and kane stones. The large enclosure is unique in the sense that there are structures and smaller enclosures

with old growth Ti plants growing on each of the corners. Every wall of each enclosure is seemingly aligned with the setting sun at the time of the winter solstice.

A book written by Ida Von Holt, the wife of Harry Von Holt the first Ranch Manager of the James Campbell Honouliuli Ranch, identifies an old stone schoolhouse in the approximate location of this large stone enclosure.

The great Oahu Chief, Kakuhihewa, established the importance of the area when he identified the area today known as Lanikuhonua, anciently known as Ko Olina, as his favorite vacation place. In doing this he placed a kapu (regulation) on all the ocean resources just off shore that extended mauka to Mauna Kapu, which takes its name from Kakuhehewa's kapu. There once existed a heiau at Mauna Kapu that was made of both basalt stones and coral. It's likely that the coral stones came from Ko Olina, assuring the relationship between Ko Olina, Lanikuhonua and Mauna Kapu.

Coral boulders have been found within this cultural landscape associated with stone mounds, and in the opinion of Kumu Hula John Kaimikaua, this is an indication that the stone mound is a burial site. The numbers of these stone mounds best describe the landscape between Mauna Kapu, Ms. Flanders lease and Lanikuhonua. This lineal cultural landscape and cultural resources provide a continuum from the area of Judith Flanders' lease to Lanikuhonua along the line identified by Makaiwa Gulch and the high ground between Makaiwa and Waimanalo Gulch. In every place that was cleaned, weed wacked and cleared of invasive species, native medicinal plants returned in numbers too difficult to even comprehend.

Presently Palehua and Makaiwa is more than simply a place of traditional and customary practices and gathering. The density of cultural resources within this landscape speaks strongly that this was a place of usefulness, productivity, spiritual and cultural renewal.

Cultural associations of the project area.

There are numerous cultural associations of the proposed project area of Makaiwa Hills, and here we offer a few.

- **Palehua Ku Ula Walking Stone**

  This stone exists today and can be seen along the Palehua Road on the way to the second gate just prior to Judith Flanders property. It stands tall in a field of stone mounds appearing seemingly as a guardian of all that may have once passed by. The ancient stories identify this stone image or Ku Ula Stone as having the ability to walk. It is a stone where ancient people on their way to the ocean to gather and fish would stop, pray and leave a ho'okupu in hopes of a bountiful harvest.

  On their way home they would stop and leave the largest of their fish in thanksgiving for a good day's meal. However the stone would not be found in the same place that it was seen at the beginning of that day. It was always found in a different place. This stone was walking all over the mountainside. Thus it became known by the ancient people of Palehua and Makaiwa as the Palehua Walking Ku Ula Stone and was identified, photographed and documented by Marion Kelley in the 1950s. *Cite: Bishop Museum Archives.*

- **Kupuahine O Pukaua**

  Pukaua is an ancient Hawaiian place name for the area on the mauka side of Farrington Hwy and the H-1 Freeway on the way from Makakilo to Waianae. This is the area of the proposed Makaiwa Hills project. Following is an excerpt from the 1978 publication of "Sites of Oahu" by Sterling and Summers.

"........That is Pu`uokapolei. It is this hill that hides Ewa from view. When you go to that side of Waimanalo, you see no more of the sight back here. You go down some small inclines, then to a plain. This plain is Pukaua and on the mauka side of the road, you will see a large rock standing on the plain. This stone has a legend that made this plain noted. This is a noted legend of this plain. There were two supernatural old women or rather peculiar women with strange powers and Pukaua belonged to them. While they were down fishing at Kualaka`i in the evening, they caught these things, aama crabs, pipipi shell fish and whatever they could get with their hands.

As they were returning to the plain from the shore and thinking of getting home while it was yet dark, they failed for they met a one-eyed person. It became light as they came near to the plain, so that passing people were distinguishable. They were still below the road and became frightened lest they be seen by men. They began to run, running, leaping, falling sprawling, rising up and running on, without a thought of the aama crabs and seaweeds that dropped on the way. So long as they would reach the upper side of the road. They did not go far for by then it was broad daylight. One woman said to the other, "Let us hide lest people see us," and so they hid. Their bodies turned into stone and that is one of the famous things on this plain to this day, the stone body. This is the end of these strange women. When one visits the plain, it will do no harm to glance on the upper side of the road and see them standing on the plain."

Cite: January 13, 1900 Ka Loea Kalaaina newspaper, "Na Wahi Pana O Ewa."

- **Na Olohe O Pukaua**

The area where Makaiwa Gulch flatten out in the region of today's Honoka.i Kai Hale was once known as a place of robbers and lua practitioners. These people or Nakoa were anciently known as Olohe. The stories associating Olohe as robbers occurred during a period after western contact and influence when the frequency of western travelers into the Waianae area was slowly increasing. This was also a period in transition when native Hawaiians were having a difficult time surviving due to illness and starvation. Some turned to crime to survive.

There were two places in the region that were known for robbers, one was Pukaua and other in the area of the Kaneana Cave adjacent to Makua. Interesting though anciently Olohe were Lua practitioners. This becomes much more interesting in consideration of the mana`o of many cultural practitioners that the Palehua enclosure may have been at one time a place of lua training providing security from outside invasion of the Ewa-Waianae region.

- **Night Marchers**

There are many stories associated with "Night Marchers" walking from the area of Lanikuhonua mauka crossing Farrington Hwy in the area makai of Honokai Hale and walking mauka by way of Makaiwa Gulch. When Kamokila Campbell lived at Lanikuhonua she had always left an opening in the Naupaka hedge that separated the beach from her property. This opening in the hedge was cut to allow Night Marchers to pass through the area on their way mauka. Members of the Campbell family have shared this story.

There are many unexplained accidents that have occurred on Farrington Hwy between Honokai Hale and the entrance to Ko Olina when drivers turned off the road in an effort to avoid something that they saw – or thought they saw -ahead of them.

- **Ancient Trails**

There may have once existed an intersection of 2 trails in the approximate location where the present entrance to Ko Olina exists today. In ancient times there were 3 ways to get to Wai`anae. One was by way of Kolekole, one was by way of Pohakea and the 3rd was by way of Pu`uokapolei. Farrington Highway follows the path of the ancient trail that passed Pu`uokapolei.

Generally, petroglyphs are found along trails or paths frequently used by the ancient Hawaiians. Petroglyphs have been found on the high ground between Waimanalo and Makaiwa Gulches indicating that a trail may have once existed in this area, again confirming a mauka-makai path. The existence of this trail is supported by the numerous amounts of cultural resources and structures built along this lineal mauka-makai relationship that follows the path of Waimanalo and Makaiwa Gulches.

- **Cultural Significance of Kakuhihewa's Ko Olina**

Chief Kakuhihewa is considered Ko Olina's first resident. Kakuhihewa was a late 16th century Mo`i of the island of Oahu who was born at the sacred Ali`i birthing site at Kukaniloko. He became one of Oahu`s greatest chiefs, his name forever linked to that of Oahu. He was a chief who loved peace and knowledge in all its forms. He was raised in Waiawa, Manana and Waipio. These are places of Ewa. Later he established residences in Waikiki, Kailua and Ewa.

Of these Ewa residences one was at Ko Olina. It was identified as his favorite vacation place and he appointed his Kahuna Napuaikamau as its first caretaker. What is not understood by many of us today is when a chief selects a place as his residence, especially one that is his favorite, there are Kapus associated with this. That Kapu extends out into the immediate ocean to protect all the ocean resources for his use. It also extends to the highest point in the mauka direction to protect all the water and resources along that mauka-makai lineal relationship.

Coral from the ocean are also deposited along this lineal relationship to secure that kapu. There was once a heiau built at the top of this lineal relationship at Mauna Kapu which was built of both basalt and coral. It is believed today that the coral in the construction of that heiau came from Ko Olina to secure that Kapu. So is the name of Mauna Kapu. The valley and high ground of Makaiwa Hills and all the properties within this cultural lineal landscape from Ko Olina to Mauna Kapu are within the sacred kapu set by Kakuhihewa.

Referral of Kupuna or elders who might be willing to share their cultural knowledge of the project area and the surrounding ahupua`a lands.

Following are some people from the area and elsewhere who are knowledgeable of the traditional and customary practices and resources of Palehua and Makaiwa Hills and may be receptive to sharing cultural knowledge of the area. These are:

Kumu Hula John Kaimikaua
Kumu Hula and Cultural Practitioner of the traditional art of hula

Kupuna Robert Alakai
Kupuna and long time resident of Honokai Hale and Makakilo

Kupuna John Peiper
Kupuna and old time Paniolo of the Makaiwa Hills area

6

Tom Pohaku Stone
Cultural Practitioner and expert on Hawaiian stone structures

Mr. Jan Becket
School Teacher and photographer of Hawaiian cultural stone structures

Hawaiian Cultural practices within the vicinity of the project area.

Thank you for the opportunity to share information and concerns with regard to the potential impact of the Makaiwa Hills Project.

There is a rare opportunity here to preserve the cultural resources of the Makaiwa Hills Project, stirring the lives of the residents in ways they never envisioned. In what is generally thought of as a "New City," we can foresee the prospect of an enriching historic and cultural foundation for the current generation and on into the future. In a society that goes to great lengths to create the "facade" of tradition and ceremony, we have reality and authenticity at our fingertips in the cultural landscape of Makaiwa.

What is needed is to go beyond the mere identification of resources, traditions and practices associated with Makaiwa Hills, and create a long-term plan that will protect and integrate these "cultural treasures" into the lives of residents to the benefit of all.

We appreciate this opportunity to comment and work with Cultural Surveys Hawaii and the Estate of James Campbell to identify, care for, and share knowledge of the people past to enhance the lives of those of tomorrow. Please feel free to contact me if you have any questions.

Mahalo nui loa,

Annelle Amaral

Annelle Amaral, President
Ahahui Siwila Hawaii O Kapolei
Ph. 808-753-1895
acamaral@yahoo.com

Cc: Shad Kane, Chair, Cultural Preservation, 'Ahahui Siwila Hawaii O Kapolei
Dan Davidson, Project Manager
Makaiwa Hills Project
Aina Nui Corporation

Appendix B Office Of Hawaiian Affairs

PHONE (808) 594-1888 FAX (808) 594-1865

STATE OF HAWAI'I
OFFICE OF HAWAIIAN AFFAIRS
711 KAPI'OLANI BOULEVARD, SUITE 500
HONOLULU, HAWAI'I 96813

HRD06/2269

March 7, 2006

Aulii Mitchell
Cultural Surveys Hawaii, Inc.
P.O. Box 1114
Kailua, HI 96734

RE: Cultural Impact Assessment for the Proposed Makaiwa Hills Project, 'Ewa, O'ahu, TMK: 9-1-15: 5, 11, 17; and 9-1-16: por. 9; 9-2-03: por. 2.

Dear Mr. Mitchell,

The Office of Hawaiian Affairs (OHA) is in receipt of your February 10, 2006 request for comment on the above listed proposed project. OHA offers the following comments:

The 'Ewa plain has historically been known to contain sinkholes in which human skeletal and avi-faunal remains have been encountered. These sinkholes can continue to exist in areas that have been graded or heavily cultivated for agricultural uses.

According to records at the Bishop Museum pertaining to inventories conducted for compliance with the Native American Graves Protection and Repatriation Act of 1990, burial sites in Honouliuli and in 'Ewa in general have been documented in the past including:

> *In 1938, human remains representing six individuals from Honouliuli, 'Ewa, O'ahu were collected by Kenneth P. Emory and William A. Lessa and acquired by the Bishop Museum. Museum documentation indicates these remains were in a shallow crypt burial one mile from the coast;*
>
> *In 1933, human remains representing three individuals from stone pits at 'Ewa, O'ahu were collected by J.W. Barrington and Edwin H. Bryan;*
>
> *In 1942, human remains representing two individuals from Kualakai, 'Ewa Beach, O'ahu were donated to the Bishop Museum;*
>
> *In 1959, human remains representing seven individuals from 'Ewa, O'ahu were donated to the Bishop Museum by the Anthropology Club of the University of Hawaii (from Standard Oil Refinery land);*

Aulii Mitchell
March 7, 2006
Page 2

In 1980, human remains representing nine individuals from Honouliuli, O'ahu were collected and donated to the Bishop Museum by Albert, Borthwick and Folk. Donor information indicates these human remains were recovered from coral sinkholes.

In the last decade, unmarked burial sites have been found in the area of St. Francis West, West Loch Estates, Old Fort Weaver Road, Kalaeloa, One'ula Beach, Campbell Estate, Ko'Olina and other areas in the vicinity of this project.

The depth of grading activities and the likelihood of adversely impacting any sub-surface cultural sites or deposits is contingent upon understanding the original surface grade as it may have existed prior to agricultural activities such as sugarcane.

Native Hawaiian burial sites have been found just on and under the surface to depths of eight or nine feet depending upon the nature of the terrain. Furthermore, the nature of documented interments in the 'Ewa area (stone pits, sinkholes, crypts, etc.) could lead to the survival of these sites despite intensive agricultural activities on the surface.

As for the future consultation process, OHA recommends contacting two individuals in particular: Shad Kane and Nettie Tiffany. Both individuals have served as cultural resources on past projects and would likely aid in the community consultation process.

OHA asks that, In accordance with Section 6E-46.6, Hawaii Revised Statutes and Chapter 13-300, Hawaii Administrative Rules, if any significant cultural deposits or human skeletal remains are encountered, work shall stop in the immediate vicinity and the State Historic Preservation Division (SHPD/DLNR) shall be contacted.

Thank you for the opportunity to comment. If you have further questions or concerns, please contact Jesse Yorck, Native Rights Policy Advocate, at (808) 594-0239 or jessey@oha.org.

'O wau iho nō,

Clyde W. Nāmu'o
Administrator

Appendix C Māhele Documents

Articles | Information | Samples | Gallery | About Us | Contact Us

Mahele Database | Boundary Commission | Land Grants | Royal Patents | Review Cart & Checkout

DOCUMENT DELIVERY Change password Log out

Mahele Database Documents

Number: 00902

Claim Number:	**00902**
Claimant:	**Haakue, wahine**
Other claimant:	
Other name:	
Island:	**Oahu**
District:	**Ewa**
Ahupuaa:	**Honouliuli**

Ili:	**Waimanalo**		
Apana:	**4**	Awarded:	**0**
Loi:	**3**	FR:	
Plus:		NR:	**516v2**
Mala Taro:		FT:	**388v2**
Kula:		NT:	**155v3**
House lot:	**1**	RP:	
Kihapai/Pakanu:		Number of Royal Patents:	
Salt lands:		Koele/Poalima:	**No**
Wauke:		Loko:	**No**
Olona:		Lokoia:	**No**
Noni:		Fishing Rights:	**No**
Hala:		Sea/Shore/Dunes:	**Yes**
Sweet Potatoes:		Auwai/Ditch:	**No**
Irish Potatoes:		Other Edifice:	**Yes**
Bananas:		Spring/Well:	**No**
Breadfruit:		Pigpen:	**No**
Coconut:		Road/Path:	**Yes**
Coffee:		Burial/Graveyard:	**No**

Oranges:		Wall/Fence:	**Yes**
Bitter Melon/Gourd:		Stream/Muliwai/River:	**Yes**
Sugar Cane:		Pali:	**No**
Tobacco:		Disease:	**No**
Koa/Kou Trees:		Claimant Died:	**No**
Other Plants:		Other Trees:	
Other Mammals:	**No**	Miscellaneous:	**1 house, government road, schoolhouse next door**

No. 902, Haakue, Honouliuli, October 16, 1847
N.R. 516-517v2

To the Honorable Land Commissioners of the Hawaiian Islands, Greetings: I hereby tell you of my land and house claim. This land is at Wai-wanana in Honouliuli, Ewa, Island of Oahu. It is bounded on the north and east by the land of Kekuahaliu, on the south by the land of Mahuia, on the west by the land of Kaneiakamea. The second of my claims is bounded on the north by a stream, on the east by the land of Kekua-halii, on the south by the stream, on the west by the land of Molea. The third of my claims is bounded on the north by kula, on the east by the land of Kekuahaliu, on the south by a government road, on the west by kula. The fourth of my claims is bounded on the north by a road, and the land of Kekuahaliu, on the east by the land of Kaneiakamea, on the south by a stream, on the west by a house and a fence, and also a house of mine which stands in these claims which is bounded on the north by kula nohu /possibly referring to a spiny weed/ called nohu/, on the east by the house of Molea, on the south by the sea and on the west by the sea and the school house. It was /given me/ by Kahahakai.
HAAKUE X

F.T. 388-389v2
Cl. 902, Haakue, 17 July [1848]

Kekuahaliu, sworn, This land is in Honouliuli, Ewa, Waimanalo - consisting of 2 kalo patches in one lot & 1 in another. There is no house on either.

First lot. 2 kalo patches, bounded:
Mauka by Kauai's land
Honolulu by Kekauonohi's
Makai by the sea shore bluff
Waianae by Kekauonohi's kula land.

Second. One patch is bounded:
Mauka by Mahina's land

Honolulu also
Makai by my place
Waianae by Kaneiakamea.

Claimant got these lands from her husband, Kaaikaai, who held it from Kahakai, luna under Kekauonohi.

Claimant got it about 1831. She & her husband before her have always held it in undisturbed peace.

Kailinaoa, sworn and fully confirmed the previous particulars.

N.T. 155-156v3
No. 902, Haakue, July 17, 1848

Kekuahaliu, sworn and said, "I have seen Haakue's land at Waimanalo in Honouliuli. There are three patches and two sections and the boundaries of the two patches are:

1. Mahina's land, mauka
Kekauonohi's land, Honolulu
a pre-cipice, makai
a pasture, Waianae.

2. Mahina's land is mauka and Honolulu
my property, makai
Kaneiakama's land, Waianae.

This property had been from Kahakai to Kaikaai who is the husband of Haakue. Kahakai was an overseer under Kekauonohi during the time Kuakini was at the fort and he has lived there to this day in peace."

Kailinaoa, sworn and said, "I have seen this property exactly as Kekuahaliu has just related here."

[No. 902 not awarded]

Number: 09037

Claim Number: **09037**

Claimant:	**Kahakai, H.**
Other claimant:	
Other name:	
Island:	**Oahu**
District:	**Ewa**
Ahupuaa:	**Honouliuli**
Ili:	**Waimanalo**

Apana:	**3**		Awarded:	**0**
Loi:	**2**		FR:	
Plus:			NR:	**414v4**
Mala Taro:			FT:	
Kula:		1	NT:	**707v3**
House lot:			RP:	
Kihapai/Pakanu:			Number of Royal Patents:	
Salt lands:			Koele/Poalima:	**No**
Wauke:			Loko:	**Yes**
Olona:			Lokoia:	**No**
Noni:			Fishing Rights:	**Yes**
Hala:			Sea/Shore/Dunes:	**No**
Sweet Potatoes:		3	Auwai/Ditch:	**No**

Irish Potatoes:		Other Edifice:	**No**
Bananas:		Spring/Well:	**No**
Breadfruit:		Pigpen:	**No**
Coconut:	1	Road/Path:	**No**
Coffee:		Burial/Graveyard:	**No**
Oranges:		Wall/Fence:	**No**
Bitter Melon/Gourd:		Stream/Muliwai/River:	**Yes**
Sugar Cane:		Pali:	**No**
Tobacco:		Disease:	**No**
Koa/Kou Trees:		Claimant Died:	**No**
Other Plants:		Other Trees:	
Other Mammals:	**No**	Miscellaneous:	**claims 2 ponds,1 coconut grove & river**

No. 9037, Kahakai, Waimanalo, February 10.1848
N.R. 414-415v4

Waimanalo, Puukuua, Aimea

Diagram/fishery claim, Diagram of kula, Diagram of kala

[DIAGRAM]

To the President of the Land Commissioners, Greetings: I hereby state my claim. For your information see the diagram above. That is my claim, which was from Kekauonohi to me. With thanks,
Ewa, Honouliuli
H. KAHAKAI

N.T. 707-708v3

No. 9037, H. Kahakai, December 18, 1850

Kekuahilo, sworn, I have seen his land at Waimanalo in Ewa, Oahu - 3 land sections.

1.1 patch at Kalaipuawa, 1 pond, 1 coconut grove:
Mauka, mine
Waikiki, Kaekuna
Makai, ?
Ewa, land of Oni.

2. 1 pond, Hapenui - The boundaries are:
Mauka, Aihonu
Honolulu, Opiopio
Makai, my place

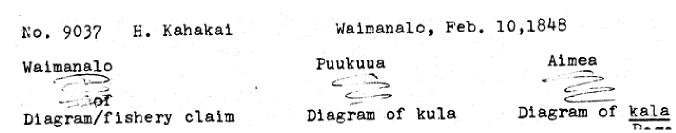
3. 1 river, 3 sweet potato ili; 1 taro patch and the boundaries are:
Mauka and Honolulu, land of Kekauonohi
Makai, Kaakau
Waianae, a stream.

He had received this as a servant in 1837 and he had lived there comfortably until 1849. He was then separated from the land without offense.

Kawahaea, sworn, We both have known alike.

Not awarded

[No. 9037 not awarded]



Appendix I
Mikiko Market Assessment

MIKIKO CORPORATION

Ewa and Oahu's Affordable For-Sale Housing

SUMMARY OF RECENT MARKET CONDITIONS

Prepared for:
Helber Hastert & Fee, Planners

September 29, 2005

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Study Background and Summary of Findings

Study Background

Aina Nui Corporation, an affiliate of the Estate of James Campbell, proposes to develop some 547 acres as a residential and recreational community known as Kapolei West. Kapolei West is located within the City's Ewa Development Plan area, between Ko Olina Resort and the City of Kapolei. While State entitlements are in place for some 373 acres of the project, Aina Nui is petitioning the State Land Use Commission (LUC) to redesignate 174.2 acres for urban uses.

In discussions with LUC staff, the Ewa area's role in providing affordable housing for Oahu has emerged as a topic of interest. Thus Aina Nui requested Mikiko Corporation to prepare this overview of affordable housing conditions on the island of Oahu and the ongoing and recent contributions of the Ewa Development Plan area to meeting needs of the for-sale segment of this market.[1]

Approach

Mikiko Corporation collected and analyzed information on households, housing demand, household incomes and residential sales transactions within a recent twelve-month period (August 1, 2004 through July 31, 2005) and for the twelve months of 2000. Data were collected for the island of Oahu and for Tax Map Key areas 1-9-1 and 1-9-2, which approximate the Ewa Development Plan Area.[2]

The Ewa DP Area stretches from Ko Olina to Ewa Beach, and encompasses existing primary residential areas such as the Villages of Kapolei, Ewa by Gentry, Ewa Marina, Ewa Villages, Kapolei Knolls, Makaiwa Hills, Makakilo, and Ewa Beach. It also includes Ko Olina Resort, which markets resort/second homes as well as primary residences.

---

[1] The for-sale segment of "affordable housing" is defined herein as that estimated to be affordable to households earning between 80% and 140% of the Honolulu County median income for any given period, under then-prevailing lending conditions. See Appendices 1 and 2 for further details.

[2] See Appendices 8 and 9 for display of Development Plan area as defined by the City and as approximated by tax map key codes. The additional lands covered by the tax map definition include relatively few housing units.
Within this report, the Ewa DP Area is also sometimes referred to as "Ewa."

Executive Summary

The Ewa DP Area has played a very significant role in meeting the island's affordable housing needs, particularly in the for-sale market segment. In 2000 and recent months, the Ewa DP Area:

1) **Recorded a higher share of affordable sales than did the island** - Sales recorded in Ewa between August 2004 and July 2005 show about 51% affordable to families earning 80% to 140% of the County median, compared to only 44% for Oahu as a whole.

2) **Increased its number of sales at affordable prices -** In the recent 12-month period, the Ewa DP Area recorded 1,258 home sales at prices considered affordable to households earning 80% to 140% of the median, compared to 712 sales in 2000.

3) **Has served far more than its "fair share"** - While Ewa is home to some 6% to 7% of Oahu households, it provided 22% of Oahu's affordable home sales recently, and 17% in 2000. Thus, in terms of number of households, Ewa served more than three times its "fair share" of affordable housing in recent months.

All of these conclusions hold when considered separately for single- and multi-family homes. The significance of Ewa is particularly pronounced in the single-family market, where its provision of affordable ownership opportunities has been one of the most important developments in island housing in recent years.[3]

It should also be noted that the Ewa data shown are skewed by the very active sales programs of higher-priced resort/second homes at Ko Olina Resort in recent months. If it were not for these sales, the Ewa DP Area would show an even greater predominance of sales at affordable prices, as well as lower average and median sales prices.

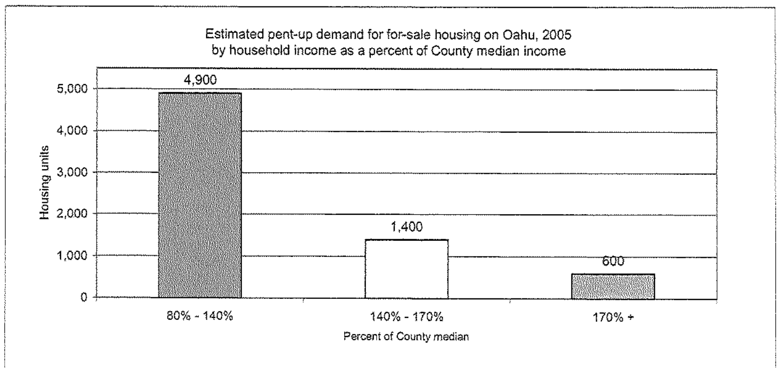
These findings, and observations on pent-up demand are shown on the following pages. Also attached are appendices that present the analyses on which these conclusions are based.

---

[3] An apparent drop in the share of Ewa DP Area single-family affordable home sales (from 64% in 2000 to 41% recently, see Appendix 5) is attributable to the relatively few sites available for new housing development and the ending of the buy-back provisions imposed on area housing in prior years. Thus, most of the units transacting in the recent period are resales, which have been affected by the state-wide rapid increase in prices.

Significant Pent-Up Demand Island-wide

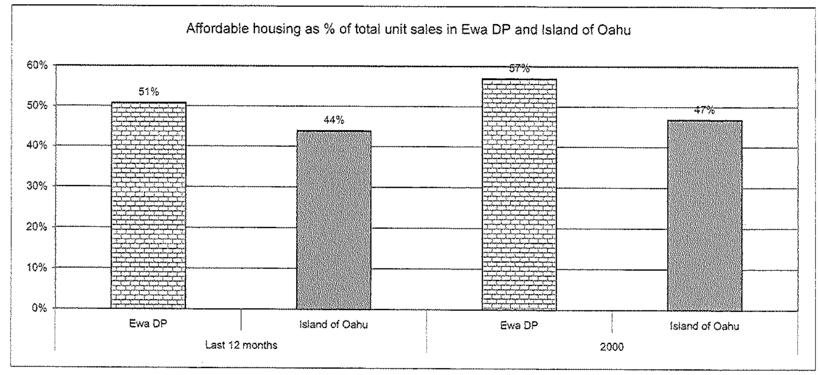
There is strong pent-up demand to purchase housing on Oahu. In total, some 16,300 housing units are estimated to be desired but not available at affordable prices. The greatest need among potential buyer markets is among households earning 80% to 140% of the County median income, or about $54,000 to $95,000 in 2005. Some 4,900 such potential households island-wide are thought to be doubled-up or otherwise unserved for financial reasons. This group is expected to be able to afford housing priced from about $200,000 to $440,000 in the current market.



Notes: Buyer markets assumed to be composed of households earning 80% or more of County median income ($54,000 or more in 2005), with the "affordable" segment those earning 80% to 140%. See Appendix 3 for derivation of numbers shown.

The Ewa DP Area Offers Relatively More Affordable Housing than Oahu

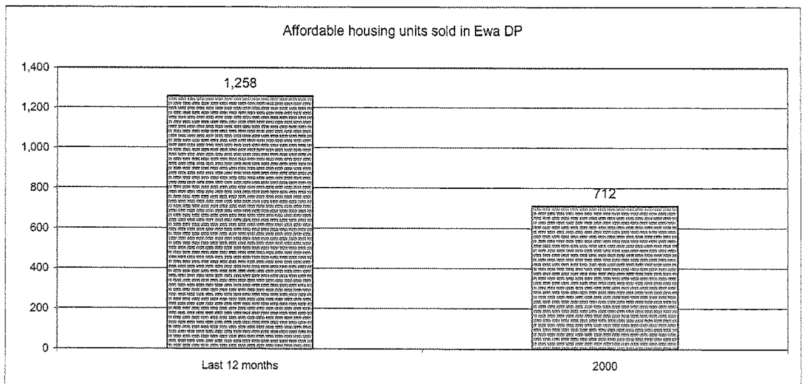
The Ewa DP Area sells a greater share of units within the affordable housing category than does the island as a whole. Although the ability of both geographic areas to deliver affordable housing has been dampened by the recent housing "boom," as a percent of total units sold, Ewa has offered **7% to 10% more affordable units** than the island as a whole.



Notes: Ewa Development Plan Area is approximated by tax map keys 1-9-1 and 1-9-2 for purposes of this analysis.
"Last 12 months" refers to units that closed escrow between 08/01/2004 and 07/31/2005.
Affordable housing markets defined as those estimated to be financially accessible to those earning between 80% and 140% of the County median income for 2005 and 2000, respectively, under then-prevalent lending conditions. See Appendices 1, 2 and 4 for further information.

The Ewa DP Area is Offering More Affordable Housing Units Than Previously

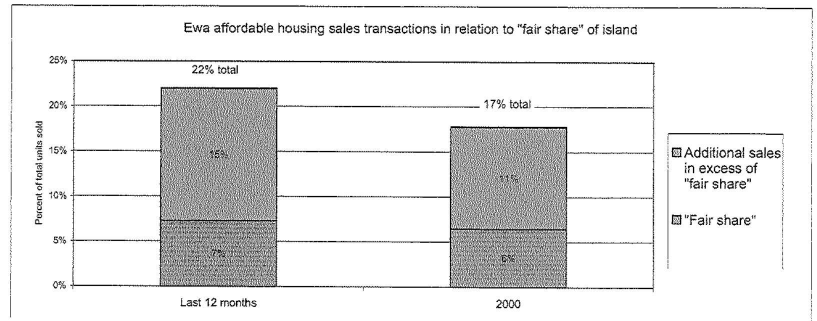
The Ewa Area is selling significantly more affordable housing units than in the past. Compared to 2000, Ewa homes sold in the recent 12-month period represented **77% more units** affordable to those in the 80% to 140% of median income category.



Notes: Ewa Development Plan Area is approximated by tax map keys 1-9-1 and 1-9-2 for purposes of this analysis.
"Last 12 months" refers to units that closed escrow between 08/01/2004 and 07/31/2005.
Affordable housing markets defined as those estimated to be financially accessible to those earning between 80% and 140% of the County median income for 2005 and 2000, respectively, under then-prevalent lending conditions. See Appendices 1, 2 and 4 for further information.

The Ewa DP Area Offers More than its "Fair Share" of Affordable Housing

The Ewa DP Area has been satisfying an increasing share of Oahu's affordable housing needs, well in excess of its "fair share." Based on affordability parameters relevant in 2000, Ewa was home to 17% of the island's for-sale affordable housing transactions in that year. Under current conditions, the district is hosting **about 22% of the island's affordable for-sale housing** transactions. Considering the relative number of households in Ewa and the island as a whole, the district's "fair share" would have been about 6% in 2000, and only 7% during the recent 12-month period.



Notes: Ewa Development Plan Area is approximated by tax map keys 1-9-1 and 1-9-2 for purposes of this analysis.
"Last 12 months" refers to units that closed escrow between 08/01/2004 and 07/31/2005.
Affordable housing markets defined as those estimated to be financially accessible to those earning between 80% and 140% of the County median income for 2005 and 2000, respectively, under then-prevalent lending conditions. See Appendices 1 and 2 for further details.
"Fair share" based on estimated percent of island households living in the Ewa DP Area in 2005 and 2000, as provided by Claritas, Inc., May 2005. See Appendix 4 for base data.

Appendices

Appendix 1: Oahu Housing Affordability Parameters: 2005

Based on estimated median County income in 2005

			80% of median	100% of median	140% of median	170% of median	200% of median
Ability to pay[1]:							
Annual income	$67,750	County median	$54,000	$68,000	$95,000	$115,000	$135,000
Monthly housing budget[2]	30%		$1,350	$1,700	$2,375	$2,875	$3,375
Less tax & insurance[3]			-$225	-$244	-$300	-$333	-$363
Net payable to mortgage			$1,125	$1,456	$2,075	$2,542	$3,013
Approximate purchase terms[4]:	5.8% interest						
Affordable purchase price			$200,000	$260,000	$440,000	$540,000	$640,000
Assumed down payment			$10,000	$13,000	$88,000	$108,000	$128,000

NAP = Not applicable

1 Based on 2005 HUD median income of $67,750 for an Oahu family of four, as shown on www.huduser.org/Datasets/IL/IL005/hi fy2005.pdf

2 Percent of monthly income, including allowance for various adjustments shown and after allowance for typical other debt.

3 Assumes $100 per month mortgage insurance, $75 per month homeowners' insurance, and real property taxes based on approximate purchase price and Honolulu County real property tax rates in FY05 of $3.75 per $1,000 assessed value less $40,000 exemption for owner-occupants. Further exemptions for elderly, disabled or other categories of buyers may also be available.
http://www3.hawaii.gov/DBEDT/images/User_Files/images/databook/db04

4 Based on 30 -year mortgage term, 5% down payment for households earning up to 120% of County median, and 20% down for those at higher income levels. Based on Fannie Mae terms applicable as of May 2005.

Appendix 2: Oahu Housing Affordability Parameters: 2000

Based on estimated median County income in 2000

			80% of median	100% of median	140% of median	170% of median	200% of median
Ability to pay[1]:							
Annual income	$60,900	County median	$49,000	$61,000	$85,000	$104,000	$122,000
Monthly housing budget[2]	30%		$1,225	$1,525	$2,125	$2,600	$3,050
Less tax & insurance[3]			-$207	-$219	-$259	-$283	-$304
Net payable to mortgage			$1,018	$1,306	$1,866	$2,317	$2,746
Approximate purchase terms[4]:	8.0% interest						
Affordable purchase price			$150,000	$190,000	$320,000	$390,000	$470,000
Assumed down payment			$7,500	$9,500	$64,000	$78,000	$94,000

NAP = Not applicable

[1] *Based on 2000 HUD median income or an Oahu family of four, as shown on www.huduser.org/datasets/il/fmr00/hud00hi.txt.*

[2] *Percent of monthly income, including allowance for various adjustments shown and after allowance for typical other debt.*

[3] *Assumes $100 per month mortgage insurance, $75 per month homeowners' insurance, and real property taxes based on approximate purchase price and Honolulu County real property tax rates in FY00 of $3.65 per $1,000 assessed value less $40,000 exemption for owner-occupants. Further exemptions for elderly, disabled or other categories of buyers may also be available. http://www.hawaii.gov/dbedt/db99/index.html*

[4] *Based on 30 -year mortgage term, 5% down payment for households earning up to 120% of County median, and 20% down for those at higher income levels. Based on Fannie Mae terms applicable as of May 2005.*

Appendix 3: Estimated Pent-Up Demand for Housing

Island of Oahu, 2005

Households by percent of median income:	Maximum household income[1]	Target maximum home price[1]	Percent of households[2]	Potential number of households[3]	Est. % pent-up demand[4]	Est. units, pent-up demand[5]
Principally rental market -						
Less than 80%	$54,000	$200,000	50%	157,000	6.0%	9,400
Potential buyer markets -						
Between 80% and 140%	$95,000	$440,000	26%	82,000	6.0%	4,900
Between 140% and 170%	$115,000	$540,000	12%	38,000	3.6%	1,400
170% or more	> $115,000	> $540,000	12%	37,000	1.5%	600
Total			100%	314,000	5.2%	16,300

Note: Totals might not add due to rounding.

[1] *As shown in Appendix 1.*

[2] *Based on estimates of Oahu households by household income as provided by Claritas Inc., May 27, 2005.*

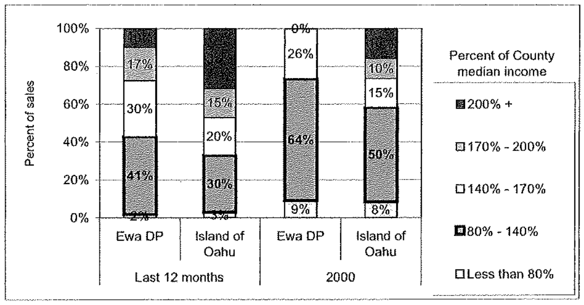
[3] *Represents demand for household formation based on population growth, household size trends and other factors, with total as shown in SMS, Inc., "Hawaii Housing Policy Study 2003," Page Section 1A-B-11, August 2003. (See also Mikiko Corporation, "Market Assessment for Residential Uses at the Proposed Kapolei West," May 21, 2004, Page 65.) Distribution based on percent of households shown.*

[4] *Share of households in each group estimated to be unable to find suitable housing due to affordability factors.*

[5] *Total as shown in Mikiko Corporation, "Market Assessment for Residential Uses at the Proposed Kapolei West," May 21, 2004, Page 65.*

Appendix 5: Single-Family Home Sales by Affordability
Ewa DP and Island of Oahu

	Last 12 months[1]		2000	
	Ewa DP[2]	Island of Oahu	Ewa DP[2]	Island of Oahu
Average sales price	$478,403	$634,357	$237,617	$369,880
Median sales price	$460,000	$525,000	$238,100	$293,000
Number of sales by target income group[3]:				
Less than 80% of median	20	144	67	368
80% - 140% of median	478	1,606	483	2,183
140% - 170% of median	345	1,069	199	679
170% - 200% of median	204	824	1	456
200% of median +	119	1,694	1	705
Total	1,166	5,337	751	4,391



Note: Includes fee simple single- and multi-family unit sales recorded at the Bureau of Conveyances within the periods shown. Excludes sales of multi-unit apartment buildings, which are presumed to be investment/rental properties.

[1] *For the time period from 08/01/2004 through 07/31/2005.*

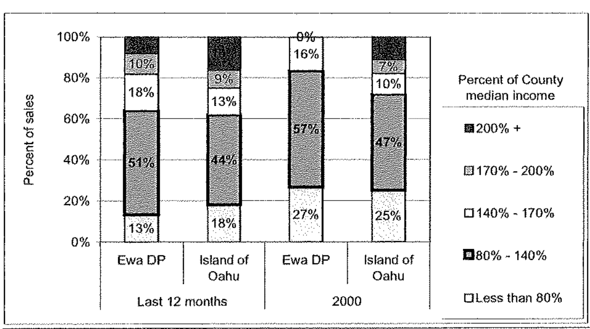
[2] *Ewa Development Plan Area, as approximated by tax map keys 1-9-1 and 1-9-2.*

[3] *Households grouped by their income in relation to County median for 2005 or 2000; number of sales occurring within price ranges affordable to each. See Appendices 1, 2 and 7.*

Source: Hawaii Information Service.

Appendix 4: Total Home Sales by Affordability
Ewa DP and Island of Oahu

	Last 12 months[1]		2000	
	Ewa DP[2]	Island of Oahu	Ewa DP[2]	Island of Oahu
Average sales price	$398,758	$446,975	$200,552	$287,998
Median sales price	$384,858	$369,000	$199,500	$232,000
Number of sales by target income group[3]:				
Less than 80% of median	328	2,348	332	2,143
80% - 140% of median	1,258	5,725	712	4,001
140% - 170% of median	443	1,714	205	877
170% - 200% of median	250	1,143	1	565
200% of median +	202	2,124	1	964
Total	2,481	13,054	1,251	8,550



Note: Includes fee simple single- and multi-family unit sales recorded at the Bureau of Conveyances within the periods shown. Excludes sales of multi-unit apartment buildings, which are presumed to be investment/rental properties.

[1] *For the time period from 08/01/2004 through 07/31/2005.*

[2] *Ewa Development Plan Area, as approximated by tax map keys 1-9-1 and 1-9-2.*

[3] *Households grouped by their income in relation to County median for 2005 or 2000; number of sales occurring within price ranges affordable to each. See Appendices 1, 2 and 7.*

Source: Hawaii Information Service.

Appendix 7: Home Sales by Price in the Ewa DP and Island of Oahu

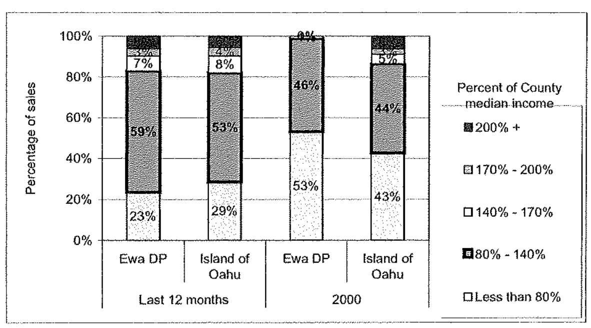
	Ewa DP[1]			Oahu		
	Multi Family	Single-Family	Total	Multi Family	Single-Family	Total
Last 12 months[2]:						
Below $200,000	308	20	328	2,204	144	2,348
$200,000 - $259,999	259	13	272	1,550	187	1,737
$260,000 - $319,999	271	60	331	1,154	270	1,424
$320,000 - $439,999	250	405	655	1,415	1,149	2,564
$440,000 - $539,999	98	345	443	645	1,069	1,714
$540,000 - $639,999	46	204	250	319	824	1,143
$640,000 +	83	119	202	430	1,694	2,124
Total	1,315	1,166	2,481	7,717	5,337	13,054
2000:						
Below $150,000	265	67	332	1,775	368	2,143
$150,000 - $189,999	55	114	169	574	386	960
$190,000 - $229,999	123	99	222	576	516	1,092
$230,000 - $319,999	51	270	321	668	1,281	1,949
$320,000 - $389,999	6	199	205	198	679	877
$390,000 - $469,999	0	1	1	109	456	565
$470,000 +	0	1	1	259	705	964
Total	500	751	1,251	4,159	4,391	8,550

1 Ewa Development Plan Area, as approximated by tax map keys 1-9-1 and 1-9-2.
2 For the time period from 08/01/2004 through 07/31/2005.

Source: Hawaii Information Service. See also Appendices 1 and 2 for derivation of price thresholds.

Appendix 6: Multi-Family Home Sales by Affordability
Ewa DP and Island of Oahu

	Last 12 months[1]		2000	
	Ewa DP[2]	**Island of Oahu**	**Ewa DP[2]**	**Island of Oahu**
Average sales price	$328,137	$317,383	$144,881	$201,548
Median sales price	$284,466	$265,000	$125,450	$170,000
Number of sales by target income group[3]:				
Less than 80% of median	308	2,204	265	1,775
80% - 140% of median	780	4,119	229	1,818
140% - 170% of median	98	645	6	198
170% - 200% of median	46	319	0	109
200% of median +	83	430	0	259
Total	**1,315**	**7,717**	**500**	**4,159**

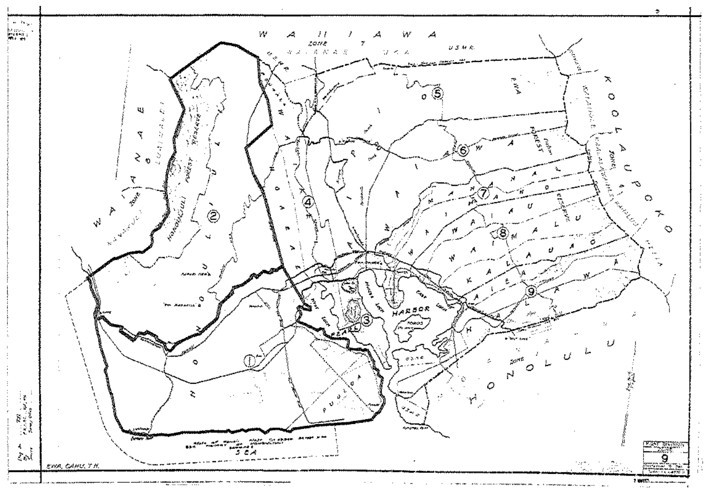


Note: Includes fee simple single- and multi-family unit sales recorded at the Bureau of Conveyances within the periods shown. Excludes sales of multi-unit apartment buildings, which are presumed to be investment/rental properties.

1 For the time period from 08/01/2004 through 07/31/2005.
2 Ewa Development Plan Area, as approximated by tax map keys 1-9-1 and 1-9-2.
3 Households grouped by their income in relation to County median for 2005 or 2000; number of sales occurring within price ranges affordable to each. See Appendices 1, 2 and 7.

Source: Hawaii Information Service.

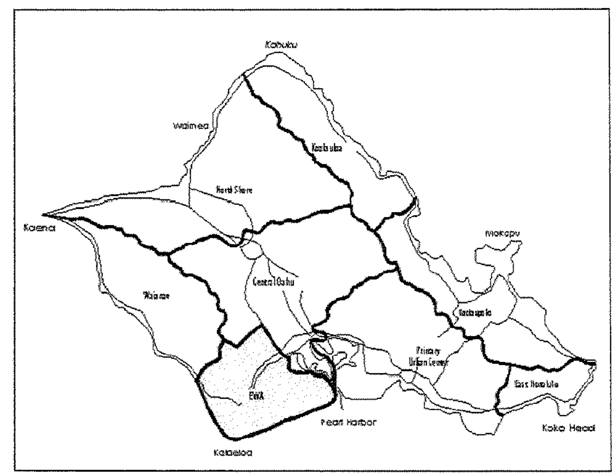
Appendix 8: Ewa DP Area as Approximated by Tax Map Key Classification



Source: Hawaii Information Service. See Appendix 9 for actual boundaries of Ewa DP Area as defined by the City.

Appendix 9: Ewa Development Plan and Other Community Plan Areas

As defined by City and County of Honolulu, Department of Planning & Permitting



Source: City and County of Honolulu, Department of Planning and Permitting, "Ewa Development Plan," August 1997 (revised May 2000,) as referenced at http://honoluludpp.org/planning/Ewa/Ewa1.pdf

Appendix J
Survey of Botanical, Avian, and Mammalian Resources

A Survey of Botanical, Avian and Mammalian Resources on the Makaīwa Hills Project Site, ‘Ewa District, O‘ahu, Hawai‘i.

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January 24, 2006

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Introduction

The Makaīwa Hills, LLC is seeking rezoning of approximately 1781-acres of land located north of the H1-freeway above the City of Kapolei, Oʻahu, Hawaiʻi (Figure 1). This report summarizes the findings of biological surveys that were conducted on the property in late November and early December, 2005.

The primary goal of the surveys was to determine if there were any Federal or State of Hawaiʻi listed endangered, threatened, proposed, or candidate avian, mammalian or botanical resources on, or in the immediate vicinity of the proposed project site. Federal and State of Hawaiʻi listed species status follows species identified in the following referenced documents (DLNR, 1998, Federal Register, 1999a, 1999b, 2001, 2002, 2004, 2005). Fieldwork was conducted on November 30, December 1, 2, and 13, 2005. The secondary goal was to describe the general floral and faunal makeup of the property.

The avian phylogenetic order and nomenclature used in this report follows *The American Ornithologists' Union Check-list of North American Birds 7th Edition* (American Ornithologists' Union 1998), and the 42nd through the 46th supplements to *Check-list of North American Birds* (American Ornithologists' Union 2000; Banks et al. 2002, 2003, 2004, 2005). Mammal scientific names follow *Mammals in Hawaii* (Tomich 1986). Native and naturalized flowering plant names follow *Manual of the Flowering Plants of Hawaiʻi* (Wagner et al. and Wagner and Herbst, 1990, 1999). Landscape plant names follow *A Tropical Garden Flora: Plants Cultivated in the Hawaiian Islands and Other Tropical Places* (Staples and Herbst 2005). Place names follow *Place Names of Hawaii* (Pukui et al. 1974).

Hawaiian and scientific names are italicized in the text. A glossary of technical terms and acronyms used in the document, which may be unfamiliar to the reader, are included at the end of the narrative text on Page 19.

General Site Description

The Makaīwa Hills project site consists of rolling foothills on the south facing slopes of the Waiʻanae Mountain Range in the ʻEwa District, Oʻahu. The site is bound to the east by Makakilo, by Farrington Highway and the H1-Freeway to the south, Waimānalo Gulch to the west, and Pālehu Road to the north (Figure 1). The terrain slopes from north-to-south, from an elevation of 1297-feet above mean sea level (ASL) at the northwestern terminus of the project, down to 50-feet ASL at the southwestern corner of the site located along the H1-Freeway (Figure 1). The site is transected by ʻAwanui Gulch, Pālailai Gulch and, Makaīwa Gulch, as well as by three other smaller unnamed gulches.

Vegetation on the site can be roughly characterized as grassland currently utilized as cattle pasturage, with scattered shrub and tree areas of variable density, the latter dominated by *kiawe* (*Prosopis pallida*). The dominant grasses are Guinea grass (*Panicum maximum*) and buffelgrass (*Cenchrus ciliaris*) and these appear to be

Figure 1 – Makaīwa Hills Project Site

distributed across the site in accordance with the existing moisture regime, with Guinea grass predominating at higher elevations, extending downslope along gulch bottoms, and buffelgrass dominating the lower elevations of the site.

Approximately one third of the project site burned during a wildfire which occurred in mid-August 2005. The area burned included the ridgeline between Waimanalo Gulch and Makaīwa Gulch, and the lower portion of Makaīwa Gulch as well as a section located in the southeast corner of the site along the old Farrington Highway (Figure 2).

Mammalian Survey Methods

All observations of mammalian species were of an incidental nature. With the exception of the endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*), or *ʻōpeʻapeʻa* as it is known locally, all terrestrial mammals currently found on the Island of Oʻahu are alien species, and most are ubiquitous. Two hours were spent within the project area on the evenings of November 30 and December 1, 2005, and again in the early morning hours of December 2, 2005 in an attempt to detect Hawaiian hoary bats. The survey of mammals was limited to visual and auditory detection, coupled with visual observation of scat, tracks, and other animal signs. A running tally was kept of all vertebrate species observed and heard within the study area.

Mammalian Survey Results

Five mammalian species were detected within the project site, domestic dog (*Canis f. familiaris*), small Indian mongoose (*Herpestes a. auropunctatus*), cat (*Felis catus*), horse (*Equus c. caballus*), and cattle (*Bos Taurus*). We saw numerous cattle throughout the site, and two small Indian mongooses just above the quarry located in the southeastern corner of the property. Numerous dogs were heard barking from within the Makakilo subdivision. Tracks and sign of dog, mongoose, cat, horse and cattle were observed in numerous locations within the site.

Avian Survey Methods

Twenty avian count stations were sited within the subject property, these were sited as close as possible to where Brunner conducted his point counts in 1990 (Bruner 1990). Eight minute point counts were made at each of the 20 count stations. Field observations were made using Leitz 10 X 42 binoculars and by listening for avian vocalizations. Counts took place between 06:30 a.m. and 11:00 a.m., the peak of daily bird activity. An additional two hours was spent within the project area on the evenings of evenings of November 30 and December 1, 2005, and again in the early morning hours of the December 2, 2005 in an attempt to detect crepuscular and/or nocturnally flying seabirds and owls. Time not spent conducting station counts was used to search the subject property for species and habitats not detected during count sessions.

Avian Survey Results

A total of 506 individual birds, of 21 different avian species, representing 16 separate families were recorded during station counts. These are summarized in Table 1. One of the species recorded, Pacific Golden-Plover (*Pluvialis fulva*), is an indigenous migratory shorebird species. Pacific Golden-Plover breed in the high Arctic, and spend their winters in Hawai'i and the tropical Pacific. The remaining 20 species detected during the course of this survey are considered to be alien to the Hawaiian Islands (Table 1).

Avian diversity and densities were relatively low, not surprising given the depauperate state of the habitat found on most of the site. Three species, Japanese White-eye (Zosterops japonicus), Red-vented Bulbul (*Pycnonotus cafer*), and Common Myna (*Acridotheres tristis*), accounted for slightly more than 36% of the total number of individual birds recorded. Japanese White-eyes were the most frequently recorded species, accounting for slightly more than 12% of the total number of individual birds recorded during station counts. We recorded an average of 25 birds per station count.

Table 1. Avian Species Detected Makaīwa Hills

Common Name	*Scientific Name*	*ST*	*RA*
	GALLIFORMES		
	PHASIANIDAE - Pheasants & Partridges		
	Phasianinae - Pheasants & Allies		
Gray Francolin	*Francolinus pondicerianus*	A	0.20
Erckel's Francolin	*Francolinus erckelii*	A	0.45
Ring-necked Pheasant	*Phasianus colchicus*	A	0.25
	CICONIIFORMES		
	ARDEIDAE - Herons, Bitterns & Allies		
Cattle Egret	*Bubulcus ibis*	A	1.00
	CHARADRIIFORMES		
	CHARADRIIDAE - Lapwings & Plovers		
	Charadriinae - Plovers		
Pacific Golden-Plover	*Pluvialis fulva*	IM	0.50
	COLUMBIFORMES		
	COLUMBIDAE - Pigeons & Doves		
Spotted Dove	*Streptopelia chinensis*	A	2.45
Zebra Dove	*Geopelia striata*	A	1.60
Mourning Dove	*Zenaida macroura*	A	0.05
	PASSERIFORMES		
	ALAUDIDAE - Larks		
Sky Lark	*Alauda arvensis*	A	2.35
	PYCNONOTIDAE - Bulbuls		
Red-vented Bulbul	*Pycnonotus cafer*	A	3.05
	TIMALIIDAE - Babblers		
Red-billed Leiothrix	*Leiothrix lutea*	A	0.10
	ZOSTEROPIDAE - White-Eyes		
Japanese White-eye	*Zosterops japonicus*	A	3.15
	MIMIDAE - Mockingbirds & Thrushes		
Northern Mockingbird	*Mimus polyglottos*	A	1.05
	STURNIDAE - Starlings		
Common Myna	*Acridotheres tristis*	A	3.00
	EMBERIZIDAE - Emberizids		
Red-crested Cardinal	*Paroaria coronata*	A	0.70
	CARDINALIDAE - Cardinals Saltators & Allies		
Northern Cardinal	*Cardinalis cardinalis*	A	0.75
	FRINGILLIDAE - Fringilline And Cardueline		

	Finches & Allies Carduelinae - Carduline Finches		
House Finch	*Carpodacus mexicanus*	A	1.90
	ESTRILDIDAE - Estrildid Finches Estrildinae - Estrildine Finches		
Common Waxbill	*Estrilda astrild*	A	1.10
Nutmeg Mannikin	*Lonchura punctulata*	A	0.90
Chestnut Munia	*Lonchura atricapilla*	A	0.35
Java Sparrow	*Padda oryzivora*	A	1.40

KEY TO TABLE 1

ST Status
A Alien – introduced to the Hawaiian Islands by humans
IM Indigenous Migrant – a native migratory species that winters in Hawai'i but breeds elsewhere
RA Relative Abundance – number of birds detected divided by the number of count stations (20)

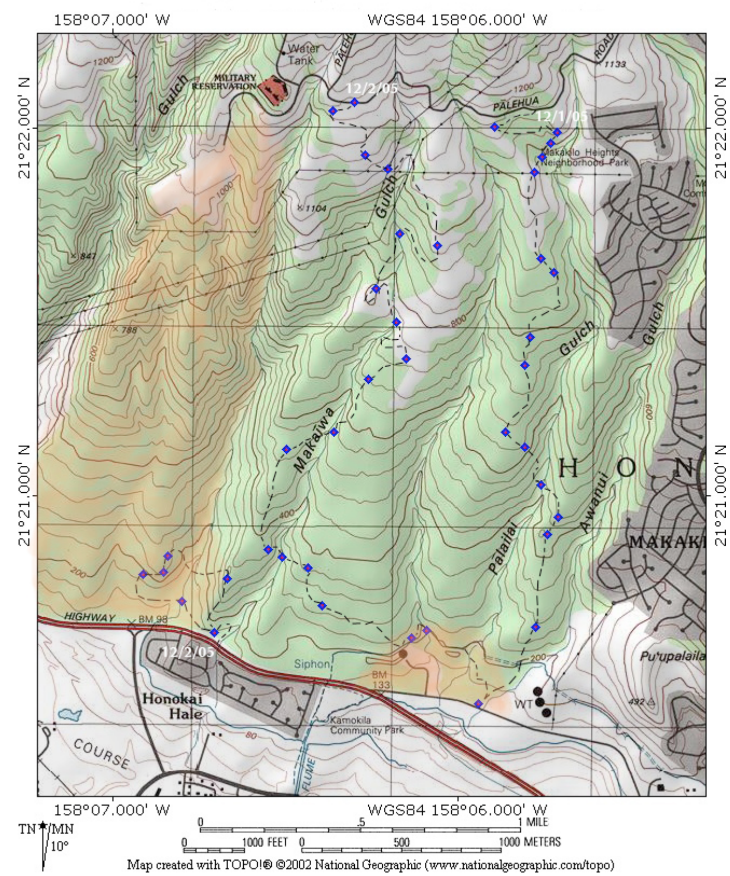
Botanical Survey Methods

A pedestrian botanical survey was conducted on December 1-2, 2005. The lower portion of the project area adjacent to the old Farrington Highway was surveyed on December 13, 2005. Wandering transects were undertaken to cover significant and representative parts of the property, and to search for native, threatened and endangered plants. Plants were identified to species in the field, and when field identification was uncertain, material was collected for later identification in the laboratory.

A Garmin *e*trex® Vista GPS unit was used to establish positions (waypoints) as the survey progressed. These were plotted on a map with an approximate route shown by the dashed line between waypoints (Figure 2). In most instances the actual routes traveled were substantially more sinuous between waypoints than illustrated in Figure 2. The faunal surveys (see above) generally followed very different routes from Palehua Road down to the old Farrington Highway. Although the vertebrate biologist did not attempt to identify all the plants he encountered along his survey route, any significant native plant resources observed were reported to the botanist.

This survey was conducted in an extremely dry part of O'ahu, the onset of the survey was delayed purposely until well into the wet season, and after some recovery from the August wildfire had occurred. It is to be expected, however, that additional species might be observed by repeating the survey later in the wet season. The site is mostly disturbed by ranching activities, reducing the possibility that important species are present.

Figure 2. Botanical Survey Routes and Waypoints



Key to Figure 2
GPS Waypoints plotted in blue
Start points are indicated by the date in white
August 20-05 Wildfire areas highlighted in Orange

Botanical Survey Results

A plant checklist was compiled from the plant observations made during the field surveys, with entries arranged alphabetically under family names. Included in the list are scientific name, common name, and status (whether native or non-native) of each species. Landscape and cultivated landscape plants found in a nursery along the old Farrington Highway near the bottom of the property were not included. However, species identified from a previous survey of the area (Char, 1990) are included in this listing. Species recorded in 1990 but not observed in 2005 are indicated by note (1) in Table 2.

In addition to identifying the plants present within the study site, qualitative estimates of plant abundance were also made. These are coded in the table as explained in the Legend to Table 2. Abundance estimates are for the survey area as a whole, and do not take into account distributional patterns of abundance. These patterns are discussed in the text.

A total of 72 species of plants were recorded during the December 2005 survey. An additional 46 species were recorded in 1990, but were not seen in 2005, resulting in a total of 118 species recorded in the course of two surveys conducted on the site within the last 25-years (Table 2). This is 15 more species than the total recorded in 1990, although the biggest change appears to be that 46 species present in 1990, were not recorded in 2005. Most of these "missing" or "missed" species are annuals, and likely still present on the site. These species would likely be recorded in a survey made further into the wet season, and after portions of the site which was burned in August have had a chance to recover more fully. Most of these missed species are naturalized alien species, of no particular interest or concern with respect to future plans for the site. Additional comparisons between the previous and present surveys in the discussion section that follows will primarily address the native flora present on the site.

Table 2. Plant Species Recorded at Makaīwa Hills

Species listed by family	Common name	Status	Abundance	Notes
FERNS				
PTERIDACEAE				
Doryopteris decipiens (Hook.) J. Sm.	*kumunui*	**End.**	--	(1)
FLOWERING PLANTS				
DICOTYLEDONES				
ACANTHACEAE				
Asystasia gangetica (L.) T. Anderson	Chinese violet	Nat.	U	
AIZOACEAE				
Trianthema portulacastrum L.	---	Nat.	O	
AMARANTHACEAE				
Achyranthes aspera L.	---	Nat.	--	(1)
Amaranthus spinosus L.	spiny amaranth	Nat.	--	(1)
Amaranthus viridis L.	slender amaranth	Nat.	U	
ANACARDIACEAE				
Schinus terebinthefolius Raddi	Christmasberry	Nat.	R	
ARALIACEAE				
Schefflera actinophylla (Endl.) Harms.	octopus tree	Nat.	--	(1)
ASCLEPIADACEAE				
Crypyostegia grandiflora (Roxb.) R.Br.	Indian rubber vine	Nat.	--	(1)
Stapelia gigantea N.E. Brown	carrion flower	Nat.	O	
ASTERACEAE (COMPOSITAE)				
Acanthospermum australe (Loefl.) Ktze.	spiny-bur	Nat.	--	(1)
Ageratum conyzoides L.	*maile hohono*	Nat.	R	
Ambrosia artemisiifolia L.	common ragweed	Nat.	--	(1)
Bidens cynapiifolia Kunth	---	Nat.	O	
Bidens pilosa L.	---	Nat.	--	(1)
Calyptocarpus vialis Less.	---	Nat.	O	
Conyza bonariensis (L.) Cronq.	horseweed	Nat.	R	
Eclipta prostrata (L.) L.	---	Nat.	R	
Emilia fosbergii Nicolson	*pualele*	Nat.	U	
Lactuca serriola L.	prickly lettuce	Nat.	--	(1)
Pluchia carolinensis (Jacq.) G. Don	sourbush	Nat.	U	
Pluchea indica (L.) Less.	Indian fleabane	Nat.	--	(1)
Sonchus oleraceus L.	sow thistle	Nat.	R	
Tridax procumbens L.	coat buttons	Nat.	U	
Verbesina enceliodes (Cav.) Benth. & Hook.	golden crown-beard	Nat.	U	

Veronia cinerea var. *parviflora* (Reinw.) DC	little ironweed	Nat.	--	(1)
Xanthium strumarium L.	*kikiana*, cockleburr	Nat.	R	
BRASSICACEAE				
Lepidium virginicum L.	peppergrass	Nat.	--	(1)
CACTACEAE				
Opuntia ficus-indica (L.) Mill.	*panini*	Nat.	R	
CAPPARACEAE				
Cleome gynandra L.	wild spider flower	Nat.	R	
CHENOPODIACEAE				
Atriplex semibaccata R. Br.	Australian saltbush	Nat.	--	(1)
Atriplex suberecta Verd.	---	Nat.	O	
Chenopodium carinatum R. Br.	---	Nat.	U	
Chenopodium murale L.	*`aheahea*	Nat.	--	(1)
CLUSIACEAE				
Clusia rosea Jacq.	copey	Nat.	--	(1)
CONVOLVULACEAE				
Ipomoea cairica (L.) Sweet	*koali `ai*	**Ind.**	U	
Ipomoea obscura (L.) Ker-Gawl.	---	Nat.	O	
Merremia aegyptia (L.) Urb.	hairy merremia	Nat.	O	
CUCURBITACEAE				
Coccinia grandis (L.) Voigt.	scarlet-fruited gourd	Nat.	R	
Cucumis dipsaceus Ehrenb. ex Spach	teasel gourd	Nat.	--	(1)
Momordica charantia L.	balsam pear	Nat.	U	
EUPHORBIACEAE				
Chamaesyce hirta (L.) Millsp.	garden spurge	Nat.	U	
Chamaesyce hypercifolia (L.) Millsp.	graceful spurge	Nat.	--	(1)
Euphorbia heterophylla L.	*kaliko*	Nat.	U	
Phyllanthus debilis Klein ex Willd.	niruri	Nat.	--	(1)
Ricinus communis L.	castor bean	Nat.	U	
FABACEAE				
Acacia confusa Merr.	Formosan koa	Nat.	--	(1)
Acacia farnesiana (L.) Willd.	*klu*	Nat.	A	
Chamaecrista nictitans (L.) Moench.	*lauki*	Nat.	U	
Crotalaria incana L.	fuzzy rattlepod	Nat.	--	(1)
Crotalaria pallida Aiton	smooth rattlepod	Nat.	O	
Desmanthus pernambucanus (L.) Thellung	virgate mimosa	Nat.	U	
Desmodium tortuosum (Sw.) DC	Florida beggarweed	Nat.	--	(1)
Indigofera suffruticosa Mill.	Indigo	Nat.	--	(1)
Leucaena leucocephala (Lam.) deWit	*koa haole*	Nat.	C	
Macroptilium atropurpureum (DC) Urb.	---	Nat.	R	
Macroptilium lathyroides (L.) Urb.	cow pea	Nat.	U	
Mimosa pudica L.	sensitive plant	Nat.	--	(1)

Prosopis pallida (Humb. & Bonpl. ex Willd.) Kunth	*kiawe*	Nat.	A	
Senna surattensis (N.L. Burm.) H. Irwin & Barneby	*kolomana*	Nat.	R	
GENTIANACEAE				
Centaurium erythraea Raf.	bitter herb	Nat.	--	(1)
LAMIACEAE				
Hyptis pectinata (L.) Poit.	comb hyptis	Nat.	O	
Hyptis suaveolens (L.) Poit.	---	Nat.	--	(1)
Leonotis nepetifolia (L.) R. Br.	lion's ear	Nat.	U	
Ocimum basilicum L.	wild basal	Nat.	O	
MALVACEAE				
Abutilon grandifolium (Willd.) Sweet	hairy abutilon	Nat.	R	
Abutilon incanum (Link) Sweet	hoary abutilon	**Ind.**	O	
Malva parviflora L.	cheese weed	Nat.	R	
Malvastrum coromandelianum (L.) Garck	false mallow	Nat.	U	
Sida ciliaris L.	---	Nat.	O	
Sida fallax Walp.	*`ilima*	**Ind.**	AA	
Sida rhombifolia L.	Cuba jute	Nat.	U	
Sida spinosa L.	prickly sida	Nat.	R	
MORACEAE				
Ficus microcarpa L. f.	Chinese banyan	Nat.	--	(1)
MYRTACEAE				
Eucalyptus sp.	gum tree	Nat.	--	(1)
Syzygium cumini (L.) Skeels	Java plum	Nat.	R	
NYCTAGINACEAE				
Boerhavia acutifolia (Choisy) J.W. Moore	alena	**Ind.**	O	
PAPAVERACEAE				
Argemone glauca (Nutt. ex Prain) Pope	*pua-kala*	**End.**	--	(1)
PASSIFLORACEAE				
Passiflora foetida L.	running pop	Nat.	U	
Passiflora suberosa L.	*huehue-haole*	Nat.	--	(1)
PLUMBAGINACEAE				
Plumbago zeylanica L.	*'ilie'e*	**Ind.**	R	
PORTULACACEAE				
Portulaca oleracea L.	pigweed	Nat.	U	
PROTEACEAE				
Grevillea robusta A. Cunn. ex R.Br.	silk oak	Nat.	R	
RUBIACEAE				
Hedyotis corymbosa (L.) Lam.	---	Nat.	R2	
Spermacoce assurgens Ruiz & Pav..	buttonweed	Nat.	R	
SAPINDACEAE				
Dodonaea viscosa Jacq.	*a'ali'i*	**Ind.**	--	(1)
SOLANACEAE				

Solanum lycopersicum var. *cerasiforme* (Dunal) Spooner, G. Anderson,& Jansen	wild cherry tomato	Nat.	--	(1)
Nicandra physalodes (L.) Gaertn.	apple of Peru	Nat.	--	(1)
Solanum americanum Mill.	*popolo*	**Ind.**	--	(1)
Solanum linnaeanum Hepper & P. Jaeger	apple-of-Sodom	Nat.	--	(1)
STERCULIACEAE				
Waltheria indica L.	*'uhaloa*	Nat..	C	
VERBENACEAE				
Lantana camara L.	lantana	Nat.	R	
Stachytarpheta australis Moldenke		Nat.	O	
Stachytarpheta cayennensis (Rich.) Vahl.	nettle-leaved vervain	Nat.	--	(1)
Stachytarpheta jamaicensis (L.) Vahl.	smooth vervain	Nat.	R	
Verbena littoralis Kunth	*oi*	Nat.	--	(1)
MONOCOTYLEDONES				
AGAVACEAE				
Agave sisalana Perrine	sisal	Nat.	R	
CYPERACEAE				
Cyperus rotundus L.	nutgrass	Nat.	--	(1)
COMMELINACEAE				
Commelina benghalensis L.	hairy honohono	Nat.	U	
POACEAE				
Bothriochloa pertusa (L.) A. Camus	pitted beardgrass	Nat.	A	
Brachiaria mutica (Forssk.) Stapf	California grass	Nat.	--	(1)
Cenchrus ciliaris L.	buffelgrass	Nat.	AA	
Chloris barbata (L.) Sw.	swollen fingergrass	Nat.	C	
Chloris radiata (L.) Sw.	radiate fingergrass	Nat.	--	(1)
Cynodon dactylon (L.) Pers.	Bermuda grass	Nat.	--	(1)
Digitaria ciliaris (Retz.) Koeler	crabgrass	Nat.	--	(1)
Digitaria insularis (L.) Mez. ex Ekman	sourgrass	Nat.	--	(1)
Digitaria setigera Roth	*kukaipua'a*	**Ind.**	--	(1)
Echinochloa colona (L.) Link	jungle-rice	Nat.	R	
Eleusine indica (L.) Gaertn.	beach wiregrass	Nat.		
Eragrostis cf. *tenella* (L.) R & S	lovegrass	Nat.	O	
Eragrostis sp.			U	
Heteropogon contortus (L.) P. Beauv. ex Roem. & Schult.	*pili*, pili grass	**Ind.**	--	(1)
Melinus repens (Willd.) Zizka	Natal redtop	Nat.	O	
Panicum maximum Jacq.	Guinea grass	Nat.	AA	
Panicum maximum var. *trichoglume* Eyles ex Robyns	Guinea grass	Nat.	--	(1)
Paspalum sp.		Nat.	R	
Setaria verticillata (L.) P. Beauv.	bristly foxtail	Nat.	--	(1)
Sporobolus sp.	---	Nat.		

Legend to Table 2

STATUS = distributional status for the Hawaiian Islands:
- **end.** = endemic; native to Hawaii and found naturally nowhere else.
- **ind.** = indigenous; native to Hawaii, but not unique to the Hawaiian Islands.
- nat. = naturalized, exotic, plant introduced to the Hawaiian Islands since the arrival of Cook Expedition in 1778, and well-established outside of cultivation.
- orn. = exotic, ornamental or cultivated; plant not naturalized (not well-established outside of cultivation).
- **pol.** = Polynesian introduction before 1778.

ABUNDANCE = occurrence ratings for plants by area:
- R – Rare: seen in only one or perhaps two locations.
- U - Uncommon-: seen at most in several locations
- O - Occasional: seen with some regularity
- C - Common: observed numerous times during the survey
- A - Abundant: found in large numbers; may be locally dominant.
- AA - Very abundant: abundant and dominant; defining vegetation type.

Numbers following an occurrence rating indicate clusters within the survey area. The ratings above provide an estimate of the likelihood of encountering a species within the specified survey area; numbers modify this where abundance, where encountered, tends to be greater than the occurrence rating:
- 1 – several plants present
- 2 - many plants present
- 3 – locally abundant

NOTES: (1) - Reported previously (Char, 1990), but not seen in 2005.

Discussion

Mammalian Resources

The findings of the mammalian survey are consistent with the findings of at least one other survey conducted on the proposed project site (Bruner 1990), and with at least one other recent survey conducted on lands immediately adjacent to the subject property (David 2005a), as well as with several others faunal surveys conducted on lands in the general vicinity of the subject property over the past five years (David, 2000, 2001, 2004, 2005b, David and Guinther 2000, 2005).

Although no rodents were detected during the course of this survey, it is likely that roof rats (*Rattus r. rattus*), Norway rats (*Rattus norvegicus*), European house mice (*Mus domesticus*) and possibly Polynesian rats (*Rattus exulans hawaiiensis*) use resources within the project site. These commensal species are all but ubiquitous on the island of O'ahu. All of these introduced rodents are deleterious to remaining native ecosystems and the native floral and faunal species that are dependant on them for their survival.

Avian Resources

The findings of the avian survey are consistent with the findings of at least one other survey conducted on a the proposed project site (Bruner 1990), and with at least one other recent survey conducted on lands immediately adjacent to the subject property (David 2005a), and with several others avifaunal surveys conducted on lands in the general vicinity of the subject property over the past five years (David, 2000, 2001, 2004, 2005b, David and Guinther 2000, 2005). During the course of this survey we detected five more avian species than did Bruner in his 1990 survey of the same site (Bruner 1990).

Only one of the 21 different avian species recorded during the course of this survey was a native species. The lone native species recorded, Pacific Golden-Plover, is an indigenous migratory shorebird species, that breeds in the high Arctic and spends the winters in Hawaiʻi and the tropical Pacific. Plover are readily seen throughout the Hawaiian Islands between late July and the end of April each year. The remaining 20 species detected during the course of this survey are considered to be alien to the Hawaiian Islands.

Although not detected during this survey, or in fact during Bruner's survey in 1990, it is likely that the Hawaiian endemic sub-species of the Short-eared Owl *(Asio flammeus sandwichensis*), or *pueo* uses resources within the general project area. This species is regularly seen along the Waiʻanae coast from the Lualualei Naval Reservation to Waimānalo Gulch (David 2005c). The Oʻahu population of the short-eared Owl is listed as an endangered species under the State of Hawaiʻi's endangered species program, though, it is not protected under the federal endangered species statutes (DLNR 1998).

From an avian and native mammalian perspective there is nothing unique about the habitat present within the subject property, and none of the habitat is important habitat for any listed avian or mammalian species currently known from the Island of Oʻahu.

Botanical Resources

No ferns or fern allies were observed during the plant survey, although Char (1990) reported a native species, *Doryopteris decipiens* or *kumunui*, from this area. The generally dry climate is not conducive to supporting most fern species found in Hawaiʻi. The vegetation identified is comprised of flowering plants which are overwhelmingly dominated by alien plant species, especially grasses. Of the total of 72 species of plants identified as present in 2005, only five (6.9%) are known from the Hawaiian Islands before the arrival of James Cook in 1778. None of these five species is considered an endemic. All five are indigenous species, and therefore very unlikely to be of concern for future listing as threatened or endangered under either Federal or State of Hawaiʻi endangered species statutes. One species, hoary abutilon (*Abutilon incanum*), which was surprisingly common in the mid-to-lower elevations on the property, is considered to be somewhat rare on O'ahu. If we consider the abundance estimates for these six native species, all but three (*ʻIlima* or *Sida fallax,* hoary abutilon or *Abutilon incanum,* and *ʻalena* or *Boerhavia acutifolia*) are rare or uncommon in the survey area. Thus, in terms of biomass, as well as number of species, native plants are a relatively minor component of the vegetation currently found on the site.

Char (1990) surveyed the same property and divided the vegetation into three "major" vegetation types: (1) Grassland/Shrubland, (2) Kiawe Forest, and (3) Buffelgrass Community on abandoned cane lands. In general, these vegetation types are recognizable today, although subject to reinterpretation. The higher elevation slopes of the parcel are

dominated by a Grassland/Shrubland of mostly Guinea grass, but several other prominent grass species are present as well: buffelgrass, pitted beardgrasss (*Bothriochloa pertusa*), and *Chloris* spp. (not in flower at the time of the survey). Common shrubs include *klu* (*Acacia farnesiana*), *ʻilima* (*Sida fallax*), wild basal (*Ocimum basilicum*), and *ʻuhaloa* (*Waltheria indica*). At the upper boundary of Palehua Road, several tree species {e.g., Christmasberry (*Schinus terebinthifolius*)} are present that increase in abundance upslope, but are not present much below the road. *Kiawe* abundance, on the other hand, increases downslope, the trees forming copses scattered around the hills and open to closed forest stands along gulch bottoms. Further downslope, an open *kiawe* forest, dominated by an understory of buffelgrass is characteristic of this part of O'ahu, and is the vegetation type now present on, and upslope of former cane lands.

Where access by cattle is restricted (and perhaps moisture regime enhanced) in the steep gulch margins, Guinea grass is especially dense and grows to a large stature . On more gentle slopes accessed by grazing cattle, the grasses tend to be cropped, although areas of dense buffelgrass are common where cattle have not recently grazed and areas of extensive erosion supporting sparse vegetation are scattered about, mostly in the upper parts of the property.

We paid particular attention to rocky areas, and especially areas of linear cliffs, as it was expected that these places would harbor plants not typically observed in the pasture and open forest areas—not just because of substratum differences but because access by cattle would be restricted or prevented by the rocky and/or steep terrain. In general, this expectation proved to be correct. The following species were characteristic of linear cliff areas (although, for some like *Boerhavia acutifolia*, distribution was not limited to such areas):

- *Abutilon incanum*
- *Bidens cynapiifolia*
- *Euphorbia heterophylla*
- *Boerhavia acutifolia*
- *Melinus repens*
- *Eragrostis* sp.
- *Portulaca oleracea*

Between 35 and 40% of the survey area was burned during wildfires in August 2005. These areas still appear as bare ground and with short stature blackened vegetation, but plant growth is slowly coming back. In such areas, the number of species is understandably limited, and species diversity can be expected to increase over the next six months through the wet season. However, it is interesting to note what species are initially populating the burned slopes, as these are species whose habit and or seeds allowed them to survive the heat of the fire. Species appearing later on are likely plants readily dispersed by birds or cattle. Species initially appearing in the burned areas are:

- *Panicum maximum**

- *Cenchrus ciliaris**
- *Merremia aegyptia*
- *Abutilon incanum*
- *Boerhavia acutifolia*

And to a lesser degree:

- *Euphorbia heterophylla*
- *Trianthema portulacastrum*
- *Sida fallax*
- *Leucaena leucocephala**
- *Portulaca oleracea*

Species marked with an asterisk (*) were seen to be recovering from established stems (i.e., the plant was not entirely killed by the heat), and it is possible that some of the others were as well, but the surviving stem was small and at or just beneath the surface. It is interesting to note that *A. incanum* and *B. acutifolia* are indigenous species, now common to abundant in the recently burned areas.

Of particular interest in comparing the previous survey conducted by Char with the present survey results are the native species, which comprised 11.7% of the 103 species recorded in 1990. Three endemics were recorded: *kumu-nui* (fern; *Doryopteris decipiens*), *nehe* (*Lipochaeta lobata*), and *pua-kala* (*Argemone glauca*), none of which was observed in 2005. These species were noted mostly from the upper part of the property. All three are distinctive and would not be easily missed except of course where the distribution is sparse since every square meter of the property was not surveyed. Still, the results suggest these species, if present, are so in low abundance. An additional nine indigenous species were recorded in 1990, of which four were not seen in 2005: *kukaipua'a* (*Digitaria setigera*), *pili* (*Heteropogon contortus*), *a'ali'i* (*Dodonaea viscosa*), and *alena* (*Boerhavia repens*). The latter may have been *Boerhavia acutifolia*, as this species was sometimes previously called *B. repens* and *B. acutifolia* is fairly common and widely distributed on the lower slopes of the property. K*ukaipua'a* resembles other crabgrasses, and could have been simply missed in 2005. The remaining two species, *a'ali'i* and *pili* grass, would be difficult to miss unless, as with the endemics, these are now present in very low numbers. For purposes of assessment, all of these natives are included in the species listing and are assumed to be present, although probably uncommon or rare in abundance.

Conclusions

Faunal Resources

It is not expected that the modification of the habitat currently found on the site or the development of the site will have a negative impact on any avian or mammalian species currently listed as endangered, threatened, or any that are currently proposed for listing under either Federal or State of Hawai'i endangered species statutes.

Botanical Resources

The results of the botanical survey indicate that there are no special concerns or legal constraints related to botanical resources on the surveyed property. Our conclusions mirror those Char made 15 years previously:

> *"There is little of botanical interest or concern on the site as it is dominated largely by introduced species; the land has also been in use for grazing cattle and horses for some time."* (Char 1990).

Char felt that the only natives of interest were confined to the *"steep gulch slopes which will not be developed."* While this is true to some extent, many of the steep, rocky areas most likely to harbor natives are located just below the less steep top surfaces of the interfluves, and are generally in areas that will be developed. Current development plans incorporate substantial open areas, including gulch bottoms and broad swaths following the energy corridors (high voltage lines from Kahe and Barbers Point electrical generation centers) that crisscross much of the property. Especially steep parts of the property would likely never be developed.

Glossary

Alien - Introduced to Hawai‘i by humans
Commensal - Animals that share humans food such as rats and mice
Crepuscular – Twilight hours
Domesticated – Feral species, not considered established in the wild on the Island of O‘ahu
Endangered – Listed and protected under the ESA as an endangered species
Endemic – Native and unique to the Hawaiian Islands
Indigenous - Native to the Hawaiian Islands, but also found elsewhere naturally
Mauka – Upslope, towards the mountains
Nocturnal – Night-time, after dark
‘ōpe‘ape‘a – Hawaiian hoary bat (*Lasiurus cinereus semotus*)
pueo – Hawaiian endemic cub-species of the Short-eared Owl (*Asio flammeus sandwichensis*)
Ruderal – Disturbed, rocky, rubbishy areas, such as old agricultural fields and rock piles
Threatened - Listed and protected under the ESA as a threatened species
Xeric – Extremely dry conditions or habitat

DLNR – Hawaii State Department of Land & Natural resources

Literature Cited

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

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

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

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

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

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

Bruner. P. L. 1990. Survey of the Avifauna and Feral mammals at Makaiwa Hills, Ewa, Oahu. Prepared for: William E. Wanket, Inc.

Char. W. P. 1990, Botanical Survey Maka‘iwa Hills ‘Ewa, District, O‘ahu. Prepared for: William E. Wanket, Inc.

David, R. E. 2000. Faunal Survey of Avian and Mammalian Species along the Proposed Leeward Bikeway Project, O‘ahu, Hawaii. Prepared for: AECOS Inc.

________. 2001. A Survey of Avian and Terrestrial Mammalian Species for the HECO Fuel Pipeline: Barbers Point to Waiau Project, O‘ahu, Hawai‘i. Prepared for: Planning Solutions, Inc., and Hawaiian Electric Company, Inc.

_______. 2004. An Avian Assessment of the Proposed Kalo‘i Gulch Drainageway Improvements at One‘ula Beach Park Project. Prepared for: Planning Solutions, Inc. & Haseko (Ewa), Inc.

_______. 2005. A Survey of Avian and Terrestrial Mammalian Species for the Kamokila Boulevard Extension Project, ‘Ewa District, O‘ahu, Hawai‘i. Prepared for: Kimura International, and the State of Hawai‘i Department of Transportation, Highways Division (HDOT).

_______. 2005. A Survey of Avian and Terrestrial Mammalian Species, Proposed Project Site, Nānākuli, Wai‘anae District, O‘ahu, Hawai‘i. Prepared for URS Corporation.

David, R. E. and E. Guinther. 2000. Biological resources survey for the Waikele Branch of the Lualualei Naval Ammunition Depot. Central O’ahu, Hawai’i Prepared for: Earthtech Inc. and the Department of the Navy.

David, R. E. and E. Guinther. 2005. A Survey of Botanical, Avian and Mammalian Resources, Hawaiian Electric Generating Station and Transmission Additions Project Site, Campbell Industrial Park, ʻEwa District, Oʻahu, Hawaiʻi. Prepared for: Planning Solutions, Inc. & Hawaiian Electric Company.

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

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

_______. 1999b. Department of the Interior, Fish and Wildlife Service, 50 CFR 17. Endangered and Threatened Wildlife and Plants. Endangered and Threatened Wildlife and Plants; Review of Plant and Animal Taxa that are Candidates or Proposed for Listing as Endangered or Threatened; Annual Notice of Findings on Recycled Petitions, and Annual Description of Progress on Listing Actions. *Federal Register*, **64** No. 205 (Monday, October 25, 1999): 57534-57547.

_______. 2001. Department of the Interior, Fish and Wildlife Service, 50 CFR 17. Endangered and Threatened Wildlife and Plants. Notice of Findings on Recycled Petitions. *Federal Register*, **66** No. 5 (Monday, January 8, 2001): 1295 – 1300.

_______. 2002. Department of the Interior, Fish and Wildlife Service, 50 CFR 17. Endangered and Threatened Wildlife and Plants. Review of Species That Are Candidate or Proposed for Listing as Endangered or Threatened; Annual Notice of Findings on Recycled Petition; Annual Description of Progress on Listing Actions. *Federal Register*, **67** No. 114 (Thursday, June 13, 2002): 40657-40679.

_______. 2004. Department of the Interior, Fish and Wildlife Service, 50 CFR 17. Endangered and Threatened Wildlife and Plants. Review of Species That Are Candidates or Proposed for Listing as Endangered or Threatened; Annual Notice of Findings on Resubmitted Petition; Annual Description of Progress on Listing Actions. *Federal Register*, **69** No. 86 (Tuesday, May 4, 2004): 24876-24904.

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

Pukui , M. K., S. H. Elbert, and E. T. Mookini 1976. *Place Names of Hawaii*. University of Hawaii Press. Honolulu, Hawaiʻi. 289 pp.

Staples, G. W., and D. R. Herbst 2005. *A Tropical Garden Flora: Plants Cultivated in the Hawaiian Islands and Other Tropical Places*. Bishop Museum Press.

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

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

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

Appendix K
Arthropod Survey

Survey of Terrestrial Invertebrate Resources
on the Makaīwa Hills Project Site, ‘Ewa District, O‘ahu, Hawai‘i

October 2006 November 2006

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Submitted to:
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For:
Group 70 International, Inc., Honolulu, Hawai‘i

December 27, 2006

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SUMMARY

The Makaīwa Hills project site sampled in this biological survey yielded native mollusks and arthropods, and adventive insect species. No invertebrate listed under either federal or state endangered species statutes was located within the survey area.

INTRODUCTION

This report summarizes the findings of an invertebrate[1] survey conducted in support of an environmental impact statement as part of a proposal to construct a residential community and supporting facilities in 'Ewa, O'ahu. Makaīwa Hills, LLC proposes to build on 1,781 acres, identified as Tax Map Keys: 9-1-15: Por. 5, 17; 9-2-03: Por. 2, Por. 5, Por. 84. This survey was conducted by Steven Lee Montgomery, Ph. D., for Rana Productions, Ltd., Kailua-Kona, Hawai'i, as part of a team effort directed by Group 70 International, Inc., Honolulu.

Invertebrates are often the dominant fauna in natural Hawaiian environments. The primary emphasis of this survey was on terrestrial arthropods, particularly those that are endemic, indigenous, or threatened species, especially those having legal status under either, or both federal and state endangered species statutes (DLNR 1996, USFWS 2005a, 2006).

Native Hawaiian plant, vertebrate, and invertebrate populations are often interdependent. Certain insects are obligatorily attached to specific host plants and are able to use only that plant as their food. Those insect - host relationships are ancient and intertwined. The health of native Hawaiian invertebrate populations depends upon habitat quality and absence or low levels of predators introduced from the continents. Sufficient food sources, host plant availability, and the absence or low levels of introduced, continental predators and parasites comprise a classic native, healthy ecosystem. Consequently, where appropriate in the survey discussion, host plants and some introduced arthropods are also noted. Plant names follow those in *Manual of the Flowering Plants of Hawai'i* (Wagner et al. 1999). Place names follow *Place Names of Hawaii* (Pukui et al. 1976).

GENERAL SITE DESCRIPTION

The area identified as Makaīwa Hills lies on the slopes of the Wai'anae Range, and is 1,781 acres of undeveloped, cattle grazed land. The area is bounded by Makakilo to the east / Diamond Head, Waimanalo Gulch to the west / 'ewa, and Farrington Highway, the H-1 Freeway, the City of Kapolei, and Kalaeloa/Barbers Point Harbor to the south / makai (Figure 1 and 2). Camp Timberline, an Air Force Solar Observatory, and a few private residences are above or mauka of the site. The project site slopes north to south, from approximately 1,300 feet above mean sea level to 50 feet at Farrington Highway.

[1] Animals without backbones: insects, spiders, snails, shrimp, etc.

The area is sited on the dry foothills of the slope of the Wai'anae Mountain Range, 'Ewa District, O'ahu. Three major gulches, 'Awanui, Pālailai and, Makaīwa, and three minor unnamed gulches run through the site, mauka to makai. There are no perpetually flowing streams or standing, open water to support hygrophilous invertebrates. Short term stream flows follow only after significant rainfall. A few small ponds of water persist for short periods in stream depressions. During this survey, small plunge pools were present and contained mosquito larvae. Vegetation is thickest and most varied in the stream channels and on the gulch walls, especially during the winter rainy season.

Known native Hawaiian plants of interest as hosts or shelter for invertebrates in this site were limited or missing in comparison to less altered dryland, low elevation locations in the islands. The majority of the land is gently sloping, broad, smooth ridges of the old shield volcano which support a few native plants in a sea of aliens. A large swath of the site, 'ewa of Makaīwa Gulch, was burned in a 2005 fire. The leeward coast has a history of anthropogenic summer fires which promote alien plan species while suppressing native vegetation. Added to decades of grazing, the result is a lack of native plant species to support associated native invertebrates. Vegetation on the site is primarily alien species introduced since 1790. The lowest elevations are now used as cattle pasturage and survive as a grassland with scattered shrub and trees. Most common is Buffelgrass (*Cenchrus ciliaris*) and occasional *Kiawe* (*Prosopis pallida*). The higher elevations show more variation, but also are dominated by a pattern of tree clusters, low shrubs, areas of open grasses, and denuded ground.

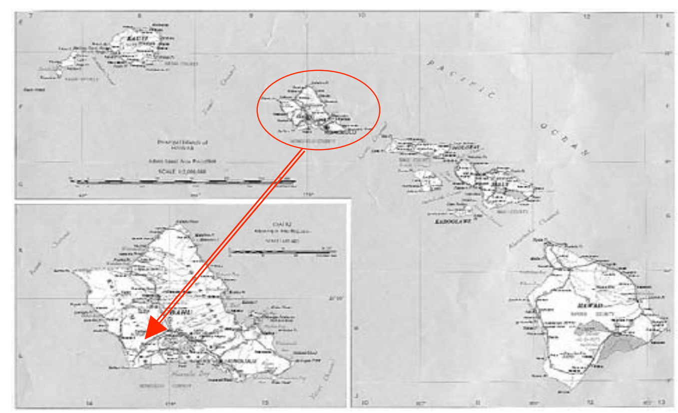


Figure 1. Map showing general location of project site on island of O'ahu

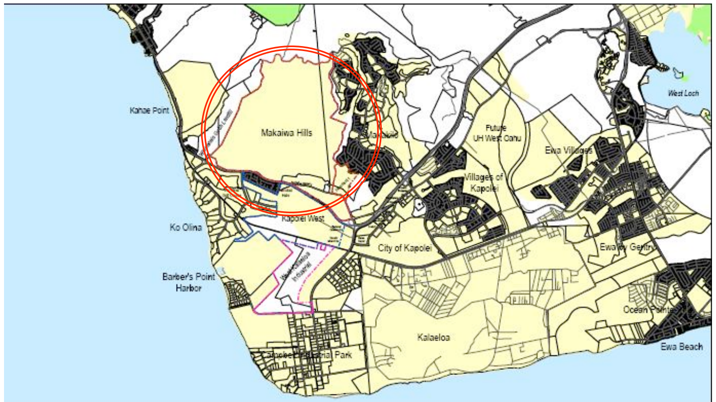


Figure 2. Map showing close up of project site Makaīwa Hills, 'Ewa, O'ahu

INVERTEBRATE SURVEY METHODS

Previous Surveys and Literature Search

Prior to the field survey, a search was made for publications relating to invertebrates associated with the Makaīwa Hills area. This review did not show any previous invertebrate surveys in the area. Earlier avian, botanical, and mammalian surveys of the Makaīwa Hills site by Char (1990) and Bruner (1990), and by David and Guinther (2006) in August and December 2005 also show no reference or evidence of surveying for invertebrates.

Since 1970, I have taken part in field projects at other locations on the slopes near Makaīwa Hills and in other dryland locations on O'ahu and throughout the island chain. Surveys of other dryland areas have created a sizeable body of information on native invertebrate and related botanical resources found in areas similar to Makaīwa Hills (Bridwell 1920, Swezey 1935a). Those experiences and the results of those surveys provided the basis for my study design and my analysis of results.

Fieldwork

Field surveys were conducted at the Makaīwa Hills site in October and November, 2006. I conducted a general assessment of terrain and habitats at the start of the survey. Surveying efforts were conducted at various times of day and night, a technique which is vital for a thorough survey. Native botanical resources identified by Char (1990) and by Guinther (David and Guinther 2006) were an important focus of my searches.

See Figure 3 for collecting locations within the survey area.

Fieldwork schedule:

October 26, 2006	Site examination and general orientation; transect
November 12-13, 2006	General collecting; light collecting using MV bulb
November 14-15, 2006	General collecting; light collecting using MV bulb
November 20-21, 2006	General collecting; light collecting using MV bulb
November 21-22, 2006	General collecting same track as Nov 12-13; light collecting using MV bulb same site as Nov 14-15

Collecting Methods

The following collecting methods for terrestrial invertebrates were used as appropriate to the terrain, botanical resources, and target species.

Baiting: Baits are used to attract insect species to specific tastes or smells. For example, some flies come to dead or dying plants with a specific odor. Baits can mimic that smell and taste and so attract those insects. Insects are enticed by the bait's 'advertisement.' Baits are placed at likely locations or inserted in bottle traps and checked periodically. Any insects at the bait are then collected. This is much more efficient than roaming the research area seeking cryptic insects.

Baited traps were deployed on November 12-13 and retrieved on November 14-15; deployed on November 21 and retrieved on November 22, 2006. Some traps used banana bait, some used fish based bait. Neither bait attracted native arthropods.

Host plant searches: Potential host plants, both native and introduced, were sampled for arthropods that feed or rest on plants.

Light sampling: A survey of insects active at night is vital to a complete record of the fauna. Many insects are only active at night to evade birds, avoid desiccation and high temperatures, or to use night food sources, such as night opening flowers. Light sampling uses a bright light source in front of a white cloth sheet. Night active insects seem to mistake the collecting light for the light of the moon, which they use to orient themselves. In attempting to navigate by the collecting light, confused insects are drawn toward the light and land on the cloth in confusion. This type of collecting is most successful during the dark phase of the moon under clouds blocking starlight. Vegetation usually blocks light from being seen over long distances, and most moths and other night fliers are not capable of very distant flight. Consequently, light sampling does not call in many insects from outside the survey area.

Sampling was conducted for 11 hours on November 12-13, for 10 hours on November14-15 and November 20-21, 9.5 hours on November 21-22. The light source was a mercury vapor (MV) bulb powered by an electric generator (left).

Collecting at upper portion of Makaïwa Hills November 14, 2006

Locations were chosen based on experience, host plant proximity, and terrain. The lack of native plants and dominance of alien fire-tolerant grass at lower elevations precluded light sampling in that area. Competing light from existing housing, street lights and other sources also were factors in location choice. The location of light sampling on November 21-22 was marked at 1200 ft. by GPS[2] at a location of 4Q 0593246, 2363082. All light sample locations and transects are marked on Figure 3.

Sweep nets: This is the most common and general method of collecting most flying and perching insects. A fine mesh net was swept across plants, leaf litter, rocks, etc. to collect any flying, perching or crawling insects. Transfer from the net was either by aspiration, or by placing the net contents into a holding container.

Visual observation: At all times, I was vigilant for any visual evidence of arthropod presence or activity. Visual observations provide valuable evidence and are a cross check that extends the reach of sampling techniques. Visual observation also included turning over rocks, dead wood, and other debris.

[2] GPS position is based on the UTM grid and the NAD 83 Datum

Survey Limitations / Conditions

My ability to form advisory opinions is limited / influenced in the following ways:

Common alien species: No attempt was made to collect or completely document the many common alien arthropod species present in the area.

Collecting conditions: Monitoring at a different time of the year, or for a longer period of time, might produce a longer or different arthropod list. Weather and seasonal vegetation plays an especially important role in any survey of invertebrates. Many arthropods time their emergence and breeding to overlap or follow seasonal weather or to coincide with growth spurts of an important plant food. Host plant presence/absence, and seasonal changes, especially plant growth after heavy rains, affect the species collected.

Weather was favorable for collecting during each day of collecting. This survey was conducted following several soaking winter rains and consequently vegetation was in a stage favorable for collecting. If vegetation had developed to a more mature stage, a different insect list might have resulted.

The moon did not present competition to light collecting efforts as it rose late and should not have affected the number of insects attracted to the light. The moon rose at 11:55 p.m. on November 12 and at 1:37 a.m. on November 15, the night of November 14. A slight cloud cover and passing light showers on the night of November 14 and the waning moon gave no interference. November 20-22 presented no moon during the collecting period – a new moon rising at 6:42 a.m. / 7:40 a.m. and setting at 5:42 p.m. / 6:31 p.m. respectively. (USNO)

Physical limitations: The density and height of the grasses made travel within the site difficult in some locations.

The large size of the project area means the survey was not comprehensive. The overall study strategy and site selections were designed to mitigate this recognized handicap. The resulting survey was representative and targeted in favor of locating and examining native host plants.

INVERTEBRATE SURVEY RESULTS

In addition to the invertebrate results noted below, I observed in the upper portion of the property a Barn Owl (*Tyto alba*) and Cattle Egret (*Bubulcus ibis*). I observed no signs of feral goats or pigs, common enemies of native host plants.

Table 1: List of Invertebrates [3]: Makaīwa Hills, O'ahu

Species / common name	Status	Abundance	Recovered at / by
MOLLUSCA GASTROPODA			
PULMONATA (Snails and Slugs)			
Succineidae			
Succinea sp. Hawaiian amber snail	End	R	under stones
ARTHROPODA ARANEAE (Spiders)			
Lycosidae			
Lycosa sp. Wolf spider	End	O	under stones at light
ARTHROPODA INSECTA			
COLLEMBOLA (Springtail)			
Entomobryidae			
undetermined sp. 1	?	O	under stones
undetermined sp. 2	?	O	under stones
LEPIDOPTERA			
Cosmopterigidae (Case bearers)			
Hyposmocoma sp. 1 (straight, slender case)	End	O	under stones
Hyposmocoma sp. 2 (curved, broad case)	End	O	under stones
Crambidae (micro-moths)			
Eudonia sp.	End	U	at light
Tamsica hyacinthina (Meyrick 1899)	End	C	at light
Mestolobes sp.	End	C	at light
Noctuidae (Miller moths)			
Ascalapha odorata (Linnaeus, 1758) Black witch moth	Adv	O	at light
Oecophoridae			
Thyrocopa abusa Walsingham, 1907	End	R	at light
Pyralidae			
Cactoblastis cactorum (Berg, 1885) Prickly Pear Moth / Argentine cactus moth	Pur	O	in *Opuntia*
Sphingidae (Hawk moths)			
Agrius cingulata (Fabricius, 1775) Sweetpotato hornworm	Adv	A	at light
Deilephila nerii (Linnaeus), 1758 Oleander hawk moth	Adv	U	at light
Hyles lineata (Fabricius), 1775 Whitelined sphinx	Adv	U	at flower

[3] Names authority: Hawaii Biological Survey 2002; Nishida 2002; Zimmerman 1948-80; Zimmerman 2001

Table 1: continued

Species / common name	Status	Abundance	Recovered at / by
HETEROPTERA (True bugs)			
Miridae (leaf bugs)			
Hyalopeplus pellucidus (Stal, 1859) Transparentwinged plant bug	End?	R	swept from *Sida*
HYMENOPTERA (Wasps, Bees, Ants)			
Formicidae			
Anoplolepis gracilipes Long-legged ant	Adv	AA	on soil
Pheidole megacephala Big-headed ant	Adv	A	on soil
ODONATA (Dragonflies and Damselflies)			
Libellulidae (Skimmers)			
Pantala flavescens (Fabricius, 1798) Globe skimmer	Ind	O	in flight on ridge in flight at Farrington Hiwy

Status:
End endemic to Hawaiian Islands
Ind indigenous to Hawaiian Islands
Adv adventive
Pur purposefully introduced
? unknown

ABUNDANCE = occurrence ratings for plants by area:

R	Rare	seen in only one or perhaps two locations.
U	Uncommon-	seen at most in several locations
O	Occasional	seen with some regularity
C	Common	observed numerous times during the survey
A	Abundant	found in large numbers; may be locally dominant.
AA	Very abundant	abundant and dominant; defining vegetation type.

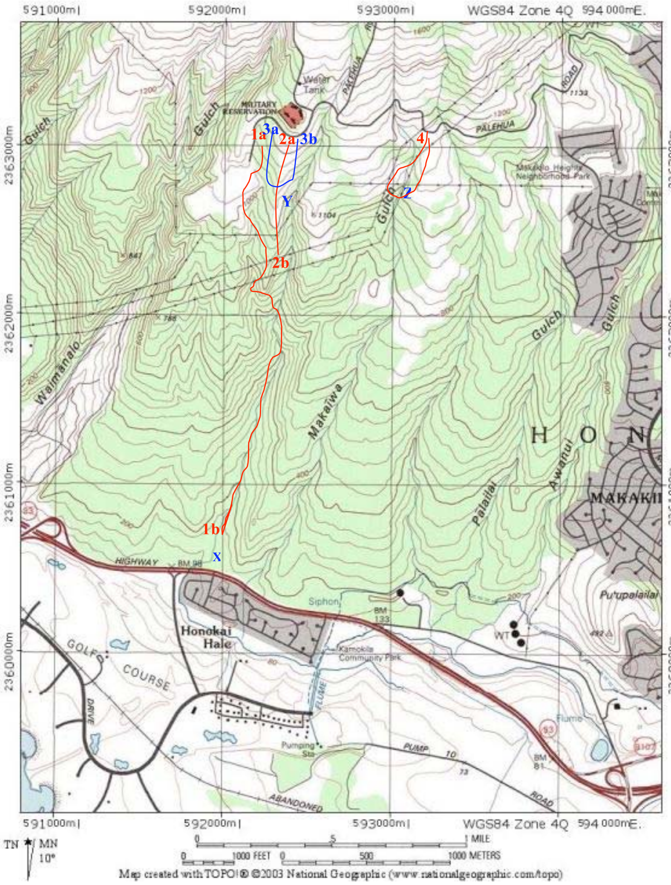


Figure 3. Map of Makaīwa Hills project area showing collecting stations

October 5, 2006	X = sighting of *Pantala*
October 26, 2006	1a = begin transect; 1b = end transect
November 12-13, 2006	2a = begin search; light sampling; 2b = end (retrace to beginning)
November 14-15, 2006	3b = light sampling; 3a = begin transact 2 3b = end transact 3
November 20-21, 2006	4 = light sampling; start/end route; Z = *Succinea, Hyposmocoma*
November 21-22, 2006	Y =*Hyposmocoma* found on retracing transect 2; light sampling at 3b

DISCUSSION

Native species of note are discussed. Also, information is provided on several adventive species often misidentified by the public, especially those confused with native species.

Invertebrate Resources

MOLLUSCA: Gastropoda Pulmonata

Succineidae: *Succinea* sp. Hawaiian amber snail

The only native terrestrial mollusk encountered was a succineid, approximately 6-8 mm. in length. Endemic *Succinea s*nails were observed under loose stones on a barren patch of pitted lava slabs at 900 ft. The lava may have provided an unburnable refuge in the sea of flammable grasses. The rock was encrusted with lichens in a veneer. This group of snails may be arboreal or ground dwelling, and occupies a wide range of habitats. They are often endemic to a single island, but are widely distributed. All *Succinea* feed on decaying plant matter. (Zimmerman 2001). They often covered their shells with bits of decaying plant matter for camouflage. They are not known to eat healthy, growing plants and pose no threat to home gardens or landscaping (R. Cowie, personal communication 2002). Refinement of the identification is in progress.

ARTHROPODS

ARANEAE

Lycosidae: *Lycosa* sp.

Native *Lycosa* or wolf spiders (18 mm) were noted in several locations on the property. These are quick, strong predators which give maternal care to their young. They hide alone by day and hunt by night in established individual territories. (Manning/Montgomery in Liittschwager & Middleton 2001)

Lycosa spider species recorded on O'ahu are all endemics: *L. hawaiiensis*, *L. oahuensis*, and *L. perkinsi*. *L. hawaiiensis* and *L. oahuensis* are known from several islands. *L. perkinsi* is known only from O'ahu. It is most likely the specimens taken at Makaīwa Hills are *L. hawaiiensis*. Refinement of the identification is in progress.

INSECTA

HETEROPTERA (True bugs)

Miridae: *Hyalopeplus pellucidus* Transparentwinged plant bug

The endemic status of this "true bug" is in doubt. It was not found by R. C. L. Perkins' comprehensive 1890s survey (Sharp 1899-1913), being first reported in 1902. Unlike most truly endemic insects, it is recorded as using crops and ornamental plants as a host (Mau and Martin 1992). It is found on all major islands.

LEPIDOPTERA

Cosmopterigidae: *Hyposmocoma*

Hyposmocoma were found on the same rocky outcroppings as the *Succinea* snails. Properly called "case bearers," the caterpillars are sometimes misleadingly called "bagworms." Very young caterpillars of case bearers find safety inside a leaf curl or similar hiding place, but when growth forces them out of that protection, they intricately weave a portable shell of their own silk from a lip spinneret. For camouflage, they add bits of their surroundings to the case using their silk: snips of dry grass or leaves, flakes of bark, maybe a little dirt. The case is then easily mistaken by a predator as another part of the landscape. These bunkers are fitted with a hinged lid (operculum), pulled shut by mini-mandibles to defend them from enemies like beetles and micro wasps. Their relationship to the case is similar to that of a hermit crab to his shell. They aren't physically connected to the case as a snail or turtle is tied to their shells. They are dependent on their case, and die if removed – even if protected from predators and given food. They don't move far, but feed while partly emerged from the case, dragging along their protective armor by their six true legs. Cases are sometimes attached to rocks a short distance above the ground. (Manning/Montgomery in Liittschwager & Middleton 2001) With over 500 kinds, *Hyposmocoma* micromoths are the greatest assemblage of Hawaiian Island moths, showing astonishing diversity. After writing 630 pages on them, Dr. Elwood Zimmerman lamented the inadequacy of his study. He noted an enormous cluster of species with explosive speciation and diverging radiation (Zimmerman 1978). Much remains to be learned about the life ways of this interesting group of insects now under study by University of Hawaii's Daniel Rubinoff and graduate student W. Haines (Rubinoff & Haines 2006).

An attempt will be made to rear out the caterpillars to identify the species.

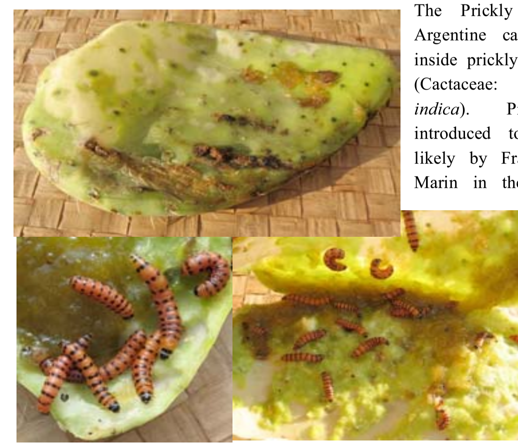
Crambidae: *Eudonia* sp.

This endemic moth is represented by 15 species known from O'ahu. The captured specimen came to lights November 21-22. A typical *Eudonia* feeds on mosses.

Noctuidae: *Ascalapha odorata*

The black witch moth has been widely distributed in the island chain since the 1920s. This large moth is occasionally mistaken for a bat. It is most frequently seen a dawn or dusk, or resting under the eaves of roofs during the day.

Pyralidae: *Cactoblastis cactorum*



The Prickly Pear Moth or Argentine cactus moth feeds inside prickly pear cactus pads (Cactaceae: *Opuntia ficus-indica*). Prickly pear was introduced to Hawai'i, most likely by Francisco de Paula Marin in the 1800s (Staples 2005) and quickly naturalized in dry, disturbed environments. It spread throughout the islands, becoming a pasture pest. In 1949-1950 the Hawai'i Board of Agriculture and Forestry introduced *Cactoblastis cactorum* and several other insect species to feed on *O. ficus-indica* for bio-control. C. *cactorum* was released in Waimea, Hawai'i, in May 1950 (Weber 1951). Without human intervention it established by 1954 on Lāna'i, Maui (Fullaway 1955), O'ahu (Bianchi 1955), and Moloka'i (Beardsley 1955). It is now known from all major islands.

C. cactorum eggs anchor to cactus spines in stacks of up to 100 eggs. When the young caterpillars hatch they walk down the spine and burrow into the cactus pad. Pads show external damage and ooze plant fluid and insect frass (above top). Larvae feed in groups inside the pad, hollowing it out (above right). Mature larvae leave the pad and pupate under nearby debris. The adult moths disperse to lay eggs on fresh plants (PPQ 2006).

Note that although considered an efficient biocontrol agent in Hawai'i, *Cactoblastis cactorum* is considered a critical threat to native cactus in North America and the Caribbean. Live specimens should not be removed from the Hawaiian islands (Gordon 2002).

Sphingidae: *Agrius cingulata* Sweet potato hornworm

This large and easily seen moth is often confused by the public with the Blackburn's sphinx moth (*Manduca blackburni*) described below. The caterpillars feed on all sweet potato, morning glory, and related plants. It is widely distributed around the Hawaiian Islands.

Sphingidae: *Deilephila nerii* Oleander hawk moth
A large moth widely distributed throughout the Hawaiian chain. Despite the 'oleander' name, a wide variety of plants can serve as host to the caterpillar of this large moth. Common is south Asia, it first appeared in the islands at Hickam Air Force Base on O'ahu in 1974 and spread from there (Kunishi 1976).

Sphingidae: *Hyles lineata* Whitelined sphinx
Frequently reported by members of the public as a hummingbird due to the way it hovers at the mouth of flowers sucking nectar.

ODONATA (Dragonflies and Damselflies)
Libellulidae: *Pantala flavescens* Globe skimmer

This indigenous dragonfly was observed on a ridge top and at the Farrington Highway edge of the property (October 5, 006). Among the most easily observed native insects, they are large, easily approached by people, and graceful in flight. Any small amount of fresh water will attract them and they often colonized human maintained water sources such as golf-course water hazards and ponds.

It is widely distributed throughout the Hawaiian Islands, from Kure to Hawai'i Island and has even been found flying at sea (Howarth & Mull 1992).

Invertebrates Not Present
Plant and invertebrate populations are interdependent. Consequently, host plant presence is one way to review invertebrate health. The absence of wiliwili (*Erythrina sandwicensis*) and ma'o or Hawaiian cotton (*Gossypium tomentosum*) together with a low level of 'ilima (*Sida* sp.) contribute to the paucity of Hawaiian arthropods at Makaīwa Hills (Swezey 1935b).

Alien predatory ants are another major cause of low native arthropods. Both the long-legged ant (*Anoplolepis gracilipes*) and big-headed ant (*Pheidole megacephala*), which prey on other insects (Zimmerman 1948-80), are present on the property. These ants are well documented as a primary cause of low levels of native arthropods at elevations up to 2000 ft. (Perkins 1913). On all nights during light collecting ants quickly appeared and began attacking the resting incoming moths and smaller insects at my light. Long-legged and big-headed ants did not overlap. Rather they have separate territories, effectively apportioning the hunting grounds between themselves, offering few ant-free zones to native arthropods.

MOLLUSCA: Gastropoda (Snails) Pulmonata
Achatinellidae
The Oahu Tree Snail (*Achatinella)*, listed on the federal endangered species list, was not found (DLNR 1996; Federal Register 1981). The habitat (elevation, host plants, and moisture levels) make the area inappropriate for the snail.

ARTHROPODA
Heteroptera Lygaeidae *Nysius* sp.
This native seed bug is commonly found in dryland locations, using many host plants, alien and native. It was not found at this location despite specific searches of the few 'ilima (*Sida* sp.) plants, the only host plant available at Makaīwa Hills. After the vegetation currently present on the site has matured following additional rains, these seed bugs might be found.

Hymenoptera Colletidae *Hylaeus* sp.
The yellow faced bee was not found despite special attention paid to searching 'ilima (*Sida* sp.) plants. This native, ground nesting bee is frequently found in similar elevation dry habitats.

Lepidoptera Sphingidae: *Manduca blackburni*
Blackburn's sphinx moth (*Manduca blackburni*), an endangered species (Fed Reg 1999-2000) which favors drylands was not found in this survey. Neither the moth's solanaceous native host plant, 'aiea (*Nothocestrum* sp.), nor the best alien host, tree tobacco (*Nicotiana glauca*), was observed on the property in my own survey or prior botanical surveys. The moth has not been seen on O'ahu for many decades. The *Recovery Plan* (USFWS 2005b) for this large sphinx moth proposes only one Management Unit on O'ahu, at the Nature Conservancy's Honouliuli Preserve and relies on future reintroductions from other islands.

Medically Important Species

The Makaīwa Hills area includes classic habitat for centipedes, scorpions, widow spiders, and paper wasps. These medically important species may be present in the area. Employees (surveyors, construction crews, landscapers) should be alert for these species during the construction phase of work. These species may pose a serious risk to some individuals, and supervisors should be aware of any special allergy by employees. Some individuals can experience anaphylactic reactions to venom. When moving stones or piled brush, use of gloves and long sleeves will greatly reduce the risk of accidental contact and bites. Please see *What Bit Me?* (Nishida and Tenorio 1993).

CONCLUSIONS

Potential Impacts on Native, Rare, Federally or State Listed Species

No federally or state listed endangered or threatened species were noted in this survey (USFWS 2006). No anticipated actions related to the proposed project activity in the surveyed locations are expected to threaten entire species or entire populations.

RECOMMENDATIONS

Prevent habitat degradation

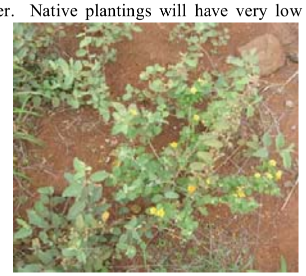
A **Best Practices Management Plan** for construction should be written and implemented specifying methods and controls for the entire construction zone to prevent or minimize impact on the gulch slope habitats.

This survey found the rocky patches and cliffs provide native species with shelter on remaining native plants. It is prudent to treat these areas with care, as here was the highest concentration of native mini-wildlife. *Hyposmocoma* micromoths found the large lichen encrusted rocks a refuge. Succineid snails are the focus of a major Pacific-wide study based at University of Hawai’i Mānoa (Cowie 2006a). Among the habitat photos displayed by the UH project on their web site are road side locations (Cowie 2006b), showing the snails surviving in close proximity with human activity.

Fulfillment of the Makaīwa Hills plan to integrate natural features, including slopes and gulches should preserve habitats for many native species.

Landscape with native dryland plants for low cost maintenance:

Makaīwa Hills, LLC noted in the *EIS Preparation Notice* their intent that the three major gulches and three minor gulches in the project area remain largely undeveloped. Their intention is to keep portions of project site in “open space that will constitute a major amenity and recreational resource.” Native insects are quite dependent upon native flora. Landscaping with native dryland plants will serve to provide habitat for native arthropods while creating an interesting recreation area for walking and bird watching. Importantly, using dryland plants to landscape will mean lower long-term watering costs will be incurred, following an initial establishment period. Native plants will remain green and thus more fire resistant throughout the summer. Native plantings will have very low human maintenance costs as well (no hedge trimming, no weed whacking). Planted in a mix of ground cover, shrub, and tree heights the native plants will also help slow run off on slopes and retain moisture. Native insects will find this refuge over time. The plantings will provide educational, visual, and aesthetic benefits to residents while holding soil at very low on-going cost.



‘ilima & ‘uhaloa at Makaīwa Hills

Some species have demonstrated their adaptation to the area by growing in Makaīwa Hills naturally. Dryland adapted plants best known as insect host plants, and most likely to be available from landscape companies are listed below.

Ground cover:
‘ilima / *Sida* sp. (prone)
maiapilo / *Capparis sandwichiana*
‘ohai / *Sesbania tomentosa*
pā’ūohi’iaka / *Jacquemontia ovalifolia*
pili grass / *Heteropogon contortus*
‘ūlei / *Osteomeles anthyllidifolia*

ko’oloa ’ula

Shrub:
a’ali’i / *Dodonaea* sp.
‘ākia / *Wikstroemia* sp.
native amaranth / *Achyranthes splendens*
‘ilie’e / *Plumbago zeylanica*
‘ilima / *Sida* sp. (upright)
ko’oloa ‘ula / *Abutilon menziesii*
ma’o / Hawaiian cotton / *Gossypium tomentosum*
naio / *Myoporum sandwicense*
pōhinahina / beach vitex / *Vitex rotundifolia*
‘uhaloa / *Waltheria indica*

Tree:
alahe’e / *Psydrax odoratum*
ma’o hau hele / yellow hibiscus / *Hibiscus brackenridgei*
wiliwili / *Erythrina sandwicensis*

a‘ali‘i

ma’o hau hele, state flower

maiapilo / Capparis *sandwichiana*
This creeper is especially good at holding hillsides, bears numerous white flowers, and is host to many Hawaiian insects.

ma'o / *Gossypium tomentosum*
Hawaiian cotton is drought tolerant, produces hibiscus-like yellow flowers, and is host to a large number of Hawaiian insects.

Pōhinahina / beach vitex / *Vitex rotundifolia*
Now considered a beach plant, this hardy, flowering creeper likes to cascade down steep rocky locations and will easily grow in upland locations. It tolerates abuse associated with human co-habitation, and even responds to pruning. It would form a natural hedge along cliff tops, keeping people away from edges, with grace and beauty and no upkeep. No watering required after establishment.

wiliwili / *Erythrina sandwicensis*
Although currently wiliwili is under attack from a recently introduced alien gall wasp, if at the time of landscaping a successful control of that pest has been accomplished, wiliwili has a proven track record as a dryland decorative, low maintenance planting.

ACKNOWLEDGMENTS
Thanks are extended to the personnel of the Dept of Land and Natural Resources for permits to conduct this work and James Campbell Company, LLC, for permission and keys to enter the property. Thanks are extended to Reginald David and William Ruffin for assistance. The images used in this report are not released for other uses. They were made by Anita Manning, Steve Montgomery, and William Ruffin. Anita Manning contributed to preparation of this report. Steven Lee Montgomery conducted all collecting and is responsible for all conclusions.

ABBREVIATIONS AND GLOSSARY

DLNR	Department of Land and Natural Resources, State of Hawai'i
DOFAW	Division of Forestry and Wildlife, State of Hawai'i
MV	Mercury Vapor
n.	new
sp.	species
spp.	more than one species
UH	University of Hawai'i
USFWS	United States Fish and Wildlife Service

GLOSSARY[4]
Adventive: organisms introduced to an area but not purposefully.
Alien: occurring in the locality it occupies ONLY with human assistance, accidental or purposeful; not native. Both Polynesian introductions (e.g., coconut) and post-1778 introductions (e.g., guava, goats, and sheep) are aliens.
Arthropod: insects and related invertebrates (e.g., spiders) having an external skeleton and jointed legs.
Endemic: naturally occurring, without human transport, ONLY in the locality occupied. Hawaii has a high percentage of endemic plants and animals, some in very small microenvironments.
Hygrophilous: literally water loving, adapted to living or breeding in wet or damp places
Indigenous: naturally occurring without human assistance in the locality it occupies; may also occur elsewhere, including outside the Hawaiian Islands. (e.g., Naupaka kahakai (*Scaevola sericea*) is the same plant in Hawai'i and throughout the Pacific).
Insects: arthropods with six legs, and bodies in 3 sections
Invertebrates: animals without backbones (insects, spiders, snails / slugs, shrimp)
Larva/larval: an immature stage of development in offspring of many types of animals.
Mollusk: invertebrates in the phylum Mollusca. Common representatives are snails, slugs, mussels, clams, oysters, squids, and octopuses.

4 Glossary based largely on definitions in *Biological Science: An Ecological Approach*, 7th ed., Kendall/Hunt Publishing Co., Dubuque, a high school text; on the glossary in *Manual of Flowering Plants of Hawai'i*, Vol.2, Wagner, et al., 1999, Bishop Museum Press, and other sources.

Glossary: cont.

Native: organism that originated in area where it lives without human assistance. May be indigenous or endemic.

Nocturnal: active or most apparent at night.

Purposefully introduced: an organism brought into an area for a specific purpose, for example, as a biological control agent.

Rare: threatened by extinction and low numbers.

Species: all individuals and populations of a particular type of organism, maintained by biological mechanisms that result in their breeding mostly with their kind.

LITERATURE CITED

Beardsley, J. W. 1955. "Notes and Exhibitions (Nov 1954)," *Proceedings of the Hawaiian Entomological Society*, 15(3):387

Bianchi, F. 1955. "Notes and Exhibitions (Sept 1954)," *Proceedings of the Hawaiian Entomological Society*, 15(3):385.

Bridwell, J. C. 1920, "A New Lowland Plagithmysine Cerambycid from Oahu with Notes on its Habits. [Ewa Dryland Insect survey]," *Proceedings of the Hawaiian Entomological Society*, 4 (2): 314-327.

Bruner, P. L. 1990. Survey of Avifauna and Feral Mammals at Makaiwa [sic] Hills, Ewa, Oahu. Prepared for: William Wanket, Inc.

Char, W. P. 1990. Botanical Survey, Maka'iwa [sic] Hills, 'Ewa District, O'ahu. Prepared for: William Wanket, Inc.

Cowie, R. H. 2006a May 05 Succineid project web data: *Systematics, Phylogenetics, and Biogeography*. www.hawaii.edu/cowielab/Succineid_project/suchome

Cowie, R. H. 2006b May 05 Hawaiian Islands Succineidae photos.www.hawaii.edu /cowielab/Succineid_project/Succineid%20website%20snail%20photographs

David, R. D. and E. B. Guinther. 2006. *Survey of Botanical, Avian and Mammalian Resources on the Makaīwa Hills Project Site, 'Ewa District, O'ahu, Hawai'i*. Prepared for: Group 70 International, and The Estate of James Campbell.

Department of Land and Natural Resources (DLNR). 1996. Indigenous Wildlife, Endangered and Threatened Wildlife and Plants, and Introduced Wild Birds. Department of Land and Natural Resources. State of Hawaii. Administrative Rule §13-124-2 -§13-124-3, June 13, 1996. www.state.hi.us/dlnr/dofaw/rules/Chap124exhib.pdf

Federal Register. 1981. Endangered and Threatened Wildlife and Plants; Listing the Hawaiian (Oahu) Tree Snails of the Genus Achatinella, as Endangered Species. Department of the Interior, Fish and Wildlife Service, Endangered and Threatened Wildlife and Plants. 50CFR 17. Federal Register, 46 No. 8 (Tuesday, January 13, 1981): 3178-3182.

_______. 1999-2000. Title 50, Volume 1, Parts 1 to 199. [Revised as of October 1, 2000] U.S. Government Printing Office via GPO Access [CITE: 50CFR17.11, Page 102-143]

Fullaway, D. T. 1955. "Notes and Exhibitions (June 1954)," *Proceedings of the Hawaiian Entomological Society*, 15(3):381.

Gordon, D. 2002 August. *The Global Invasive Species Initiative* The Nature Conservancy. tncweeds.ucdavis.edu/alert/alrtcact.html

LITERATURE CITED: cont.

Hawai'i Biological Survey. 2002 update. Hawaiian Arthropod Checklist, online authority file of terrestrial arthropod names for the Hawaiian Islands. B. P. Bishop Museum, Honolulu, Hawai'i. www2.bishopmuseum.org/HBS/checklist/

Howarth, F. G. and W. P. Mull. 1992. *Hawaiian Insects and Their Kin*. University of Hawai'i Press, Honolulu. 160p.

Kunishi, R. 1976. "Notes and Exhibitions (Oct 1974)," *Proceedings of the Hawaiian Entomological Society*, 22(2): 175-176.

Liittschwager, D. and S. Middleton, photographers. 2001. *Remains of a Rainbow*, National Geographic / Environmental Defense Fund. Accompanying zoological captions by Manning, Montgomery, *et al*.

Mau, R. and J. Martin. 1992. *Hyalopeplus pellucidus*. www.extento.hawaii.edu/Kbase/Crop/Type/h_pelluc.htm

Nishida, G. M. (ed.). 2002. *Hawaiian Terrestrial Arthropod Checklist*. Fourth edition. *Bishop Museum Technical Report* 22, 313 pp

Nishida, G. M. and J. M. Tenorio. 1993. *What Bit Me?* Univ. of Hawaii Press. 72 p.

Perkins, R. C. L. 1913. "Introduction. Being a review of the land-fauna of Hawaiia," and "Vertebrates." *In*: Sharp, D., ed., *Fauna Hawaiiensis. Vol. 1*. Cambridge University Press, Cambridge, and Bishop Museum Special Pub. 6.

Plant Protection and Quarantine (PPQ) Animal and Plant Health inspection Service, US Department of Agriculture, updated September 5, 2006 www.aphis.usda.gov/ppq/ep/ emerging_pests/cactoblastis/ and www.aphis.usda.gov/ppq/ep/cactoblastis/ pest_alert.pdf

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

Rubinoff, D. and W. P. Haines. 2006. "*Hyposmocoma molluscivora* Description," *Science,* 311:1377; www.ctahr.hawaii.edu/acad/CTAHRInAction/Dec_05/caterpillar.asp

Sharp, D., ed. 1899-1913. *Fauna Hawaiiensis*. University of Cambridge Press and Bishop Museum Special Publication 6, 3v.

Staples, G. W. and D. R. Herbst. 2005. *A tropical garden flora.* Honolulu, Bishop Museum Press, 908 p.

Swezey, O. H. 1935a. "Winter Revival of Insect Life in the Arid Region at Koko Head, O'ahu," *Proceedings of the Hawaiian Entomological Society*, 9: 95- 96.

Swezey, O. H. 1935b. "Insect Fauna of *Gossypium tomentosum,*" *Proceedings of the Hawaiian Entomological Society*, 9: 96-98.

LITERATURE CITED: cont.

U.S. Fish & Wildlife Service (USFWS). 2005a. Endangered and Threatened Wildlife and Plants. 50CFR 17:11 and 17:12 (Tuesday, November 1, 2005).

_______. 2005b. *Recovery Plan for the Blackburn's Sphinx Moth (Manduca blackburni).* Portland, Oregon. 125 p.

_______. 2006. USFWS Threatened and Endangered Species System (TESS), online at http://ecos.fws.gov/tess_public/StartTESS.do

U.S. Naval Observatory (USNO), Astronomical Applications Department. *Sun and Moon Data for One Day*. http://aa.usno.navy.mil/

Wagner, W. L., D. R. Herbst, and S. H. Sohmer. 1999. *Manual of the flowering plants of Hawaii*, Rev. ed. University of Hawaii Press and Bishop Museum Press, Honolulu, 1919 pp.

Weber, P. W. 1951. "Notes and Exhibitions" (Sept 1950), *Proceedings of the Hawaiian Entomological Society*, 14(2):217-8.

Zimmerman, E. C. 1948- 80. *Insects of Hawaii*. University of Hawaii Press, Honolulu.

_______. 1978. *Insects of Hawaii*. *Volume 9: Microlepidoptera Part II.* University of Hawaii Press, Honolulu. Pp. 1029-1699.

_______. 2001. *Insects of Hawai'i*. *Volume 1: Introduction*. University of Hawai'i Press, Honolulu. xx + 206 pp.

Appendix L
Air Quality Assessment

AIR QUALITY STUDY

FOR THE PROPOSED

MAKAIWA HILLS PROJECT

EWA, OAHU, HAWAII

Prepared for:

Group 70 International, Inc.

December 2006

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1.0 SUMMARY

Makaiwa Hills, LLC is proposing to develop the Makaiwa Hills Project adjacent to Makakilo on Oahu. The proposed project will consist of single- and multi-family residential units, commercial/retail space, recreational facilities, a school and other associated facilities and infrastructure on approximately 1,781 acres of land. Development of the project is expected to be completed and fully occupied by 2020. This study examines the potential short- and long-term air quality impacts that could occur as a result of construction and use of the proposed facilities and suggests mitigative measures to reduce any potential air quality impacts where possible and appropriate.

Both federal and state standards have been established to maintain ambient air quality. At the present time, seven parameters are regulated including: particulate matter, sulfur dioxide, hydrogen sulfide, nitrogen dioxide, carbon monoxide, ozone and lead. Hawaii air quality standards are comparable to the national standards except those for nitrogen dioxide and carbon monoxide which are more stringent than the national standards.

Regional and local climate together with the amount and type of human activity generally dictate the air quality of a given location. The climate of the project area is very much affected by its leeward situation. Winds are predominantly trade winds from the east northeast except for occasional periods when kona storms may generate strong winds from the south or when the trade winds are weak and landbreeze-seabreeze circulations may develop. Wind speeds typically vary between about 5 and 15 miles per hour providing relatively good ventilation much of the time.

Temperatures in the leeward Oahu area are generally very moderate with average daily temperatures ranging from about 65°F to 84°F. The extreme minimum temperature recorded at the nearby (former) Ewa Plantation is 47°F, while the extreme maximum temperature is 93°F. This area of Oahu is one of the drier locations in the state with rainfall often highly variable from one year to the next. Monthly rainfall has been measured to vary from as little as a trace to as much as 15 inches. Average annual rainfall in the area amounts to about 21 inches with summer months being the driest.

The present air quality of the project area appears to be reasonably good based on nearby air quality monitoring data. Air quality data from the nearest monitoring stations operated by the Hawaii Department of Health suggest that all state and national ambient air quality standards are currently being met.

If the proposed project is given the necessary approvals to proceed, it may be inevitable that some short- and/or long-term impacts on air quality will occur either directly or indirectly as a consequence of project construction and use. Short-term impacts from fugitive dust will likely occur during the project construction phase. To a lesser extent, exhaust emissions from stationary and mobile construction equipment, from the disruption of traffic, and from workers' vehicles may also affect air quality during the period of construction. State air pollution control regulations require that there be no visible fugitive dust emissions at the property line. Hence, an effective dust control plan must be implemented to ensure compliance with state regulations. Fugitive dust emissions can be controlled to a large extent by watering of active work areas, using wind screens, keeping adjacent paved

roads clean, and by covering of open-bodied trucks. Other dust control measures could include limiting the area that can be disturbed at any given time and/or mulching or chemically stabilizing inactive areas that have been worked. Paving and landscaping of project areas early in the construction schedule will also reduce dust emissions. Monitoring dust at the project boundary during the period of construction could be considered as a means to evaluate the effectiveness of the project dust control program. Exhaust emissions can be mitigated by moving construction equipment and workers to and from the project site during off-peak traffic hours.

After construction, motor vehicles coming to and from the proposed development will result in a long-term increase in air pollution emissions in the project area. To assess the impact of emissions from these vehicles, an air quality modeling study was undertaken to estimate current ambient concentrations of carbon monoxide at intersections in the project vicinity and to predict future levels both with and without the proposed project. During worst-case conditions, model results indicated that present 1-hour and 8-hour carbon monoxide concentrations are within both the state and the national ambient air quality standards. In the year 2015 without the project, carbon monoxide concentrations were predicted to increase at the intersection of Kamokila Boulevard and Wakea Street but remain largely unchanged at other locations in the project area. With the project in the year 2015, carbon monoxide concentrations were estimated to increase by about 27 percent at the intersection of Farrington Highway and Road D compared to the without-project case, while concentrations at other locations studied would increase only slightly or remain unchanged. Even with those increases, worst-case concentrations should remain within both national and state standards through the year 2015 with or without the project. By the year 2020, with or without the project, assumed roadway improvements would result in improved air quality at some locations, and carbon monoxide concentrations would increase only slightly near other intersections. Implementing mitigation measures for traffic-related air quality impacts is probably unnecessary and unwarranted.

Depending on the demand levels, long-term impacts on air quality are also possible due to indirect emissions associated with a development's electrical power and solid waste disposal requirements. Quantitative estimates of these potential impacts were not made, but based on the estimated demand levels and emission rates involved, any impacts will likely be negligible. Nevertheless, incorporating energy conservation design features and promoting conservation and recycling programs within the proposed development could serve to further reduce any associated impacts.

2.0 INTRODUCTION

Makaiwa Hills, LLC is proposing to develop the Makaiwa Hills Project on approximately 1,781 acres of vacant lands adjacent to Makakilo on the island of Oahu (see Figure 1 for project location). The project site is located on the Waianae (west) side of the Makakilo residential community, east of Waimanalo Gulch Sanitary Landfill and mauka (north) of the City of Kapolei and Ko Olina Resort. The development will include 4,100 single- and multi-family residential units, a community commercial center, neighborhood retail center, recreational facilities, an elementary school, an amenity center and associated infrastructure (i.e.,

roadways, utilities, drainage, wastewater and potable water systems). Affordable housing will also be provided in accordance with County standards. Construction of initial phases of the project is expected to commence during 2008, and full development and occupancy is planned by 2020.

The purpose of this study is to describe existing air quality in the project area and to assess the potential short- and long-term direct and indirect air quality impacts that could result from construction and use of the proposed facilities as planned. Measures to mitigate impacts by the project are suggested where possible and appropriate.

3.0 AMBIENT AIR QUALITY STANDARDS

Ambient concentrations of air pollution are regulated by both national and state ambient air quality standards (AAQS). National AAQS are specified in Section 40, Part 50 of the Code of Federal Regulations (CFR), while State of Hawaii AAQS are defined in Chapter 11-59 of the Hawaii Administrative Rules. Table 1 summarizes both the national and the state AAQS that are specified in the cited documents. As indicated in the table, national and state AAQS have been established for particulate matter, sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone and lead. The state has also set a standard for hydrogen sulfide. National AAQS are stated in terms of both primary and secondary standards for most of the regulated air pollutants. National primary standards are designed to protect the public health with an "adequate margin of safety". National secondary standards, on the other hand, define levels of air quality necessary to protect the public welfare from "any known or anticipated adverse effects of a pollutant". Secondary public welfare impacts may include such effects as decreased visibility, diminished comfort levels, or other potential injury to the natural or man-made environment, e.g., soiling of materials, damage to vegetation or other economic damage. In contrast to the national AAQS, Hawaii State AAQS are given in terms of a single standard that is designed "to protect public health and welfare and to prevent the significant deterioration of air quality".

Each of the regulated air pollutants has the potential to create or exacerbate some form of adverse health effect or to produce environmental degradation when present in sufficiently high concentration for prolonged periods of time. The AAQS specify a maximum allowable concentration for a given air pollutant for one or more averaging times to prevent harmful effects. Averaging times vary from one hour to one year depending on the pollutant and type of exposure necessary to cause adverse effects. In the case of the short-term (i.e., 1- to 24-hour) AAQS, both national and state standards allow a specified number of exceedances each year.

The Hawaii AAQS are in some cases considerably more stringent than the comparable national AAQS. In particular, the Hawaii 1-hour AAQS for carbon monoxide is four times more stringent than the comparable national limit. The U.S. Environmental Protection Agency (EPA) is currently working on a plan to phase out the national 1-hour ozone standard in favor of the new (and more stringent) 8-hour standard.

The Hawaii AAQS for sulfur dioxide were relaxed in 1986 to make the state standards essentially the same as the national limits. In 1993, the state also revised its particulate standards to follow those set by the federal government. During 1997, the federal government again revised its standards for particulate, but the new standards were challenged in federal court. A Supreme Court ruling was issued during February 2001, and as a result, the new standards for particulate were implemented during 2005. To date, the Hawaii Department of Health has not updated the state particulate standards. In September 2001, the state vacated the state 1-hour standard for ozone and an 8-hour standard was adopted.

4.0 REGIONAL AND LOCAL CLIMATOLOGY

Regional and local climatology significantly affects the air quality of a given location. Wind, temperature, atmospheric turbulence, mixing height and rainfall all influence air quality. Although the climate of Hawaii is relatively moderate throughout most of the state, significant differences in these parameters may occur from one location to another. Most differences in regional and local climates within the state are caused by the mountainous topography.

Hawaii lies well within the belt of northeasterly trade winds generated by the semi-permanent Pacific high pressure cell to the north and east. On the island of Oahu, the Koolau and Waianae Mountain Ranges are oriented almost perpendicular to the trade winds, which accounts for much of the variation in the local climatology of the island. The site of the proposed project is located on the southern (leeward) slopes of the Waianae Range.

Wind frequency data for Honolulu International Airport (HIA), which is located about 12 miles to the east of the project site, are given in Table 2. Wind frequency for HIA show that the annual prevailing wind direction for this area of Oahu is east northeast. On an annual basis, 34.7 percent of the time the wind is from this direction, and more than 70 percent of the time the wind is in the northeast quadrant. Winds from the south are infrequent occurring only a few days during the year and mostly in winter in association with kona storms. Wind speeds average about 10 knots (12 mph) and mostly vary between about 5 and 15 knots (6 and 17 mph). Winds at the project site likely show some deviation from those at HIA due to the effects of the mountains.

Air pollution emissions from motor vehicles, the formation of photochemical smog and smoke plume rise all depend in part on air temperature. Colder temperatures tend to result in higher emissions of contaminants from automobiles but lower concentrations of photochemical smog and ground-level concentrations of air pollution from elevated plumes. In Hawaii, the annual and daily variation of temperature depend to a large degree on elevation above sea level, distance inland and exposure to the trade winds. Average temperatures at locations near sea level generally are warmer than those at higher elevations. Areas exposed to the trade winds tend to have the least temperature variation, while inland and leeward areas often have the most. The project's leeward location results in a relatively moderate temperature profile compared to other locations around Oahu and the state. Based on more than 50 years of data collected at the former nearby Ewa Plantation, average annual daily minimum and maximum temperatures in the project area are 65°F and 84°F,

respectively [1]. The extreme minimum temperature on record is 47°F, and the extreme maximum is 93°F. Temperatures at the upper elevations of the project site are likely slightly cooler.

Small scale, random motions in the atmosphere (turbulence) cause air pollutants to be dispersed as a function of distance or time from the point of emission. Turbulence is caused by both mechanical and thermal forces in the atmosphere. It is oftentimes measured and described in terms of Pasquill-Gifford stability class. Stability class 1 is the most turbulent and class 6 the least. Thus, air pollution dissipates the best during stability class 1 conditions and the worst when stability class 6 prevails. In the Kapolei area, stability class 5 or 6 is generally the highest stability class that occurs, developing during clear, calm nighttime or early morning hours when temperature inversions form due to radiational cooling. Stability classes 1 through 4 occur during the daytime, depending mainly on the amount of cloud cover and incoming solar radiation and the onset and extent of the sea breeze.

Mixing height is defined as the height above the surface through which relatively vigorous vertical mixing occurs. Low mixing heights can result in high ground-level air pollution concentrations because contaminants emitted from or near the surface can become trapped within the mixing layer. In Hawaii, minimum mixing heights tend to be high because of mechanical mixing caused by the trade winds and because of the temperature moderating effect of the surrounding ocean. Low mixing heights may sometimes occur, however, at inland locations and even at times along coastal areas early in the morning following a clear, cool, windless night. Coastal areas also may experience low mixing levels during sea breeze conditions when cooler ocean air rushes in over warmer land. Mixing heights in Hawaii typically are above 3000 feet (1000 meters).

Rainfall can have a beneficial affect on the air quality of an area in that it helps to suppress fugitive dust emissions, and it also may "washout" gaseous contaminants that are water soluble. Rainfall in Hawaii is highly variable depending on elevation and on location with respect to the trade wind. The Ewa area is one of the driest areas on Oahu due to its leeward. Average annual rainfall amounts to about 21 inches but may vary from about 10 inches during a dry year to more than 40 inches during a wet year [1]. Rainfall at the project site is probably slightly higher at the upper elevations. Most of the rainfall in the Ewa area usually occurs during the winter months. Monthly rainfall may vary from as little as a trace to as much as 15 inches or more.

5.0 PRESENT AIR QUALITY

Present air quality in the project area is mostly affected by air pollutants from motor vehicles, industrial sources, agricultural operations and to a lesser extent by natural sources. Table 3 presents an air pollutant emission summary for the island of Oahu for calendar year 1993. The emission rates shown in the table pertain to manmade emissions only, i.e., emissions from natural sources are not included. As suggested in the table, much of the particulate emissions on Oahu originate from area sources, such as the mineral products industry and agriculture. Sulfur oxides are emitted almost exclusively by point sources, such as power plants and refineries. Nitrogen oxides emissions emanate predominantly from industrial point sources, although area sources (mostly motor

vehicle traffic) also contribute a significant share. The majority of carbon monoxide emissions occur from area sources (motor vehicle traffic), while hydrocarbons are emitted mainly from point sources. Based on previous emission inventories that have been reported for Oahu, emissions of particulate and nitrogen oxides may have increased during the past ten years, while emissions of sulfur oxides, carbon monoxide and hydrocarbons probably have declined.

Farrington Highway and the H-1 Freeway, which border the project site on the south, are major arterial roadways that presently carry moderate to heavy levels of vehicle traffic during peak traffic hours. Emissions from motor vehicles using these roadways, primarily nitrogen oxides and carbon monoxide, will tend to be carried away from the project site by the prevailing winds.

Several sources of industrial air pollution are located in the Campbell Industrial Park, which is located about 3 miles south of the project site at Barbers Point. Industries currently operating there include the Chevron and BHP refineries, H-Power, Kalaeloa Partners, Applied Energy Services, Hawaiian Cement and others. Hawaiian Electric Company’s Kahe Generating Station is located about 2 miles to the northwest at Kahe Point. These industries emit large amounts of sulfur dioxide, nitrogen oxides, particulate matter, carbon monoxide and other air pollutants. Prevailing winds from the east or northeast will carry these emissions away from the site most of the time.

Until recently, air pollution in the project area originating from agricultural sources could mainly be attributed to sugar cane operations on the Ewa plain. Emissions from both the mill and the canefield operations in the area have been eliminated with the closure of the Oahu Sugar Company, and much of the former sugarcane lands are currently being used as pastureland or for diversified agriculture.

Natural sources of air pollution emissions that also could affect the project area but cannot be quantified very accurately include the ocean (sea spray), plants (aero-allergens), wind-blown dust, and perhaps distant volcanoes on the island of Hawaii.

The State Department of Health operates a network of air quality monitoring stations at various locations on Oahu. Each station, however, typically does not monitor the full complement of air quality parameters. Table 4 shows annual summaries of air quality measurements that were made nearest to the project area for several of the regulated air pollutants for the period 2001 through 2005. These are the most recent data that are currently available.

During the 2001-2005 period, sulfur dioxide was monitored by the State Department of Health at an air quality station located at Kapolei. Concentrations monitored were consistently low compared to the standards. Annual second-highest 3-hour concentrations (which are most relevant to the air quality standards) ranged from 12 to 28 $\mu g/m^3$, while the annual second-highest 24-hour concentrations ranged from 6 to 9 $\mu g/m^3$. Annual average concentrations were only about 1 to 2 $\mu g/m^3$. There were no

exceedances of the state/national 3-hour or 24-hour AAQS for sulfur dioxide during the 5-year period.

Particulate matter less than 10 microns in diameter (PM-10) is also measured at the Kapolei monitoring station. Annual second-highest 24-hour PM-10 concentrations ranged from 29 to 104 $\mu g/m^3$ between 2001 and 2005. Average annual concentrations ranged from 13 to 19 $\mu g/m^3$. All values reported were within the state and national AAQS.

Carbon monoxide measurements were also made at the Kapolei monitoring station. The annual second-highest 1-hour concentrations ranged from 1.6 to 2.0 mg/m^3. The annual second-highest 8-hour concentrations ranged from 0.8 to 1.8 mg/m^3. No exceedances of the state or national 1-hour or 8-hour AAQS were reported.

Nitrogen dioxide is also monitored by the Department of Health at the Kapolei monitoring station. Annual average concentrations of this pollutant ranged from 8 to 9 $\mu g/m^3$, safely inside the state and national AAQS.

The nearest available ozone measurements were obtained at Sand Island (about 15 miles east of the project area). The second-highest 8-hour concentrations for the period 2002 through 2005 ranged between 77 and 108 $\mu g/m^3$, which is well inside the state and federal standards. The 8-hour standard for ozone did not exist prior to 2002. Prior to 2002, the now obsolete state 1-hour standard was typically exceeded several times each year.

Although not shown in the table, the nearest and most recent measurements of ambient lead concentrations that have been reported were made at the downtown Honolulu monitoring station between 1996 and 1997. Average quarterly concentrations were near or below the detection limit, and no exceedances of the state AAQS were recorded. Monitoring for this parameter was discontinued during 1997.

Based on the data and discussion presented above, it appears likely that the State of Hawaii AAQS for sulfur dioxide, nitrogen dioxide, particulate matter, ozone and lead are currently being met at the project site. While carbon monoxide measurements at the Kapolei monitoring station suggest that concentrations are within the state and national standards, local "hot spots" may exist near traffic-congested intersections. The potential for this within the project area is examined later in this report.

6.0 SHORT-TERM IMPACTS OF PROJECT

Short-term direct and indirect impacts on air quality could potentially occur due to project construction. For a project of this nature, there are two potential types of air pollution emissions that could directly result in short-term air quality impacts during project construction: (1) fugitive dust from vehicle movement and soil excavation; and (2) exhaust emissions from on-site construction equipment. Indirectly, there also could be short-term impacts from slow-moving construction equipment traveling to and from the project site, from a temporary increase in local traffic caused by commuting

construction workers, and from the disruption of normal traffic flow caused by lane closures of adjacent roadways.

Fugitive dust emissions may arise from the grading and dirt-moving activities associated with site clearing and preparation work. The emission rate for fugitive dust emissions from construction activities is difficult to estimate accurately. This is because of its elusive nature of emission and because the potential for its generation varies greatly depending upon the type of soil at the construction site, the amount and type of dirt-disturbing activity taking place, the moisture content of exposed soil in work areas, and the wind speed. The EPA [2] has provided a rough estimate for uncontrolled fugitive dust emissions from construction activity of 1.2 tons per acre per month under conditions of "medium" activity, moderate soil silt content (30%), and precipitation/evaporation (P/E) index of 50. Uncontrolled fugitive dust emissions at the project site would likely be somewhere near that level, depending on the amount of rainfall that occurs. In any case, State of Hawaii Air Pollution Control Regulations [3] prohibit visible emissions of fugitive dust from construction activities at the property line. Thus, an effective dust control plan for the project construction phase is essential.

Adequate fugitive dust control can usually be accomplished by the establishment of a frequent watering program to keep bare-dirt surfaces in construction areas from becoming significant sources of dust. In dust-prone or dust-sensitive areas, other control measures such as limiting the area that can be disturbed at any given time, applying chemical soil stabilizers, mulching and/or using wind screens may be necessary. Control regulations further stipulate that open-bodied trucks be covered at all times when in motion if they are transporting materials that could be blown away. Haul trucks tracking dirt onto paved streets from unpaved areas is often a significant source of dust in construction areas. Some means to alleviate this problem, such as road cleaning or tire washing, may be appropriate. Paving of parking areas and/or establishment of landscaping as early in the construction schedule as possible can also lower the potential for fugitive dust emissions. Monitoring dust at the project property line could be considered to quantify and document the effectiveness of dust control measures.

On-site mobile and stationary construction equipment also will emit air pollutants from engine exhausts. The largest of this equipment is usually diesel-powered. Nitrogen oxides emissions from diesel engines can be relatively high compared to gasoline-powered equipment, but the standard for nitrogen dioxide is set on an annual basis and is not likely to be violated by short-term construction equipment emissions. Carbon monoxide emissions from diesel engines, on the other hand, are low and should be relatively insignificant compared to vehicular emissions on nearby roadways.

Project construction activities will also likely obstruct the normal flow of traffic at times to such an extent that overall vehicular emissions in the project area will temporarily increase. The only means to alleviate this problem will be to attempt to keep roadways open during peak traffic hours and to move heavy construction equipment and workers to and from construction areas during periods of low traffic volume. Thus, most potential short-term air quality impacts from project construction can be mitigated.

7.0 LONG-TERM IMPACTS OF PROJECT

7.1 Roadway Traffic

After construction is completed, use of the proposed facilities will result in increased motor vehicle traffic in the project area, potentially causing long-term impacts on ambient air quality. Motor vehicles with gasoline-powered engines are significant sources of carbon monoxide. They also emit nitrogen oxides and other contaminates.

Federal air pollution control regulations require that new motor vehicles be equipped with emission control devices that reduce emissions significantly compared to a few years ago. In 1990, the President signed into law the Clean Air Act Amendments. This legislation requires further emission reductions, which have been phased in since 1994. More recently, additional restrictions were signed into law during the Clinton administration, which will begin to take effect during the next decade. The added restrictions on emissions from new motor vehicles will lower average emissions each year as more and more older vehicles leave the state's roadways. It is estimated that carbon monoxide emissions, for example, will go down by an average of about 30 to 40 percent per vehicle during the next 10 years due to the replacement of older vehicles with newer models.

To evaluate the potential long-term indirect ambient air quality impact of increased roadway traffic associated with a project such as this, computerized emission and atmospheric dispersion models can be used to estimate ambient carbon monoxide concentrations along roadways leading to and from the project. Carbon monoxide is selected for modeling because it is both the most stable and the most abundant of the pollutants generated by motor vehicles. Furthermore, carbon monoxide air pollution is generally considered to be a microscale problem that can be addressed locally to some extent, whereas nitrogen oxides air pollution most often is a regional issue that cannot be addressed by a single new development.

For this project, five scenarios were selected for the carbon monoxide modeling study: (1) year 2006 with present conditions, (2) year 2015 without the project, (3) year 2015 with the project, (4) year 2020 without the project, and (5) year 2020 with the project. To begin the modeling study of the five scenarios, critical receptor areas in the vicinity of the project were identified for analysis. Generally speaking, roadway intersections are the primary concern because of traffic congestion and because of the increase in vehicular emissions associated with traffic queuing. For this study, several of the key intersections identified in the traffic study were also selected for air quality analysis. These included the following intersections:

- Farrington Highway at Koio Drive
- Farrington Highway at Waiomea Street
- Farrington Highway at Laaloa Street
- Farrington Highway at Road D
- Road D at Eastbound Farrington Ramp
- Road D at Westbound Farrington Ramp
- Kapolei Parkway at Kalaeloa Boulevard
- Kamokila Boulevard at Wakea Street

The traffic impact report for the project [4] describes the projected future traffic conditions and laneage configurations of these intersections in detail. In performing the air quality impact analysis, it was assumed that all recommended traffic mitigation measures would be implemented.

The main objective of the modeling study was to estimate maximum 1-hour average carbon monoxide concentrations for each of the three scenarios studied. To evaluate the significance of the estimated concentrations, a comparison of the predicted values for each scenario can be made. Comparison of the estimated values to the national and state AAQS was also used to provide another measure of significance.

Maximum carbon monoxide concentrations typically coincide with peak traffic periods. The traffic impact assessment report evaluated morning and afternoon peak traffic periods. These same periods were evaluated in the air quality impact assessment.

The EPA computer model MOBILE6 [5] was used to calculate vehicular carbon monoxide emissions for each year studied. One of the key inputs to MOBILE6 is vehicle mix. Unless very detailed information is available, national average values are typically assumed, which is what was used for the present study. Based on national average vehicle mix figures, the present vehicle mix in the project area was estimated to be 40.9% light-duty gasoline-powered automobiles, 46.2% light-duty gasoline-powered trucks and vans, 3.6% heavy-duty gasoline-powered vehicles, 0.2% light-duty diesel-powered vehicles, 8.5% heavy-duty diesel-powered trucks and buses, and 0.6% motorcycles. For the future scenarios studied, the vehicle mix was estimated to change slightly with fewer light-duty gasoline-powered automobiles and more light-duty gasoline-powered trucks and vans.

Ambient temperatures of 59 and 68 degrees F were used for morning and afternoon peak-hour emission computations, respectively. These are conservative assumptions since morning/afternoon ambient temperatures will generally be warmer than this, and emission estimates given by MOBILE6 generally have an inverse relationship to the ambient temperature.

After computing vehicular carbon monoxide emissions through the use of MOBILE6, these data were then input to an atmospheric dispersion model. EPA air quality modeling guidelines [6] currently recommend that the computer model CAL3QHC [7] be used to assess carbon monoxide concentrations at roadway intersections, or in areas where its use has previously been established, CALINE4 [8] may be used. Until a few years ago, CALINE4 was used extensively in Hawaii to assess air quality impacts at roadway intersections. In December 1997, the California Department of Transportation recommended that the intersection mode of CALINE4 no longer be used because it was thought the model has become outdated. Studies have shown that CALINE4 may tend to over-predict maximum concentrations in some situations. Therefore, CAL3QHC was used for the subject analysis.

CAL3QHC was developed for the U.S. EPA to simulate vehicular movement, vehicle queuing and atmospheric dispersion of vehicular

emissions near roadway intersections. It is designed to predict 1-hour average pollutant concentrations near roadway intersections based on input traffic and emission data, roadway/receptor geometry and meteorological conditions.

Although CAL3QHC is intended primarily for use in assessing atmospheric dispersion near signalized roadway intersections, it can also be used to evaluate unsignalized intersections. This is accomplished by manually estimating queue lengths and then applying the same techniques used by the model for signalized intersections.

Input peak-hour traffic data were obtained from the traffic study cited previously. This included vehicle approach volumes, saturation capacity estimates, intersection laneage and signal timings (where applicable). All emission factors that were input to CAL3QHC for free-flow traffic on roadways were obtained from MOBILE6 based on assumed free-flow vehicle speeds corresponding to the posted speed limits (25 to 45 mph depending on location).

Model roadways were set up to reflect roadway geometry, physical dimensions and operating characteristics. Concentrations predicted by air quality models generally are not considered valid within the roadway-mixing zone. The roadway-mixing zone is usually taken to include 3 meters on either side of the traveled portion of the roadway and the turbulent area within 10 meters of a cross street. Model receptor sites were thus located at the edges of the mixing zones near all intersections that were studied for all three scenarios. This implies that pedestrian sidewalks either already exist or are assumed to exist in the future. All receptor heights were placed at 1.8 meters above ground to simulate levels within the normal human breathing zone.

Input meteorological conditions for this study were defined to provide "worst-case" results. One of the key meteorological inputs is atmospheric stability category. For these analyses, atmospheric stability category 6 was assumed for the morning cases, while atmospheric stability category 4 was assumed for the afternoon cases. These are the most conservative stability categories that are generally used for estimating worst-case pollutant dispersion within suburban areas for these periods. A surface roughness length of 100 cm and a mixing height of 1000 meters were used in all cases. Worst-case wind conditions were defined as a wind speed of 1 meter per second with a wind direction resulting in the highest predicted concentration. Concentration estimates were calculated at wind directions of every 5 degrees.

Existing background concentrations of carbon monoxide in the project vicinity are believed to be at low levels. Thus, background contributions of carbon monoxide from sources or roadways not directly considered in the analysis were accounted for by adding a background concentration of 1.0 ppm to all predicted concentrations for 2006. Although increased traffic is expected to occur within the project area during the next several years with or without the project, background carbon monoxide concentrations may not change significantly since individual emissions from motor vehicles are forecast to decrease with time. Hence, a background value of 1.0 ppm was assumed to persist for the future scenarios studied.

Predicted Worst-Case 1-Hour Concentrations

Table 5 summarizes the final results of the modeling study in the form of the estimated worst-case 1-hour morning and afternoon ambient carbon monoxide concentrations. These results can be compared directly to the state and the national AAQS. Estimated worst-case carbon monoxide concentrations are presented in the table for each of the five scenarios studied. The locations of these estimated worst-case 1-hour concentrations all occurred at or very near the indicated intersections.

As indicated in the table, the highest estimated 1-hour concentration within the project vicinity for the present (2006) case was 6.9 mg/m^3. This was projected to occur during the morning peak traffic hour near the intersection of Farrington Highway and Waiomea Street. Concentrations at other locations and times studied were 6.4 mg/m^3 or lower. All predicted worst-case 1-hour concentrations for the 2006 scenario were within both the national AAQS of 40 mg/m^3 and the state standard of 10 mg/m^3.

In the year 2015 without the proposed project, the highest worst-case 1-hour concentration was predicted to occur during the morning at the intersection of Kamokila Boulevard and Wakea Street. A value of 7.5 mg/m^3 was predicted to occur at this location and time. Peak-hour worst-case values at the other locations and times studied for the 2015 without project scenario ranged between 4.6 and 6.7 mg/m^3. Compared to the existing case, concentrations remained about the same except for an increase at the intersection of Kamokila Boulevard and Wakea Street. All projected worst-case concentrations for this scenario remained within the state and national standards.

In the year 2015 with the proposed project, the predicted highest worst-case 1-hour concentration occurred during the morning at the intersection of Farrington Highway and Road D with a value of 8.0 mg/m^3, which is about 27 percent higher compared to the without project case. As noted in the table, this assumes that Mitigation Option No. 4 from the project traffic study is implemented. Other concentrations for this scenario ranged between 4.8 and 7.5 mg/m^3, and these were slightly higher compared to the without project scenario. All values remained within the state and federal standards.

In the year 2020 with or without the proposed project, worst-case concentrations remained about the same as the 2015 scenarios with and without the project except that the two locations with the highest concentrations, Farrington Highway at Road D and Kamokila Boulevard at Wakea Street, were ameliorated by roadway improvements that were assumed to occur. Without the project, concentrations ranged between 1.5 and 6.8 mg/m^3, and with the project, concentrations ranged between 2.6 and 7.1 mg/m^3. With or without the project, concentrations should remain well within standards.

Predicted Worst-Case 8-Hour Concentrations

Worst-case 8-hour carbon monoxide concentrations were estimated by multiplying the worst-case 1-hour values by a persistence factor of 0.5. This accounts for two factors: (1) traffic volumes averaged over eight hours are lower than peak 1-hour values, and (2) meteorological conditions are more variable (and hence more favorable for dispersion) over an 8-hour period than they are for a single hour. Based on monitoring data, 1-hour to 8-hour persistence factors for most locations generally vary from 0.4 to 0.8 with 0.6 being the most typical. One study based on modeling [9] concluded that 1-hour to 8-hour persistence factors could typically be expected to range from 0.4 to 0.5. EPA guidelines [10] recommend using a value of 0.7 unless a locally derived persistence factor is available. Recent monitoring data for locations on Oahu reported by the Department of Health [11] suggest that this factor may range between about 0.2 and 0.7 depending on location and traffic variability. Considering the location of the project and the traffic pattern for the area, a 1-hour to 8-hour persistence factor of 0.5 will likely yield reasonable estimates of worst-case 8-hour concentrations.

The resulting estimated worst-case 8-hour concentrations are indicated in Table 6. For the 2006 scenario, the estimated worst-case 8-hour carbon monoxide concentrations for the four locations studied ranged from 1.8 mg/m^3 at the Kamokila Boulevard/Wakea Street intersection to 3.4 mg/m^3 at the Farrington Highway/Waiomea Street intersection. The estimated worst-case concentrations for the existing case were within both the state standard of 5 mg/m^3 and the national limit of 10 mg/m^3.

For the year 2015 without project scenario, worst-case concentrations ranged between 2.9 and 3.8 mg/m^3, with the highest concentration occurring at Kamokila Boulevard and Wakea Street. All predicted concentrations were within the standards.

For the 2015 with project scenario, worst-case concentrations increased only slightly or remained about the same at most locations compared to the without project case, although the location with the highest value, Farrington Highway at Road D increased by about 25 percent. Worst-case concentrations ranged from 3.0 to 4.0 mg/m^3. All predicted 8-hour concentrations for this scenario were within both the national and the state AAQS.

Without the project in the year 2020, worst-case concentrations would be nearly unchanged compared to the 2015 without project scenario except that concentrations would be reduced in the vicinity of Farrington Highway and Road D and at Kamokila Boulevard and Wakea Street due to the assumed roadway improvements at those locations. With the project in the year 2020, worst-case concentrations would increase only slightly or remain unchanged compared to without the project at the locations studied. With or without the project in the year 2020, the air quality modeling analyses indicate that the 8-hour air quality standards for carbon monoxide should be met.

Conservativeness of Estimates

The results of this study reflect several assumptions that were made concerning both traffic movement and worst-case meteorological conditions. One such assumption concerning worst-

case meteorological conditions is that a wind speed of 1 meter per second with a steady direction for 1 hour will occur. A steady wind of 1 meter per second blowing from a single direction for an hour is extremely unlikely and may occur only once a year or less. With wind speeds of 2 meters per second, for example, computed carbon monoxide concentrations would be only about half the values given above. The 8-hour estimates are also conservative in that it is unlikely that anyone would occupy the assumed receptor sites (within 3 m of the roadways) for a period of 8 hours.

7.2 Electrical Demand

The proposed project also will cause indirect air pollution emissions from power generating facilities as a consequence of electrical power usage. Peak power demand from the project is estimated at 20 megawatts [12]. Assuming average demand is about one-half peak demand, the annual electrical demand of the project when fully developed will reach approximately 88 million kilowatt-hours. Electrical power for the project will most probably be provided mainly by oil-fired generating facilities located on Oahu, but some of the project power could also come from sources burning other fuels, such as H-Power and the AES coal-fired power plant at Campbell Industrial Park. In order to meet the electrical power needs of the proposed project, power generating facilities will be required to burn more fuel and hence more air pollution will be emitted at these facilities. Given in Table 7 are estimates of the indirect air pollution emissions that would result from the project electrical demand assuming all power is provided by burning more fuel oil at Oahu's power plants. These values can be compared to the island-wide emission estimates for 1993 given in Table 3. The estimated indirect emissions from project electrical demand amount to less than 1 percent of the present air pollution emissions occurring on Oahu. If power is supplied instead or in part by coal or solid waste burning facilities, emissions will likely be higher than the values given in Table 7.

7.3 Solid Waste Disposal

Solid waste generated by the proposed development when fully completed and occupied is not expected to exceed about 33 tons per day [13]. Most project refuse will likely be hauled away and burned at the H-Power facility at Campbell Industrial Park to generate electricity. Burning of the waste to generate electricity will result in emissions of particulate, carbon monoxide and other contaminants, but these will be offset to some extent by reducing the amount of fuel oil that would be required to generate electricity for the project. Table 8 gives emission estimates assuming all project solid waste is burned at H-Power. These values can be compared to the island-wide emission estimates for 1993 given in Table 3. The estimated potential indirect emissions from project solid waste disposal demand amount to less than 0.1 percent of the present air pollution emissions occurring on Oahu.

8.0 CONCLUSIONS AND RECOMMENDATIONS

The major potential short-term air quality impact of the project will occur from the emission of fugitive dust during construction. Uncontrolled fugitive dust emissions from construction activities are estimated to amount to about 1.2 tons per acre per month, depending on rainfall. To control dust, active work areas and any temporary unpaved work roads should be watered at least twice

daily on days without rainfall. Use of wind screens and/or limiting the area that is disturbed at any given time will also help to contain fugitive dust emissions. Wind erosion of inactive areas of the site that have been disturbed could be controlled by mulching or by the use of chemical soil stabilizers. Dirt-hauling trucks should be covered when traveling on roadways to prevent windage. A routine road cleaning and/or tire washing program will also help to reduce fugitive dust emissions that may occur as a result of trucks tracking dirt onto paved roadways in the project area. Paving of parking areas and establishment of landscaping early in the construction schedule will also help to control dust. Monitoring dust at the project boundary during the period of construction could be considered as a means to evaluate the effectiveness of the project dust control program and to adjust the program if necessary.

During construction phases, emissions from engine exhausts (primarily consisting of carbon monoxide and nitrogen oxides) will also occur both from on-site construction equipment and from vehicles used by construction workers and from trucks traveling to and from the project. Increased vehicular emissions due to disruption of traffic by construction equipment and/or commuting construction workers can be alleviated by moving equipment and personnel to the site during off-peak traffic hours.

After construction of the proposed project is completed and it is fully occupied, carbon monoxide concentrations in the project area will likely increase due to emissions from project-related motor vehicle traffic, but worst-case concentrations should remain within both the state and the national ambient air quality standards. Implementing any air quality mitigation measures for long-term traffic-related impacts is probably unnecessary and unwarranted.

Any long-term impacts on air quality due to indirect emissions from supplying the project with electricity and from the disposal of waste materials generated by the project will likely be negligible based on the magnitudes of the estimated emissions compared to the current island-wide emissions. To further moderate any impacts, indirect emissions from project electrical demand could likely be reduced somewhat by incorporating energy-saving features into project design requirements. This might include the use of solar water heaters, water heater timers or possibly hot water on demand systems; designing building space so that window positions maximize indoor light without unduly increasing indoor heat; using landscaping where feasible to provide afternoon shade to cut down on the use of air conditioning; installation of insulation and double-glazed doors to reduce the effects of the sun and heat; movable, controlled openings for ventilation at opportune times; and possibly automated room occupancy sensors. Solid waste related air pollution could likely be reduced somewhat by the promotion of conservation and recycling programs within the proposed development.

REFERENCES

1. "Climatic Summary of the United States, Supplement for 1951 through 1960, Hawaii and Pacific", U.S. Department of Commerce, Weather Bureau, Washington, D.C., 1965.

2. Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, Fifth Edition, AP-42, U.S. Environmental Protection Agency, Research Triangle Park, NC, January 1995.

3. State of Hawaii. Hawaii Administrative Rules, Chapter 11-60, Air Pollution Control.

4. Wilbur Smith Associates, Makaiwa Hills Traffic Impact Study, Draft, December 2006.

5. User's Guide to MOBILE6.0, Mobile Source Emission Factor Model, U.S. Environmental Protection Agency, Office of Transportation and Air Quality, Assessment and Standards Division, Ann Arbor, Michigan, January 2002.

6. Guideline on Air Quality Models (Revised), Including Supplements A and B, EPA-450/2-78-027R, U.S. Environmental Protection Agency, Research Triangle Park, NC, July 1986.

7. User's Guide to CAL3QHC Version 2.0: A Modeling Methodology for Predicting Pollutant Concentrations Near Roadway Intersections, U.S. Environmental Protection Agency, November 1992.

8. CALINE4 - A Dispersion Model for Predicting Air Pollutant Concentrations Near Roadways, FHWA/CA/TL-84/15, California State Department of Transportation, November 1984 with June 1989 Revisions.

9. "Persistence Factors for Mobile Source (Roadway) Carbon Monoxide Modeling", C. David Cooper, Journal of the Air & Waste Management Association, Volume 39, Number 5, May 1989.

10. Guideline for Modeling Carbon Monoxide from Roadway Intersections, U.S. Environmental Protection Agency, EPA-454/R-92-005, November 1992.

11. Annual Summaries, Hawaii Air Quality Data, 2001-2005, State of Hawaii Department of Health.

12. Personal Communication (via Email), Tom Eisen, Group 70, to Barry Neal, B.D. Neal & Associates, November 21, 2006, Makaiwa Hills electrical demand information.

13. Personal Communication (via Email), Tom Eisen, Group 70, to Barry Neal, B.D. Neal & Associates, November 14, 2006, Makaiwa Hills solid waste demand information.

Figure 1 - Project Location

Table 1

SUMMARY OF STATE OF HAWAII AND NATIONAL AMBIENT AIR QUALITY STANDARDS

Pollutant	Units	Averaging Time	Maximum Allowable Concentration		
			National Primary	National Secondary	State of Hawaii
Particulate Matter (<10 microns)	μg/m³	Annual 24 Hours	50[a] 150[b]	50[a] 150[b]	50 150[c]
Particulate Matter (<2.5 microns)	μg/m³	Annual 24 Hours	15[a] 65[d]	15[a] 65[d]	- -
Sulfur Dioxide	μg/m³	Annual 24 Hours 3 Hours	80 365[c] -	- - 1300[c]	80 365[c] 1300[c]
Nitrogen Dioxide	μg/m³	Annual	100	100	70
Carbon Monoxide	mg/m³	8 Hours 1 Hour	10[c] 40[c]	- -	5[c] 10[c]
Ozone	μg/m³	8 Hours 1 Hour	157[e] 235[f]	157[e] 235[f]	157[e] -
Lead	μg/m³	Calendar Quarter	1.5	1.5	1.5
Hydrogen Sulfide	μg/m³	1 Hour	-	-	35[c]

[a] Three-year average of annual arithmetic mean.
[b] 99th percentile value averaged over three years.
[c] Not to be exceeded more than once per year.
[d] 98th percentile value averaged over three years.
[e] Three-year average of fourth-highest daily 8-hour maximum.
[f] Standard is attained when the expected number of exceedances is less than or equal to 1.

Table 2

ANNUAL WIND FREQUENCY FOR HONOLULU INTERNATIONAL AIRPORT (%)

Wind Direction	Wind Speed (knots)									Total
	0-3	4-6	7-10	11-16	17-21	22-27	28-33	34-40	>40	
N	0.5	2.5	1.3	0.5	0.0	0.0	0.0	0.0	0.0	4.8
NNE	0.3	1.2	1.6	1.5	0.2	0.0	0.0	0.0	0.0	4.7
NE	0.3	2.1	6.1	11.0	3.2	0.3	0.0	0.0	0.0	23.0
ENE	0.2	2.5	10.9	16.6	4.1	0.3	0.0	0.0	0.0	34.7
E	0.1	1.0	2.5	2.8	0.5	0.0	0.0	0.0	0.0	7.0
ESE	0.0	0.3	0.4	0.3	0.0	0.0	0.0	0.0	0.0	1.1
SE	0.0	0.3	0.8	1.0	0.1	0.0	0.0	0.0	0.0	2.2
SSE	0.1	0.4	1.2	0.7	0.1	0.0	0.0	0.0	0.0	2.4
S	0.1	0.5	1.4	0.6	0.1	0.0	0.0	0.0	0.0	2.7
SSW	0.0	0.3	0.8	0.3	0.0	0.0	0.0	0.0	0.0	1.5
SW	0.0	0.2	0.8	0.4	0.0	0.0	0.0	0.0	0.0	1.5
WSW	0.0	0.3	0.5	0.4	0.0	0.0	0.0	0.0	0.0	1.2
W	0.1	0.5	0.2	0.0	0.0	0.0	0.0	0.0	0.0	1.1
WNW	0.2	1.4	0.3	0.1	0.0	0.0	0.0	0.0	0.0	2.0
NW	0.4	2.3	0.8	0.1	0.0	0.0	0.0	0.0	0.0	3.8
NNW	0.5	2.3	0.8	0.2	0.0	0.0	0.0	0.0	0.0	3.8
Calm	2.5									2.5
Total	5.4	18.3	30.6	36.5	8.5	0.7	0.0	0.0	0.0	100.0

Source: Climatography of the United States No. 90 (1965-1974), Airport Climatological Summary, Honolulu International Airport, Honolulu, Hawaii, U.S. Department of Commerce, National Climatic Center, Asheville, NC, August 1978.

Table 3

AIR POLLUTION EMISSIONS INVENTORY FOR ISLAND OF OAHU, 1993

Air Pollutant	Point Sources (tons/year)	Area Sources (tons/year)	Total (tons/year)
Particulate	25,891	49,374	75,265
Sulfur Oxides	39,230	nil	39,230
Nitrogen Oxides	92,436	31,141	123,577
Carbon Monoxide	28,757	121,802	150,559
Hydrocarbons	4,160	421	4,581

Source: Final Report, "Review, Revise and Update of the Hawaii Emissions Inventory Systems for the State of Hawaii", prepared for Hawaii Department of Health by J.L. Shoemaker & Associates, Inc., 1996

Table 4

ANNUAL SUMMARIES OF AIR QUALITY MEASUREMENTS FOR MONITORING STATIONS NEAREST MAKAIWA HILLS PROJECT

Parameter / Location	2001	2002	2003	2004	2005
Sulfur Dioxide / Kapolei					
3-Hour Averaging Period:					
No. of Samples	2511	2420	2461	2504	2396
Highest Concentration ($\mu g/m^3$)	24	47	26	17	64
2nd Highest Concentration ($\mu g/m^3$)	15	19	19	12	28
No. of State AAQS Exceedances	0	0	0	0	0
24-Hour Averaging Period:					
No. of Samples	359	344	351	355	333
Highest Concentration ($\mu g/m^3$)	7	9	9	7	21
2nd Highest Concentration ($\mu g/m^3$)	6	7	9	6	9
No. of State AAQS Exceedances	0	0	0	0	0
Annual Average Concentration ($\mu g/m^3$)	2	2	1	1	2
Particulate (PM-10) / Kapolei					
24-Hour Averaging Period:					
No. of Samples	352	351	343	339	352
Highest Concentration ($\mu g/m^3$)	121	55	72	53	53
2nd Highest Concentration ($\mu g/m^3$)	104	35	29	41	36
No. of State AAQS Exceedances	0	0	0	0	0
Annual Average Concentration ($\mu g/m^3$)	19	16	14	13	15
Carbon Monoxide / Kapolei					
1-Hour Averaging Period:					
No. of Samples	8577	8354	8559	8507	8556
Highest Concentration (mg/m^3)	2.3	2.2	2.2	2.4	1.7
2nd Highest Concentration (mg/m^3)	1.9	2.0	1.6	1.7	1.6
No. of State AAQS Exceedances	0	0	0	0	0
8-Hour Averaging Period:					
No. of Samples	1073	1044	n/a	n/a	n/a
Highest Concentration (mg/m^3)	1.6	1.8	0.8	1.0	1.0
2nd Highest Concentration (mg/m^3)	1.3	1.8	0.8	1.0	1.0
No. of State AAQS Exceedances	0	0	0	0	0
Nitrogen Dioxide / Kapolei					
Annual Average Concentration ($\mu g/m^3$)	8	9	9	9	9
Ozone / Sand Island					
8-Hour Averaging Period:					
No. of Samples	-	8549	8641	8474	8670
Highest Concentration (mg/m^3)	-	89	79	110	92
2nd Highest Concentration (mg/m^3)	-	88	77	108	92
No. of State AAQS Exceedances	-	0	0	0	0

Source: State of Hawaii Department of Health, "Annual Summaries, Hawaii Air Quality Data, 2001 - 2005"

Table 5

ESTIMATED WORST-CASE 1-HOUR CARBON MONOXIDE CONCENTRATIONS ALONG ROADWAYS NEAR MAKAIWA HILLS PROJECT (milligrams per cubic meter)

Roadway Intersection	Year/Scenario									
	2006/ Present		2015/ Without Project		2015/ With Project		2020/ Without Project		2020/ With Project	
	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Farrington Highway at Koio Drive	-	-	5.8	4.6	6.1	4.8	5.9[a]	4.8[a]	6.3[a]	5.1[a]
Farrington Highway at Waiomea Street	6.9	5.0	6.7	5.0	6.8	5.1	6.7[a]	4.8[a]	7.1[a]	5.0[a]
Farrington Highway at Laaloa Street	6.4	5.3	6.1	5.0	6.4	5.2	6.0[a]	5.1[a]	6.6[a]	5.2[a]
Farrington Highway at Road D	-	-	6.3	5.0	8.0[b]	5.8[b]	-	-	-	-
Road D at Eastbound Farrington Ramp	-	-	-	-	-	-	1.8	1.5	3.9	2.6
Road D at Westbound Farrington Ramp	-	-	-	-	-	-	-	-	3.9	3.0
Kapolei Parkway at Kalaeloa Blvd	5.6	4.7	6.6	5.4	6.8	5.5	6.7	5.3	7.0[c]	5.6[c]
Kamokila Blvd at Wakea Street	3.6	3.3	7.5	5.6	7.5	5.8	6.8	5.4	6.9[c]	5.6[c]

Hawaii State AAQS: 10
National AAQS: 40

[a]Assumes Farrington Highway is four lanes.
[b]Assumes Mitigation Option 4 recommended in traffic study.
[c]Assumes mitigation recommended in traffic study.

Table 6

ESTIMATED WORST-CASE 8-HOUR CARBON MONOXIDE CONCENTRATIONS ALONG ROADWAYS NEAR MAKAIWA HILLS PROJECT (milligrams per cubic meter)

Roadway Intersection	Year/Scenario				
	2006/ Present	2015/ Without Project	2015/ With Project	2020/ Without Project	2020/ With Project
Farrington Highway at Koio Drive	-	2.9	3.0	3.0[a]	3.2[a]
Farrington Highway at Waiomea Street	3.4	3.4	3.4	3.4[a]	3.6[a]
Farrington Highway at Laaloa Street	3.2	3.0	3.2	3.0[a]	3.3[a]
Farrington Highway at Road D	-	3.2	4.0[b]	-	-
Road D at Eastbound Farrington Ramp	-	-	-	0.9	2.0
Road D at Westbound Farrington Ramp	-	-	-	-	2.0
Kapolei Parkway at Kalaeloa Blvd	2.8	3.3	3.4	3.4	3.5[c]
Kamokila Blvd at Wakea Street	1.8	3.8	3.8	3.4	3.4[c]

Hawaii State AAQS: 5
National AAQS: 10

[a]Assumes Farrington Highway is four lanes.
[b]Assumes Mitigation Option 4 recommended in traffic study.
[c]Assumes mitigation recommended in traffic study.

Table 7

ESTIMATED INDIRECT AIR POLLUTION EMISSIONS FROM MAKAIWA HILLS PROJECT ELECTRICAL DEMAND[a]

Air Pollutant	Emission Rate (tons/year)
Particulate	4
Sulfur Dioxide	29
Carbon Monoxide	2
Volatile Organics	<1
Nitrogen Oxides	13

[a]Based on U.S. EPA emission factors for utility boilers [2]. Assumes electrical demand of 88 million kilowatt-hrs per year and low-sulfur oil used to generate power.

Table 8

ESTIMATED INDIRECT AIR POLLUTION EMISSIONS FROM MAKAIWA HILLS PROJECT SOLID WASTE DISPOSAL DEMAND[a]

Air Pollutant	Emission Rate (tons/year)
Particulate	<1
Sulfur Dioxide	3
Carbon Monoxide	6
Volatile Organics	<1
Nitrogen Oxides	15
Lead	<1

[a]Based on U.S. EPA emission factors for municipal waste incinerators [2]. Assumes mass burn unit with 99 percent control of particulate emissions and solid waste disposal demand of 33 tons per day.

Appendix M
Acoustical Study

D. L. ADAMS ASSOCIATES, LTD.
Consultants in Acoustics and Performing Arts Technologies

Environmental Noise Assessment Report
Makaiwa Hills
Kapolei, Oahu, Hawaii

March 2007

DLAA Project No. 05-61

Prepared for:
Group 70 International
Honolulu, Hawaii

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1.0 EXECUTIVE SUMMARY

1.1 The planned Makaiwa Hills project proposes to add single and multi-family homes, a golf course, parks, preservation areas, and commercial development to the north of Kapolei on the Island of O'ahu, Hawaii. Full development of the Project is anticipated in 2020.

1.2 The lower portion of the project site is currently exposed to ambient noise levels that range from 39 dBA to 59 dBA depending on the time of day and traffic volume on Farrington Highway. Noise sources in this area include vehicular traffic, wind, birds, and occasional distant aircraft flyovers. At the upper boundaries of the site, the ambient noise levels range from 31dBA to 55 dBA.

1.3 Development of project areas will involve excavation, grading, and other typical construction activities during construction. The Makaiwa Hills project may impact adjacent properties and residences from the initial phases may be impacted by construction noise from subsequent phases due to their proximity to the construction site. Noise from construction activities should be short term and must comply with State Department of Health noise regulations.

1.4 After construction is complete, noise generated from stationary mechanical equipment on the project site must meet the State of Hawaii noise regulations.

1.5 Increases in peak hour traffic noise Farrington Highway due to the project along are estimated to be less than 1 dB. This analysis includes years 2015 and 2020 traffic volume projections with and without the project. The change in traffic noise does not represent a significant increase for homes currently located along Farrington Highway.

1.6 Vehicular traffic noise from Farrington Highway may significantly impact the proposed development. Any residential units built within 300 feet of Farrington Highway will require noise mitigation to meet the FHWA maximum exterior L_{eq} noise limit of 67 dBA. Homes should not be built within 75 feet of Farrington Highway, even if noise mitigation treatments are planned.

1.7 Aircraft noise due to operations at nearby Kalaeloa Airport and the Honolulu International Airport may be audible at the project site. However, flights directly above the site are infrequent and the project site is outside of the L_{dn} 55 noise contour for both airports.

2.0 PROJECT DESCRIPTION

The proposed Makaiwa Hills development site is approximately 1,781 acres of undeveloped land on the southern slopes of the Waianae Range near Kapolei on the Island of O'ahu, Hawaii. The planned development would include the construction of 4,100 new single- and multi-family residential units at low- and medium-densities, a community commercial center, neighborhood retail center, recreational facilities (e.g., parks, trails, open spaces), an elementary school, an amenity center and associated infrastructure (e.g., new roadways, utilities, drainage, wastewater and potable water distribution systems). Full development of the project is anticipated in 2020. The Makaiwa Hills development, shown in Figure 1, is bordered by the Makakilo community to the east; the existing Honokai Hale and the Kapolei West and Ko Olina development areas to the south; and the Waimanalo Gulch land fill and Kahe Point power plant to the west.

3.0 NOISE STANDARDS

Various local and federal agencies have established guidelines and standards for assessing environmental noise impacts and set noise limits as a function of land use. A brief description of common acoustic terminology used in these guidelines and standards is presented in Appendix A.

3.1 State of Hawaii, Community Noise Control (DOH)

The State of Hawaii Community Noise Control Rule [Reference 1] defines three classes of zoning districts and specifies corresponding maximum permissible sound levels due to *stationary* noise sources such as air-conditioning units, exhaust systems, generators, compressors, pumps, etc. The Community Noise Control Rule does not address most *moving* sources, such as vehicular traffic noise, air traffic noise, or rail traffic noise. However, the Community Noise Control Rule does regulate noise related to agricultural, construction, and industrial activities, which may not be stationary.

The maximum permissible noise levels are enforced by the State Department of Health (DOH) for any location at or beyond the property line and shall not be exceeded for more than 10% of the time during any 20-minute period. The specified noise limits which apply are a function of the zoning and time of day as shown in Figure 2. With respect to mixed zoning districts, the rule specifies that the primary land use designation shall be used to determine the applicable zoning district class and the maximum permissible sound level. In determining the maximum permissible sound level, the background noise level is taken into account by the DOH.

3.2 U.S. Federal Highway Administration (FHWA)

The FHWA defines four land use categories and assigns corresponding maximum hourly equivalent sound levels, $L_{eq(h)}$, for traffic noise exposure [Reference 2], which are listed in Figure 3. For example, Category B, defined as picnic and recreation areas, parks, residences, motels, hotels, schools, churches, libraries, and hospitals, has a corresponding maximum exterior L_{eq} of 67dBA and a maximum

interior L_{eq} of 52 dBA. These limits are viewed as design goals, and all projects meeting these limits are deemed in conformance with FHWA noise standards. Calculation of traffic noise levels should be conducted using a Federal Highway Administration traffic noise model [Reference 3].

3.3 Hawaii Department of Transportation (HDOT)

The HDOT has adopted FHWA's design goals for traffic noise exposure in its noise analysis and abatement policy [Reference 4]. According to the policy, a traffic noise impact occurs when the predicted traffic noise levels "approach" or exceed FHWA's design goals or when the predicted traffic noise levels "substantially exceed the existing noise levels." The policy also states that "approach" means at least 1 dB less than FHWA's design goals and "substantially exceed the existing noise levels" means an increase of at least 15 dB.

3.4 U.S. Environmental Protection Agency (EPA)

The U.S. EPA has identified a range of yearly day-night equivalent sound levels, L_{dn}, sufficient to protect public health and welfare from the effects of environmental noise [Reference 5]. The EPA has established a goal to reduce exterior environmental noise to an L_{dn} not exceeding 65 dBA and a future goal to further reduce exterior environmental noise to an L_{dn} not exceeding 55 dBA. Additionally, the EPA states that these goals are not intended as regulations as it has no authority to regulate noise levels, but rather they are intended to be viewed as levels below which the general population will not be at risk from any of the identified effects of noise.

3.5 U.S. Department of Housing and Urban Development (HUD)

HUD's environmental noise criteria and standards in 24 CFR 51 [Reference 6] were established for determining housing project site acceptability and must be satisfied for projects involving HUD or federal financing. These standards are based on day-night equivalent sound levels, L_{dn}, and are not limited to traffic noise exposure. However, for project sites in the vicinity of highways, the L_{dn} may be estimated to be equal to the design hour $L_{eq(h)}$, provided "heavy trucks (vehicles with three or more axles) do not exceed 10 percent of the total traffic flow in vehicles per 24 hours and the traffic flow between 10:00 p.m. and 7:00 a.m. does not exceed 15 percent of the average daily traffic flow in vehicles per 24 hours." For these same conditions, L_{dn}, may also be estimated as 3 dB less than the design hour L_{10}.

HUD site acceptability criteria rank sites as Acceptable, Normally Unacceptable, or Unacceptable. "Acceptable" sites are those where exterior noise levels do not exceed an L_{dn} of 65 dBA. Proposed housing projects on "Acceptable" sites do not require additional noise attenuation other than that provided by customary building techniques. "Normally Unacceptable" sites are those where the L_{dn} is above 65 dBA, but does not exceed 75 dBA. Housing on "Normally Unacceptable" sites requires some form of noise abatement, either at the property line or in the building construction, to ensure the interior noise levels are acceptable. "Unacceptable" sites are those where the L_{dn} is 75 dBA or higher. The term "Unacceptable" does not necessarily mean that housing cannot be built on those sites; however, more elaborate sound attenuation will likely be needed.

3.6 Federal Aviation Administration (FAA)

The FAA addresses guidelines for compatible land use that surrounds airports [Reference 7]. Noise contour maps are expressed in terms of yearly day-night average sound levels, L_{dn}, due to aircraft operations. The FAA states that residences outside of the L_{dn} 65 noise contour are compatible without restrictions. Residences between the L_{dn} 65 and 75 contours are only compatible if noise mitigation measures are incorporated into the building structure. Residences inside of the L_{dn} 75 noise contour are generally not compatible. The compatibility of other land uses, such as commercial, manufacturing, public, and recreation, are shown in Table 1.

3.7 Hawaii Department of Transportation (HDOTA), Airports Division

The State of Hawaii, Department of Transportation, Airports Division has adopted noise restrictions that are similar to the FAA's, but more stringent [Reference 8]. Similar to the FAA, HDOTA expresses land use compatibility guidelines based on yearly day-night average sound levels, L_{dn}, due to aircraft operations. In most cases, the HDOTA states maximum noise limits that are 5 dB lower than the FAA. For example, the HDOTA states that residences outside of the 60 L_{dn} noise contour are compatible. Residences between 60 and 70 L_{dn} contours are only compatible if noise mitigation treatments are implemented. However, HDOTA states:

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

The HDOTA guidelines also specify 60 dBA as the maximum allowable L_{dn} level for school, day care center, and church uses without any mitigation measures. Commercial uses such as retail shops, restaurants, shopping centers, etc. are compatible with L_{dn} levels up to 65 dBA without any mitigation measures. With noise mitigation measures implemented, such commercial uses are allowed in areas exposed to an L_{dn} as high as 75 dBA. The compatibility of other land uses, such as manufacturing, public, and recreation, are shown in Table 2.

In addition to the HDOTA compatibility guidelines, The Hawaii Revised Statutes, Chapter 0508D, Section 15 states a notification is required to the buyer for real estate property that lies,

> "Within the boundaries of the noise exposure area shown on maps prepared by the department of transportation in accordance with Federal Aviation Regulation Part 150-Airport Noise Compatibility Planning (14 Code of Federal Regulations Part 150) for any public airport;"

The FAR Part 150 noise exposure area boundary is defined as the 55 L_{dn} noise contour. Therefore, a notification to the buyer is required for all real estate transactions within the 55 L_{dn} noise contour.

4.0 EXISTING ACOUSTICAL ENVIRONMENT

Two types of noise measurements were conducted to assess the existing acoustical environment in the vicinity of the project location. The first noise measurement type consisted of continuous long-term ambient noise level measurements (Locations L1 and L2), as shown in Figure 4. The second type of noise measurement was short-term and included traffic counts. The purpose of the short-term noise measurements and corresponding traffic counts were to validate a traffic noise prediction model. The noise measurements were conducted between November 8, 2006 and November 15, 2006.

4.1 Noise Measurement Procedure

Long-Term Noise Measurement Procedure

Continuous, hourly, statistical sound levels were recorded for approximately 4 days at each location. The measurements were taken using a Larson-Davis Laboratories, Model 820, Type-1 Sound Level Meter together with a Larson-Davis, Model 2560 Type-1 Microphone. Calibration was checked before and after the measurements with a Larson-Davis Model CAL200 calibrator. Both the sound level meter and the calibrator have been certified by the manufacturer within the recommended calibration period. The microphone was mounted on a tripod, approximately 5 feet above grade. A windscreen covered the microphone during the entire measurement period. The sound level meter was secured in a weather resistant case.

Short-Term Noise Measurement Procedure

An approximate 30-minute equivalent sound level, L_{eq}, was measured. Vehicular traffic counts and traffic mix were documented during the measurement period. The noise measurement was taken using a Larson-Davis Laboratories, Model 824, Type-1 Sound Level Meter together with a Larson-Davis, Model 2541 Type-1 Microphone. Calibration was checked before and after the measurements with a Larson-Davis Model CAL200 calibrator. Both the sound level meter and the calibrator have been certified by the manufacturer within the recommended calibration period. The microphone and sound level meter were mounted on a tripod, approximately 5 feet above grade. A windscreen covered the microphone during the entire measurement period.

4.2 Noise Measurement Locations

Long-Term Noise Measurement Locations

Location L1: Approximately 500 feet mauka of Farrington Highway. The dominant noise source was vehicular traffic from the highway. Secondary noise sources included birds, wind, occasional aircraft flyovers, and possible farm equipment.

Location L2: Adjacent to Palehua Road above the Makaiwa Hills project site. The location overlooked the Waimanalo Gulch land fill and Kahe Point power plant. The dominant noise sources were wind and birds.

4.3 Long-Term Noise Measurement Results

The results from the long-term noise measurements are graphically presented in Figure 5, which shows the measured equivalent sound level, L_{eq}, in A-weighted decibels (dBA) as a function of the measurement date and time.

At location L1, the sound levels are relatively dynamic and depend significantly on the vehicular traffic patterns on Farrington Highway. The hourly L_{eq} noise levels generally range from 39 dBA during the low traffic times to approximately 59 dBA during peak hour traffic times. The average day-night level, L_{dn} was 56 dBA for the measurement period.

Location L2 was very quiet and the ambient noise environment is caused by natural sources such as wind and birds. The hourly L_{eq} noise levels generally range from 31 dBA at night to 55 during the day. The average day-night level, L_{dn} was 48 dBA for the measurement period.

4.4 Kalaeloa Airport and Honolulu International Airport Noise Contours

The project is several miles northwest of the Kalaeloa Airport and Honolulu International Airport. Therefore, the project site was assessed for aircraft noise using airport noise contour maps. The Kalaeloa Master Plan completed in November 1998 [Reference 9] includes year 2020 projections of airport operations and noise contour maps for three airport alternates. Also included in the airport noise contour maps is the affect of the Honolulu International Airport operations. The Makaiwa Hills project is well outside of the L_{dn} noise contours for all three alternates. A complete description of the Kalaeloa Airport alternates can be found in the Kalaeloa Master Plan.

4.5 Waimanalo Gulch Landfill and Kahe Point Power Plant

There are two public utility plants located to the west of the project site: Waimanalo Gulch landfill and Kahe Point power plant. Noise from these industrial activities may be audible at times but is not expected to exceed the State Department of Health maximum permissible noise level.

5.0 POTENTIAL NOISE IMPACTS AND NOISE MITIGATION

5.1 Project Construction Noise

Development of project areas will involve excavation, grading, and other typical construction activities during construction. The various construction phases of the project will generate significant amounts of noise. The Makaiwa Hills development may impact existing adjacent properties, such as the homes in the adjacent Makakilo community. Similarly, residences from the initial phases may be impacted by construction noise from subsequent phases due to their proximity to the construction site. The actual noise levels produced during construction will be a function of the methods employed during each stage of the construction process. Typical ranges of construction equipment noise are shown in Figure 6. Pile driving and earthmoving equipment, e.g., bulldozers and diesel-powered trucks, will probably be the loudest equipment used during construction.

5.2 Project Generated Stationary Mechanical Noise and Compliance with State of Hawaii Community Noise Control Rule

The new land development will incorporate stationary mechanical equipment that is typical for residential housing, commercial buildings, etc. Expected mechanical equipment may include air handling equipment, condensing units, etc. Noise from this mechanical equipment and other equipment must meet the State noise rules, which stipulate maximum permissible noise limits at the property line. For multi-family dwellings and commercial areas, the noise limits are 60 dBA during the day and 50 dBA during the night, as shown in Figure 2. For residential areas (i.e., single-family homes), noise limits are 55 dBA during the day and 45 during the night. Mitigation of mechanical noise to meet the State DOH noise rules should be incorporated into the project design.

5.3 Compliance with FHWA/HDOT Noise Limits

A vehicular traffic noise analysis was completed for the existing conditions, future years 2015 and 2020 projections with the “No Build” condition, and future years 2015 and 2020 projections with the “Build” condition using the FHWA Traffic Noise Model Look-up Tables Software Version 2.5 (2004) [Reference 10]. The traffic noise analysis is based on the traffic counts provided by the Traffic Consultant [Reference 11]. Farrington Highway was assumed to be widened to 6 lanes for the year 2020 traffic projections. Vehicular traffic noise levels were calculated for 2 locations along Farrington Highway, Locations A and B, as shown in Figure 4. The results of the traffic noise analysis are described below and summarized in Table 3.

5.3.1 Vehicular Traffic Noise Impacts on the Surrounding Community

The Makaiwa Hills land development project will provide housing for many residents, which will increase vehicular traffic in the area. The increase in traffic noise along Farrington Highway in the vicinity of the project site will not significantly increase due to the project. Year 2020 projections of traffic volumes along Farrington Highway (Location A) both with and without the project indicate an increase in traffic noise of less than 3 dB can be expected, which is not a significant noise impact.

5.3.2 Vehicular Traffic Noise Impacts on the Project

Noise from vehicular traffic is the primary noise source where the planned development is close to Farrington Highway. Results from the traffic noise analysis show that homes within 300 feet from the centerline of Farrington Highway will experience noise levels that exceed the FHWA maximum noise limit of 67 dBA for peak hour traffic volumes.

5.4 Compliance with EPA and HUD Noise Guidelines

The results from the long-term noise measurements conducted at the proposed Makaiwa Hills project site show a calculated day-night noise level, L_{dn}, of 56 dBA in the vicinity of Farrington Highway and 48 dBA in the upper reaches of the project site. By 2020, traffic noise levels at the proposed project site are predicted to increase by approximately 2 to 3 dB. The EPA has an existing design goal of $L_{dn} \leq 65$ dBA and a future design goal $L_{dn} \leq 55$ dBA for exterior noise levels. Noise levels at homes more than 300 feet from Farrington Highway are expected to be below the existing EPA/HUD design goals but exceed the future EPA design goal.

It is important to note that the HUD and EPA noise guidelines are design goals and not enforceable regulations, although the HUD noise guidelines must be satisfied for projects involving HUD or federal financing. However, these guidelines and design goals are useful tools for assessing the noise environment.

5.5 Compliance with FAA and HDOT Airports Division Guidelines

The Makaiwa Hills project site is outside of the $L_{dn} = 55$ noise contours of both Honolulu International Airport and Kalaeloa Airport. Therefore, the project will not be significantly impacted by aircraft noise. However, infrequent aircraft flyovers due to military aircraft operations may be audible at the project site. These flyovers should be infrequent, and therefore, should not significantly impact the proposed development.

5.6 Public Utilities and Compliance with State of Hawaii Community Noise Control Rule

Intermittent industrial noises from the existing Waimanalo Gulch landfill and Kahe Point power plant may be audible at the adjacent Makaiwa Hills community. Mechanical noise from these areas must meet the State noise rules, which stipulate maximum permissible noise limits at the property line. These noises are not expected to impact the project.

6.0 POTENTIAL NOISE IMPACT ON THE PROJECT AND NOISE MITIGATION

6.1 Mitigation of Construction Noise

In cases where construction noise exceeds, or is expected to exceed the State's "maximum permissible" property line noise levels [Reference 1], a permit must be obtained from the State DOH to allow the operation of vehicles, cranes, construction equipment, power tools, etc., which emit noise levels in excess of the "maximum permissible" levels.

In order for the State DOH to issue a construction noise permit, the Contractor must submit a noise permit application to the DOH, which describes the construction activities for the project. Prior to issuing the noise permit, the State DOH may require action by the Contractor to incorporate noise mitigation into the construction plan. The DOH may also require the Contractor to conduct noise monitoring or community meetings inviting the neighboring residents and business owners to discuss construction noise. The Contractor should use reasonable and standard practices to mitigate noise, such as using mufflers on diesel and gasoline engines, using properly tuned and balanced machines, etc. However, the State DOH may require additional noise mitigation, such as temporary noise barriers, or time of day usage limits for certain kinds of construction activities.

Specific permit restrictions for construction activities [Reference 1] are:

> "No permit shall allow any construction activities which emit noise in excess of the maximum permissible sound levels ... before 7:00 a.m. and after 6:00 p.m. of the same day, Monday through Friday."
> "No permit shall allow any construction activities which emit noise in excess of the maximum permissible sound levels... before 9:00 a.m. and after 6:00 p.m. on Saturday."
>
> "No permit shall allow any construction activities which emit noise in excess of the maximum permissible sound levels on Sundays and on holidays."

The use of hoe rams and jack hammers 25 lbs. or larger, high pressure sprayers, chain saws, and pile drivers are restricted to 9:00 a.m. to 5:30 p.m., Monday through Friday. In addition, construction equipment and on-site vehicles or devices whose operations involve the exhausting of gas or air, excluding pile hammers and pneumatic hand tools weighing less than 15 pounds, must be equipped with mufflers [Reference 1].

The DOH noise permit does not limit the noise level generated at the construction site, but rather the times at which noisy construction can take place. Therefore, noise mitigation for construction activities should be addressed using project management, such that the time restrictions within the DOH permit are followed.

6.2 Mitigation of the Makaiwa Hills Development Noise

The design of the new development should give consideration to controlling the noise emanating from stationary mechanical equipment so as to comply with the State Department of Health *Community Noise Control* rules [Reference 1]. Noisy equipment should be located away from neighbors and the residential units, as much as is practical. Enclosed mechanical rooms may be required for some equipment.

6.3 Mitigation of Traffic Noise

Vehicular traffic noise from Farrington Highway may significantly impact the proposed development. The calculated traffic noise levels show that the residences constructed on parcels that border Farrington Highway and are closer than 300 feet from the centerline will require noise mitigation to meet the criteria. Homes should not be built within 75 feet of Farrington Highway, even if noise mitigation treatments are planned.

A comprehensive traffic noise and barrier analysis using roadway coordinates and the FHWA Traffic Noise Model Software was not performed. The guidelines listed below are general in nature and should be applied where residential housing is constructed within the setback limits listed above and noise abatement becomes necessary. Effective noise mitigation measures might include:

- constructing barrier walls and/or earth berms along roadways;
- air-conditioning;
- sound rated exterior wall constructions

Typical exterior-to-interior noise reductions for naturally ventilated homes, i.e., with open windows, are approximately 9 dB. Adding absorption to interior spaces, (acoustically softening), can further reduce the noise levels 1 to 5 dB, depending upon the absorption initially present, and the amount of absorption added to the space. Air-conditioned or mechanically ventilated homes will also typically exhibit higher exterior-to-interior noise reductions achieved by several types of building constructions. Estimating the noise reduction provided by a barrier, however, is more difficult to generalize. Factors such as distances to roadways and setbacks, intervening ground conditions, barrier construction, barrier height, roadway elevations, etc., will determine the noise reduction afforded by a traffic noise barrier.

6.4 Mitigation of Aircraft Noise

The Makaiwa Hills project site is well outside the L_{dn} 55 dBA noise contour. Therefore, noise mitigation to attenuate aircraft noise is not necessary.

REFERENCES

1. Chapter 46, *Community Noise Control*, Department of Health, State of Hawaii, Administrative Rules, Title 11, September 23, 1996.

2. *Department of Transportation, Federal Highway Administration Procedures for Abatement of Highway Traffic Noise,* Title 23, CFR, Chapter 1, Subchapter J, Part 772, 38 FR 15953, June 19, 1973; Revised at 47 FR 29654, July 8, 1982.

3. *Federal Highway Administration's Traffic Noise Model,* FHWA-RD-77-108; U.S. Department of Transportation, December 1978.

4. *Noise Analysis and Abatement Policy,* Department of Transportation, Highways Division, State of Hawaii, June 1977.

5. *Toward a National Strategy for Noise Control*, U.S. Environmental Protection Agency, April 1977.

6. *Department of Housing and Urban Development Environmental Criteria and Standards*, Title 24, CFR, Part 51, 44 FR 40860, July 12, 1979; Amended by 49 FR 880, January 6, 1984.

7. *FAA Regulations on Airport Noise Compatibility Planning Programs,* Code of Federal Regulations, Title 14, Chapter 1, Subchapter 1, Part 150; Issued by 49 FR 49269, December 18, 1984; corrected by 50 FR 5063, February 6, 1985; amended by 53 FR 8723, March 16, 1988; corrected by 53 FR 9726, March 24, 1988.

8. *Honolulu International Airport Master Plan Update and Noise Compatibility Program*, State of Hawaii Department of Transportation, Airports Division, Vol. 2, December 1989.

9. *Kalaeloa Airport Master Plan,* State of Hawaii Department of Transportation, Airports Division, November 1998.

10. *Federal Highway Administration's Traffic Noise Model Look-up Tables Software*, Ver. 2.5; U.S. Department of Transportation, December 17, 2004.

11. *Makaiwa Hills Traffic Impact Analysis Report - Draft,* Wilbur Smith Associates, Inc., December, 2006.

TABLE 1:
FAR Part 150 Recommendations for Land Use Compatibility in Yearly Day-Night Average Sound Levels

TYPE OF LAND USE	Yearly Day-Night Average Sound Level (L_{dn})					
	< 65	65-70	70-75	75-80	80-85	> 85
RESIDENTIAL:						
Residential (except mobile homes & transient lodgings)	Y	N(1)	N(1)	N	N	N
Mobile home parks	Y	N	N	N	N	N
Transient lodgings	Y	N(1)	N(1)	N(1)	N	N
PUBLIC USE:						
Schools	Y	N(1)	N(1)	N	N	N
Hospitals and nursing homes	Y	25	30	N	N	N
Churches, auditoriums, and concert halls	Y	25	30	N	N	N
Government services	Y	Y	25	30	N	N
Transportation	Y	Y	Y(2)	Y(3)	Y(4)	Y(4)
Parking	Y	Y	Y(2)	Y(3)	Y(4)	N
COMMERCIAL USE:						
Offices, business and professional	Y	Y	25	30	N	N
Wholesale/Retail: (bldg. mater., hardware, & farm equip.)	Y	Y	Y(2)	Y(3)	Y(4)	N
Retail trade – general	Y	Y	25	30	N	N
Utilities	Y	Y	Y(2)	Y(3)	Y(4)	N
Communication	Y	Y	25	30	N	N
MANUFACTURING AND PRODUCTION:						
Manufacturing, general	Y	Y	Y(2)	Y(3)	Y(4)	N
Photographic and optical	Y	Y	25	30	N	N
Agriculture (except livestock) and forestry	Y	Y(6)	Y(7)	Y(8)	Y(8)	Y(8)
Livestock farming and breeding	Y	Y(6)	Y(7)	N	N	N
Mining and fishing, resource production and extraction	Y	Y	Y	Y	Y	Y
RECREATIONAL USE:						
Outdoor sports arenas and spectator sports	Y	Y(5)	Y(5)	N	N	N
Outdoor music shells, amphitheaters	Y	N	N	N	N	N
Nature exhibits and zoos	Y	Y	N	N	N	N
Amusements, parks, resorts and camps	Y	Y	Y	N	N	N
Golf courses, riding stables and water recreation	Y	Y	25	30	N	N

Note: Numbers in parentheses refer to the following notes.

(1) Where the community determines that residential or school uses must be allowed, measures to achieve outdoor-to-indoor Noise Level Reduction (NLR) of at least 25 dB and 30 dB should be incorporated into building codes and be considered in individual approvals. Normal residential construction can be expected to provide a NLR of 20 dB, thus, the reduction requirements are often stated as 5, 10, or 15 dB over standard construction and normally assume mechanical ventilation and closed windows year round. However, the use of NLR criteria will not eliminate outdoor noise problems.

(2) Measures to achieve NLR 25 must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas, or where the normal noise level is low.

(3) Measures to achieve NLR 30 must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas, or where the normal noise level is low.

(4) Measures to achieve NLR 35 must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas, or where the normal noise level is low.

(5) Land use compatible provided special sound reinforcement systems are installed.

(6) Residential buildings require a NLR of 25.

(7) Residential buildings require a NLR of 30.

(8) Residential buildings are not permitted.

Abbreviations:

Y(Yes) = Land Use and related structures compatible w/o restrictions.

N(No) = Land Use and related structures are not compatible and should be prohibited.

NLR = Noise Level Reduction (outdoor-to-indoor) to be achieved through incorporation of noise attenuation into the design and construction of the structure.

25, 30, or 35 = Land use and related structures general compatible; measures to achieve NLR of 25, 30, or 35 dB must be incorporated into design and construction of structures.

Regulatory Note.

The designations contained in this table do not constitute a Federal determination that any use of land covered by the program is acceptable or unacceptable under Federal, State, or local law. The responsibility for determining the acceptable and permissible land uses and the relationship between specific properties and specific noise contours rests with the local authorities. FAA determinations under Part 150 are not intended to substitute federally determined land uses for those determined to be appropriate by local authorities in response to locally determined needs and values in achieving noise compatible land uses.

Source: FAR Part 150, Appendix A, Table 1. "Land Use Compatibility with Yearly Day-Night Average Sound Levels."

TABLE 2:
State Department of Transportation Airports Division Recommendations for Local Land Use Compatibility in Yearly Day-Night Average Sound Levels (Ldn)

	Yearly Day-Night Average Sound Level (L_{dn})					
TYPE OF LAND USE	**< 60**	**60-65**	**65-70**	**70-75**	**75-80**	**80-85**
RESIDENTIAL:						
Low density residential, resorts, & hotels (w/ outdoor facil.)	Y(a)	N(b)	N	N	N	N
Low density apartment w/ moderate outdoor use	Y	N(b)	N	N	N	N
High density apartment with limited outdoor use	Y	N(b)	N(b)	N	N	N
Transient lodgings (w/limited outdoor use)	Y	N(b)	N(b)	N	N	N
PUBLIC USE:						
Schools, day care centers, libraries, and churches	Y	N(c)	N(c)	N(c)	N	N
Hospitals, nursing homes, clinics, and health facilities	Y	Y(d)	Y(d)	Y(d)	N	N
Indoor auditoriums, and concert halls	Y(c)	Y(c)	N	N	N	N
Government services and offices serving the public	Y	Y	Y(d)	Y(d)	N	N
Transportation and parking	Y	Y	Y(d)	Y(d)	Y(d)	Y(d)
COMMERCIAL USE:						
Offices - government, business and professional	Y	Y	Y(d)	Y(d)	N	N
Wholesale/Retail: bldg. mater., hardware, & heavy equip.	Y	Y	Y(d)	Y(d)	Y(d)	Y(d)
Airport businesses - car rental, ticketing, lei stands, etc	Y	Y	Y(d)	Y(d)	N	N
Retail trade, restaurants, shop. centers, financial inst., etc	Y	Y	Y(d)	Y(d)	N	N
Power plants, sewage treatment plants, & base yards	Y	Y	Y(d)	Y(d)	Y(d)	N
Studios w/o outdoor sets, broadcasting & production facil.	Y(c)	Y(c)	N	N	N	N
MANUFACTURING AND PRODUCTION:						
Manufacturing, general	Y	Y	Y(d)	Y(d)	Y(d)	N
Photographic and optical	Y	Y	Y(d)	Y(d)	N	N
Agriculture (except livestock) and forestry	Y	Y(e)	Y(e)	Y(e)	Y(e)	Y(e)
Livestock farming and breeding	Y	Y(e)	Y(e)	N	N	N
Mining and fishing, resource production and extraction	Y	Y	Y	Y	Y	Y
RECREATIONAL USE:						
Outdoor sports arenas and spectator sports	Y	Y(f)	Y(f)	N	N	N
Outdoor music shells, amphitheaters	Y(f)	N	N	N	N	N
Nature exhibits and zoos, neighborhood parks	Y	Y	Y	N	N	N
Amusements, beach parks, active playgrounds, etc	Y	Y	Y	Y	N	N
Public golf courses, riding stables, cemeteries, gardens, etc	Y	Y	N	N	N	N
Professional/resort sports facil., media event facil., etc	Y(f)	N	N	N	N	N
Extensive natural wildlife and recreation areas	Y(f)	N	N	N	N	N

Note: Letters in parentheses refer to the following notes.
(a) A noise level of 60 L_{dn} does not eliminate all risks of adverse noise impacts from aircraft noise. However, the 60 L_{dn} planning level has been selected by the State Airports Division as an appropriate compromise between the minimal risk of level of 55 L_{dn} and the significant risk level of 65 L_{dn}.
(b) Where the community determines that these uses should be allowed, Noise Level Reduction (NLR) measures to achieve interior levels of 45 L_{dn} or less should be incorporated into building codes and be considered in individual approvals. Normal local construction employing natural ventilation can be expected to provide an average NLR of approximately 9 dB. Total closure plus air conditioning may be required to provide additional outdoor-to-indoor NLR, but will not eliminate outdoor noise problems.
(c) Because the L_{dn} noise descriptor system represents a 24-hour average of individual aircraft noise events, each of which can be unique in respect to amplitude, duration, and tonal content, the NLR requirements should be evaluated for the specific land use, interior acoustical requirements, and properties of the aircraft noise events. NLR requirements should not be based solely upon the exterior L_{dn} exposure level.
(d) Measures to achieve required NLR must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas, or where the normal noise level is low.
(e) Residential buildings require NLR. Residential buildings should not be located where exterior noise is greater than 65 L_{dn}.
(f) Impact of amplitude, duration, frequency, and tonal content of aircraft noise events should be evaluated.

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

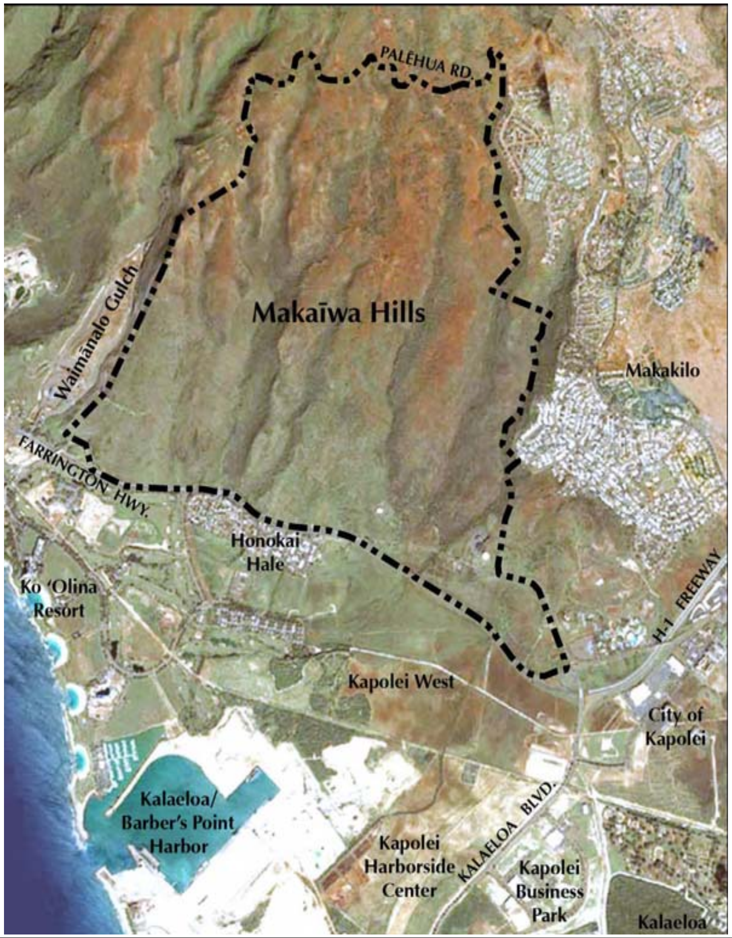
Source: Airports Division, Department of Transportation, State of Hawaii

TABLE 3:
Predicted Traffic Noise Levels With and Without the Project and Resulting Increases Due to the Project+

Noise levels shown in the table are based on peak-hour traffic volumes, and are expressed in A-weighted decibels (dBA).

	Location A*		**Location B***	
	AM	**PM**	**AM**	**PM**
Existing (Calculated)	70.0	71.0	64.8	66.0
Future Without Project (2015)	71.4	72.1	66.1	67.0
Future Without Project (2020)	72.0	72.5	66.6	67.4
Future With Project (2015)	71.6	72.2	66.4	67.2
Future With Project (2020)	72.3	72.8	67.0	67.7
Future Increase Without Project (2015)	1.4	1.1	1.3	1.0
Future Increase Without Project (2020)	2.0	1.5	1.8	1.4
Future Increase With Project (2015)	1.6	1.2	1.6	1.2
Future Increase With Project (2020)	2.3	1.8	2.2	1.7
Future Increase Due to Project (2015)	**0.2**	**0.1**	**0.3**	**0.2**
Future Increase Due to Project (2020)	**0.3**	**0.3**	**0.4**	**0.3**

+ The noise level calculations were based on the traffic study provided by the Traffic Consultant [Reference 11].
* Location A - 75 feet south of Farrington Highway centerline
Location B - 300 feet north of Farrington Highway centerline



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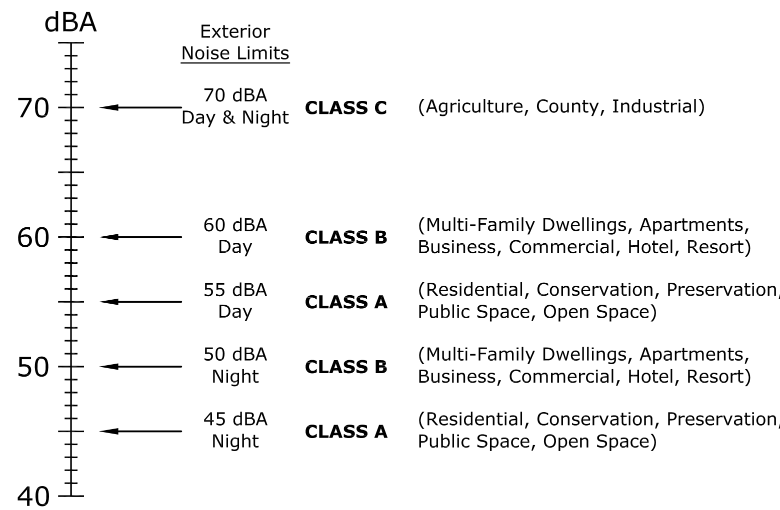
Project Location

Makaiwa Hills

Not to Scale

Date	Project No.	Drawn By	Figure No
December 2006	05-61	DFD	1

Zoning District	**Day Hours** (7 AM to 10 PM)	**Night Hours** (10 PM to 7 AM)
CLASS A Residential, Conservation, Preservation, Public Space, Open Space	55 dBA (Exterior)	45 dBA (Exterior)
CLASS B Multi-Family Dwellings, Apartments, Business, Commercial, Hotel, Resort	60 dBA (Exterior)	50 dBA (Exterior)
CLASS C Agriculture, Country, Industrial	70 dBA (Exterior)	70 dBA (Exterior)



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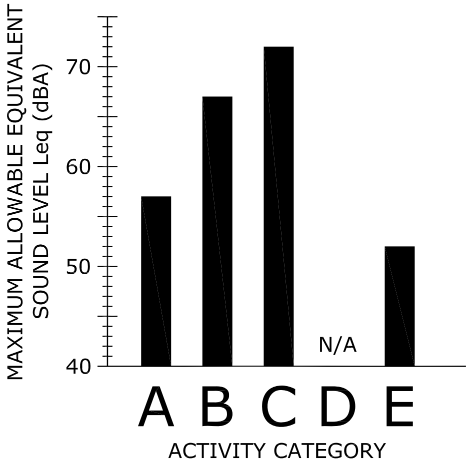
Hawaii Maximum Permissible Sound Levels for Various Zoning Districts

Makaiwa Hills

Not to Scale

Date	Project No.	Drawn By	Figure No
December 2006	05-61	TRB	2

ACTIVITY CATEGORY	ACTIVITY CATEGORY DESCRIPTION	MAXIMUM EQUIVALENT SOUND LEVEL $L_{eq(h)}$
A	LANDS ON WHICH SERENITY AND QUIET ARE OF EXTRAORDINARY SIGNIFICANCE AND SERVE AN IMPORTANT PUBLIC NEED AND WHERE THE PRESERVATION OF THOSE QUALITIES IS ESSENTIAL IF THE AREA IS TO CONTINUE TO SERVE ITS INTENDED PURPOSE.	57 dBA (EXTERIOR)
B	PICNIC AREAS, RECREATION AREAS, PLAYGROUNDS, ACTIVE SPORT AREAS, PARKS, RESIDENCES, MOTELS, HOTELS, SCHOOLS, CHURCHES, LIBRARIES, AND HOSPITALS.	67 dBA (EXTERIOR)
C	DEVELOPED LANDS, PROPERTIES, OR ACTIVITIES NOT INCLUDED IN ACTIVITY CATEGORIES A OR B ABOVE.	72 dBA (EXTERIOR)
D	UNDEVELOPED LAND	N/A
E	RESIDENCES, MOTELS, HOTELS, PUBLIC MEETING ROOMS, SCHOOLS, CHURCHES, LIBRARIES, HOSPITALS, AND AUDITORIUMS.	52 dBA (INTERIOR)



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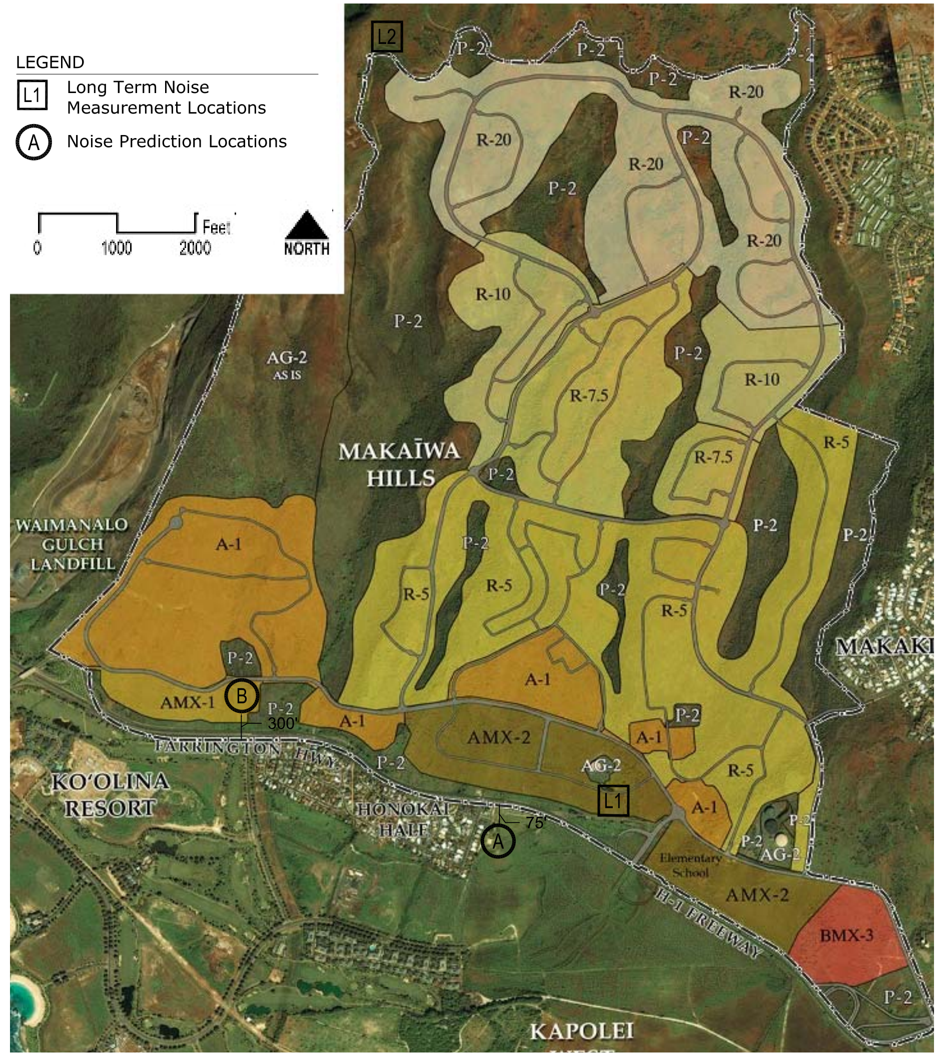
Federal Highways Administration Recommended Equivalent Hourly Sound Levels Based on Land Use

Makaiwa Hills

Not to Scale

Date December 2006 | Project No. 05-61 | Drawn By TRB

Figure No 3



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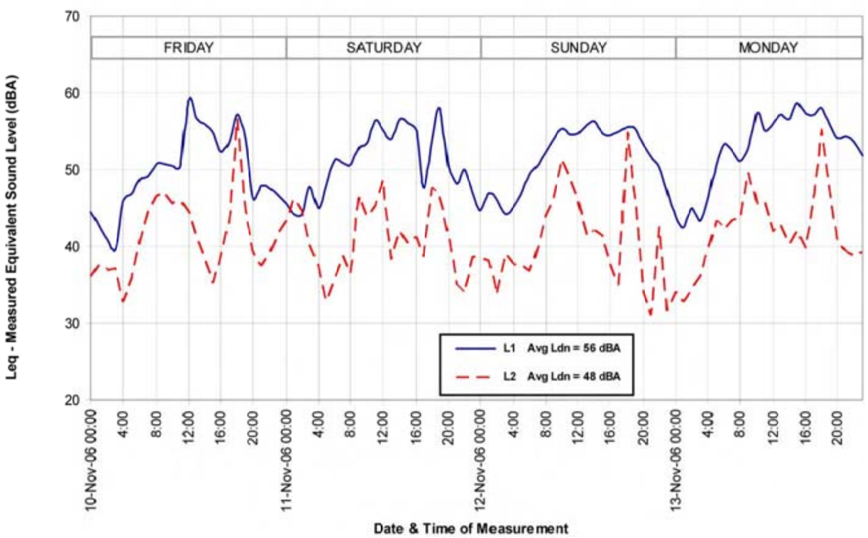
Noise Measurement and Prediction Locations

Makaiwa Hills

Not to Scale

Date March 2007 | Project No. 05-61 | Drawn By DFD

Figure No 4



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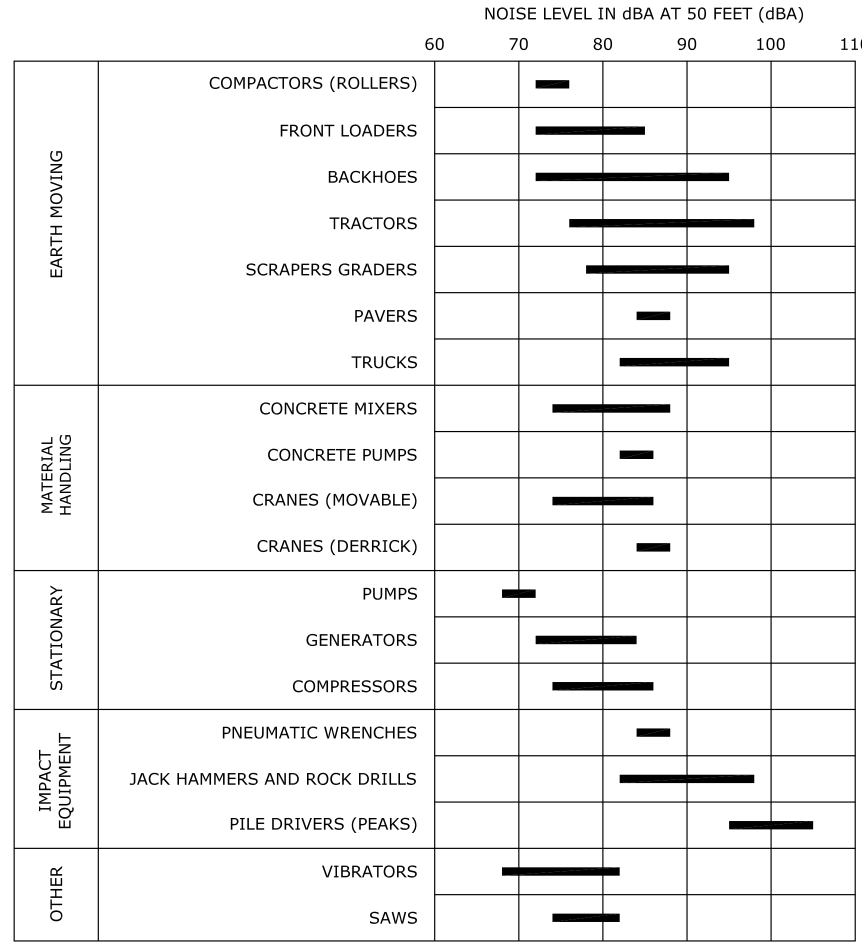
Graph of Long Term Noise Measurements

Makaiwa Hills

Not to Scale

Date	Project No.	Drawn By	Figure No
December 2006	05-61	DFD	5



NOTE: BASED ON LIMITED AVAILABLE DATA SAMPLES

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Typical Sound Levels from Construction Equipment

Makaiwa Hills

Not to Scale

Date	Project No.	Drawn By	Figure No
December 2006	05-61	TRB	6

APPENDIX A

Acoustic Terminology

Acoustic Terminology

Sound Pressure Level

Sound, or noise, is the term given to variations in air pressure that are capable of being detected by the human ear. Small fluctuations in atmospheric pressure (sound pressure) constitute the physical property measured with a sound pressure level meter. Because the human ear can detect variations in atmospheric pressure over such a large range of magnitudes, sound pressure is expressed on a logarithmic scale in units called decibels (dB). Noise is defined as "unwanted" sound.

Technically, sound pressure level (SPL) is defined as:

$$SPL = 20 \log (P/P_{ref}) \text{ dB}$$

where P is the sound pressure fluctuation (above or below atmospheric pressure) and P_{ref} is the reference pressure, 20 µPa, which is approximately the lowest sound pressure that can be detected by the human ear. For example:

If P = 20 µPa, then SPL = 0 dB
If P = 200 µPa, then SPL = 20 dB
If P = 2000 µPa, then SPL = 40 dB

The sound pressure level that results from a combination of noise sources is not the arithmetic sum of the individual sound sources, but rather the logarithmic sum. For example, two sound levels of 50 dB produce a combined sound level of 53 dB, not 100 dB. Two sound levels of 40 and 50 dB produce a combined level of 50.4 dB.

Human sensitivity to changes in sound pressure level is highly individualized. Sensitivity to sound depends on frequency content, time of occurrence, duration, and psychological factors such as emotions and expectations. However, in general, a change of 1 or 2 dB in the level of sound is difficult for most people to detect. A 3 dB change is commonly taken as the smallest perceptible change and a 6 dB change corresponds to a noticeable change in loudness. A 10 dB increase or decrease in sound level corresponds to an approximate doubling or halving of loudness, respectively.

A-Weighted Sound Level

Studies have shown conclusively that at equal sound pressure levels, people are generally more sensitive to certain higher frequency sounds (such as made by speech, horns, and whistles) than most lower frequency sounds (such as made by motors and engines)[1] at the same level. To address this preferential response to frequency, the A-weighted scale was developed. The A-weighted scale adjusts the sound level in each frequency band in much the same manner that the

[1] D.W. Robinson and R.S. Dadson, "A Re-Determination of the Equal-Loudness Relations for Pure Tones," *British Journal of Applied Physics*, vol. 7, pp. 166 - 181, 1956. (Adopted by the International Standards Organization as Recommendation R-226.

human auditory system does. Thus the A-weighted sound level (read as "dBA") becomes a single number that defines the level of a sound and has some correlation with the sensitivity of the human ear to that sound. Different sounds with the same A-weighted sound level are perceived as being equally loud. The A-weighted noise level is commonly used today in environmental noise analysis and in noise regulations. Typical values of the A-weighted sound level of various noise sources are shown in Figure A-1.

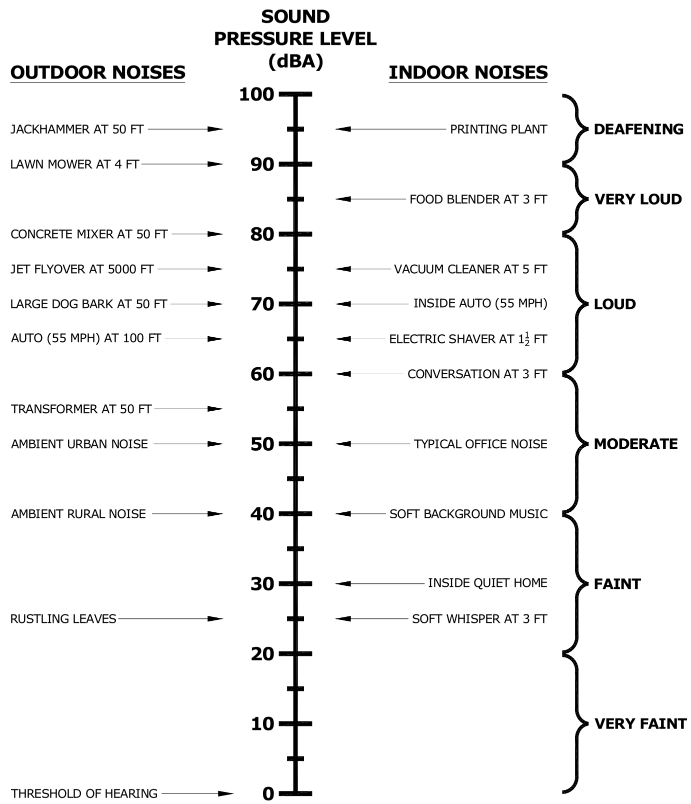


Figure A-1. Common Outdoor/Indoor Sound Levels

Equivalent Sound Level

The Equivalent Sound Level (L_{eq}) is a type of average which represents the steady level that, integrated over a time period, would produce the same energy as the actual signal. The actual *instantaneous* noise levels typically fluctuate above and below the measured L_{eq} during the measurement period. The A-weighted L_{eq} is a common index for measuring environmental noise. A graphical description of the equivalent sound level is shown in Figure A-2.

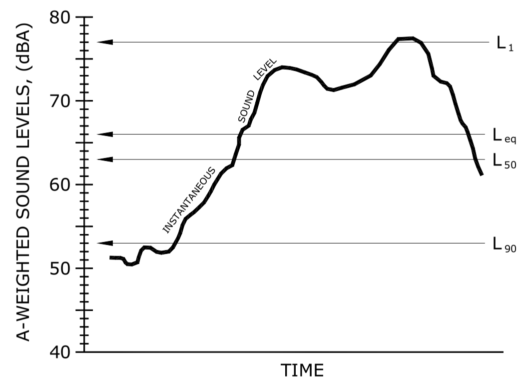


Figure A-2. Example Graph of Equivalent and Statistical Sound Levels

Statistical Sound Level

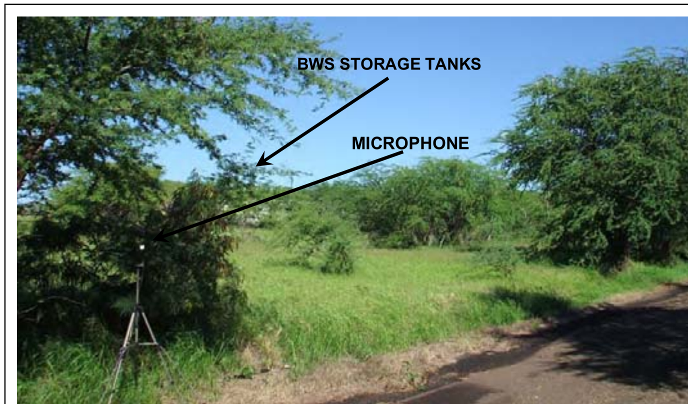
The sound levels of long-term noise producing activities such as traffic movement, aircraft operations, etc., can vary considerably with time. In order to obtain a single number rating of such a noise source, a statistically-based method of expressing sound or noise levels has been developed. It is known as the Exceedence Level, L_n. The L_n represents the sound level that is exceeded for n% of the measurement time period. For example, L_{10} = 60 dBA indicates that for the duration of the measurement period, the sound level exceeded 60 dBA 10% of the time. Typically, in noise regulations and standards, the specified time period is one hour. Commonly used Exceedence Levels include L_{01}, L_{10}, L_{50}, and L_{90}, which are widely used to assess community and environmental noise. A graphical description of the equivalent sound level is shown in Figure A-2.

Day-Night Equivalent Sound Level

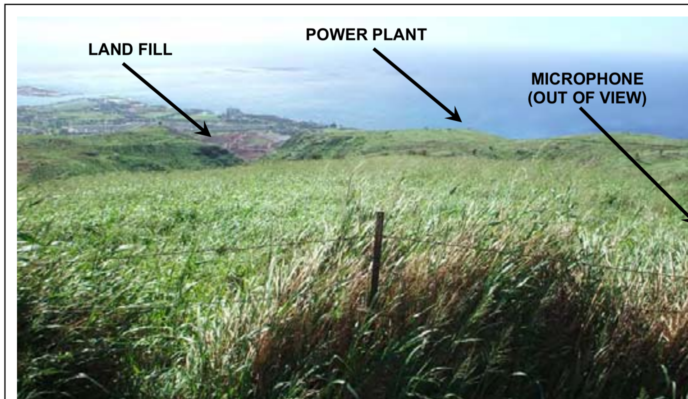
The Day-Night Equivalent Sound Level, L_{dn}, is the Equivalent Sound Level, L_{eq}, measured over a 24-hour period. However, a 10 dB penalty is added to the noise levels recorded between 10 p.m. and 7 a.m. to account for people's higher sensitivity to noise at night when the background noise level is typically lower. The L_{dn} is a commonly used noise descriptor in assessing land use compatibility, and is widely used by federal and local agencies and standards organizations.

APPENDIX B

Photographs at Project Site



Location L1
Approximately 500 feet mauka of Farrington Highway, in the vicinity of the Board of Water Supply Storage Tanks.



Location L2
Adjacent to Palehua Road above the Makaiwa Hills project site. The location overlooked the Waimanalo Gulch land fill and Kahe Point power plant.

Appendix N
1993 Findings of Fact, Conclusions of Law, and Decision and Order

BEFORE THE LAND USE COMMISSION

OF THE STATE OF HAWAII

In the Matter of the Petition of THE TRUSTEES UNDER THE WILL AND OF THE ESTATE OF JAMES CAMPBELL, DECEASED To Amend the Land Use District Boundary of Approximately 1,781.122 Acres Situated at Honouliuli, Ewa, Island of Oahu, State of Hawaii from Agricultural to Urban; TMK Nos.: 9-1-15: Por. 5, 17; 9-2-03: Por. 2 and Por. 5	DOCKET NO. A92-687 FINDINGS OF FACT, CONCLUSIONS OF LAW, AND DECISION AND ORDER

This is to certify that this is a true and correct copy of the Decision and Order on file in the office of the State Land Use Commission, Honolulu Hawaii.

OCT 28 1993 by [signature]
Date Executive Officer

MH

LAND USE COMMISSION
STATE OF HAWAII
OCT 28 7 31 AM '93

FINDINGS OF FACT,
CONCLUSIONS OF LAW, AND DECISION AND ORDER

BEFORE THE LAND USE COMMISSION

OF THE STATE OF HAWAII

In the Matter of the Petition of THE TRUSTEES UNDER THE WILL AND OF THE ESTATE OF JAMES CAMPBELL, DECEASED To Amend the Land Use District Boundary of Approximately 1,781.122 Acres Situated at Honouliuli, Ewa, Island of Oahu, State of Hawaii from Agricultural to Urban; TMK Nos.: 9-1-15: Por. 5, 17; 9-2-03: Por. 2 and Por. 5	DOCKET NO. A92-687 FINDINGS OF FACT, CONCLUSIONS OF LAW, AND DECISION AND ORDER

FINDINGS OF FACT,
CONCLUSIONS OF LAW, AND DECISION AND ORDER

The Trustees Under the Will and of the Estate of James Campbell, Deceased, acting in their fiduciary and not in their individual capacities ("Petitioner"), filed a Petition with the Land Use Commission ("Commission") on December 24, 1992 pursuant to Hawaii Revised Statutes ("HRS") Chapter 205, as amended, and Title 15, Subtitle 3, Chapter 15, of the Hawaii Administrative Rules ("HAR"), as amended ("Commission Rules"), to amend the Land Use District Boundary to reclassify approximately 1,781.122 acres situated in Honouliuli, Ewa, Island of Oahu, Oahu Tax Map Key Numbers 9-1-15: Por. 5 and 17, and 9-2-03: Por. 2 and Por. 5, ("Property") from the Agricultural District to the Urban District to permit the development of the Makaiwa Hills project, which will include residential units, a commercial area, parks, roads, and preservation land ("Project").

The Commission, having heard and examined the testimony and evidence presented during the hearing, the Petitioner's proposed findings of fact, conclusions of law and decision and order, the responses to Petitioner's findings of fact, conclusions of law, and decision and order by the City and County of Honolulu Planning Department ("Planning Department") and the Office of State Planning ("OSP"), respectively, the stipulation between Petitioner and the OSP re: proposed findings of fact, conclusions of law, and decision and order, and the Petitioner's position statement re: OSP's proposed condition nos. 26, 27 and 28, and good cause appearing therefrom, hereby makes the following findings of fact, conclusions of law and decision and order:

PROCEDURAL MATTERS

1. On December 24, 1992, Petitioner filed a Petition For Land Use District Boundary Amendment.

2. On February 2, 1993, Petitioner filed its First Amendment To Petition For Land Use District Boundary Amendment.

3. On March 15, 1993, a prehearing conference was held at the Old Federal Building, Conference Room 238, 335 Merchant Street, Honolulu, Hawaii with all respective parties present.

4. On April 1, July 15 and July 16, 1993, the Commission conducted hearings on the Petition pursuant to

notice published on February 19, 1993 in the Honolulu Star Bulletin, a newspaper of general circulation.

5. During the hearings, the Commission received written testimony and heard oral testimony by the Petitioner, the OSP for the State of Hawaii, and the Planning Department for the City & County of Honolulu ("City and County").

6. The Commission did not receive any petition to intervene in the proceeding and there were no public witnesses.

DESCRIPTION OF THE PROPERTY

7. The Property consists of approximately 1,781.122 acres of land located on the slopes of the Waianae Mountain Range, in the Ewa District, Island of Oahu. Farrington Highway forms the seaward (or southern) boundary of the Property, separating the Property from the residential communities of Honokai Hale and Nanakai Gardens and the Ko Olina Resort. Campbell Industrial Park lies to the south, the City of Kapolei lies southeast, and Makakilo City lies to the east of the Property. Preservation land and unimproved hillside lie to the north of the Property. To the west is the City and County of Honolulu's Waimanalo sanitary landfill.

8. The Property is identified by the following tax map key parcel designations:

TMK: 9-1-15: POR. 5 and 17

TMK: 9-2-03: POR. 2 and POR. 5

The lots within the Property are broken down by lot number, tax map key number, and land court certificate of title number as follows:

Lot No.	TMK No.	TCT No.
79	9-1-15: POR.5	15,790
4024	9-1-15: POR.5	15,790
4025	9-1-15: POR.5	15,790
4026	9-1-15: POR.5	15,790
4027	9-2-03: POR.2 & 5	15,790
4022-A-1	9-2-03: POR.2	15,790
5553-B	9-2-03: POR.5	347,108
2681	9-1-15: 17	192,508

9. The total project area for Makaiwa Hills encompasses approximately 1,842 acres ("Project Area"), of which approximately 61 acres are within the State Land Use Urban District and the remaining 1,781 acres are within the State Land Use Agricultural District. The Urban District land is located on the eastern side of the Project near Makakilo City, with an additional small area being used for the Ko Olina Resort traffic interchange.

10. Petitioner is the owner in fee simple of the Property. The Property consists of portions of the real property described in Land Court Certificates of Title Nos. 15,790, 192,508 and 347,108. Portions of the Property are currently leased to the Oahu Sugar Company, Ltd. and Rocker G. Livestock. These leases allow for partial withdrawal of lands for urbanization.

11. Under the existing Ewa Development Plan of the City and County of Honolulu, most of the Project Area is

currently designated for agricultural uses (zoned AG-2, general agriculture or AG-1, restricted agriculture) with smaller portions designated for low density apartment and residences (zoned R-5). Most of the Project Area is presently undeveloped with a portion leased for ranch land.

12. The Property rises in elevation from 50 feet at the makai boundary fronting Farrington Highway to 1,300 feet at its northern or mauka boundary. Three major gulches and three minor gulches transect the Property. Slopes as low as 2 percent exist in the southeastern corner of the Property. Across the plateaus and ridges, slopes of 10 percent are common, and steeper slopes are found within the gulches.

13. Vegetation on the Property is mainly tall grasses with clumps of scattered brush and eroded patches of ground. Kiawe and koa-haole shrubs are found in the gulch areas. Rainfall is light, with mean annual rainfall varying between 20 inches at the makai boundary to 30 inches at the mauka boundary.

14. Approximately 6% of the Project Area is rated as "prime" agricultural land according to the Agricultural Lands of Importance in the State of Hawaii ("ALISH") system. Under the overall productivity rating devised by the University of Hawaii Land Study Bureau, about 0.4% of the land has the highest rating of "A", 5.2% is rated "B", about 0.5% is rated "C", about 12.6% is rated "D" and 81.2% is classified with the lowest rating of "E".

15. Approximately 100 acres of flatland along the H-1 Freeway in the southeast portion of the Project Area consist of good soils and terrain conducive to commercial crop production. The land was formerly used for sugarcane production but is now used as a pasture for grazing cattle and horses. The balance of the Project Area is poorly suited for growing crops because the soils are rocky, the slopes are steep, and low-cost water is not available.

DESCRIPTION OF THE PROPOSED DEVELOPMENT

16. Petitioner proposes to develop the Project as one component of the Kapolei Master Plan. As proposed by Petitioner, the Project will consist of approximately 2,706 single family residences, 1,404 multi-family units, and a 78 acre commercial area. The focal point of the commercial area is currently planned by Petitioner as a regional mall of up to 1,000,000 square feet. Also included in the Project are park areas, roadways and preservation areas.

17. The approximately 1,781.122 acres that comprise the Property are allocated for land use purposes as follows:

Residential (2,706 units)	596.9
Low Density Apartment (1,404 units)	123.5
Commercial	78.0
Park	25.0
Circulation/Roads	66.0
Preservation/Open Space	891.6
TOTAL	1,781.0

18. The Project is planned as a moderate to upscale master-planned suburb of the City of Kapolei.

19. Grading within the Project Area is expected to be limited to the ridges and plateau areas where slopes are less steep, favoring development. The grading concept for the residential lots will be to provide a level pad area for the house, rather than levelling the entire lot.

20. The steep gulch areas will generally remain in their natural or undeveloped state. However, some grading in gulches may be required to support bridges and roadways between ridges. Grading operations will be in conformance with the applicable ordinances of the City and County.

21. The Project will be constructed in two phases. Completion of Phase I is estimated by the year 2005. The entire Project Area could be completed by the year 2015.

22. Petitioner's current plans include provision for onsite multi-family affordable housing units targeted at gap group income residents. In addition, Petitioner's current plans also include the development of offsite affordable rental units to be located north of the city of Kapolei, mauka of the H-1 Freeway and makai of Makakilo. The rental development will consist of low density apartments, with a target income of 50 to 140 percent of the median family income. The first phase of the affordable rental development would consist of 250 low density apartments, aimed at families earning between 50 and 80 percent of the median income. Ultimately, that site will accommodate 750 rental apartments to be built before or concurrent with the residential development of Makaiwa Hills.

23. Petitioner has a target of 60 percent affordable housing and supports a condition to meet the affordable housing guidelines of the State Housing Finance and Development Corporation.

24. The proposed project has land improvement costs of approximately $275,000,000.00 onsite and $27,500,000.00 offsite.

PETITIONER'S CAPABILITY TO UNDERTAKE THE PROPOSED DEVELOPMENT

25. Petitioner's Balance Sheet and Income Statement as of November 30, 1992 lists current assets of $185,324,378.23, current liabilities of $35,513,480.70, total assets of $466,736,620.46, total liabilities of $206,243,885.14, and principal of $260,492,735.32.

26. The Estate, in its current form, will terminate on January 20, 2007. The Estate is currently looking into various concepts to succeed the existing form. The successor to the Estate will continue to develop the project and will fulfill any outstanding commitments, including financial commitments, associated with the Project.

STATE AND COUNTY PLANS AND PROGRAMS

27. The Property is located within the State Land Use Agricultural District as reflected on Land Use District Boundary Map, O-6 (Ewa).

28. The City and County of Honolulu General Plan, as amended, encourages the development of a secondary urban center

at Kapolei and the Ewa and Central Oahu urban-fringe areas, to meet housing needs not readily provided in the primary urban center. The Property is in the Ewa urban-fringe area.

29. The Property is zoned by the City and County as AG-1 (Restricted Agriculture) and AG-2 (General Agriculture).

30. The Property is not located within the Special Management Area established by the City and County.

31. The City and County recommends denial of the petition based on the timing of the project in relation to the development of the secondary urban center and based on the general plan population guidelines.

32. The OSP's Oahu report on the State Land Use District Boundary Review supports the concept of developing the second city in Ewa. The developable portions of the subject Project (which excludes the gulches and lands with steep slopes) are recommended for urban reclassification in the Oahu report.

NEED FOR THE PROPOSED DEVELOPMENT

33. Petitioner's market analyst, The Hallstrom Appraisal Group, Inc. ("Hallstrom"), prepared a market analysis for the proposed Project. Hallstrom's study considered whether there is sufficient market demand to absorb the residential and commercial uses planned for Makaiwa Hills and whether the proposed development is an appropriate use of the Property from a market perspective. Hallstrom's research and inquiry program incorporated data derived through market investigation,

discussions with and material provided by governmental agencies, and other available public and private sources.

34. Significant projections for the Ewa/Kapolei subregion and the important elements of Makaiwa Hills are as follows:

a. Over the past two decades, the Ewa district has experienced an expansion that is twice the statewide average, with the residential population nearly doubling since 1970. By 2010, the population of the Ewa/Kapolei subregion is forecast to be as high as 150,000 people.

b. The effective de facto population of the project upon build-out would be about 11,315 persons.

c. A healthy and stable housing market in this Ewa/Kapolei subregion will require the construction of about 34,000 to 50,000 additional housing units by the year 2010, or an average of 1,700 to 2,600 new units per year.

d. Even if all of the presently proposed units for the Ewa/Kapolei subregion are developed, including the 3,700 residential/resort units at Ko Olina, the added housing inventory would be approximately 34,000 units. This may be sufficient to meet minimum demand levels, but inadequate to service probable moderate to maximum market demand requirements.

e. Makaiwa Hills will also provide moderate to upper-end priced housing units which are presently under-represented in the currently proposed housing inventory for the

Ewa/Kapolei region that is bolstered by large numbers of government-developed affordable housing units.

f. The availability of quality moderate to upper-end homes, commensurate with the evident market demand, will assist in achieving the long-term goal of alleviating the transportation problems of those workers who continue to move to the Ewa region because the region will now offer attractive housing alternatives for their employers and added incentive to move businesses to this region.

g. The 78-acre commercial site, currently planned as a regional mall, is located fronting H-1 freeway and a major interchange leading into both Makaiwa Hills and the City of Kapolei. The 78-acre commercial site will also service the growing consumer needs of nearby Campbell Business and Industrial Park, Ko Olina Resort and other Waianae Coast communities.

35. Petitioner also recognizes the major regional goal in Ewa is to provide affordable homes for workers in nearby employment centers, thereby lessening commuter burden on urban Honolulu transportation systems. To address this goal, Petitioner has agreed to work with the State Housing Finance and Development Corporation and the City & County to reach a mutual agreement on the number, location and distribution of affordable housing opportunities for low, low-moderate, and gap group income residents.

IMPACTS UPON RESOURCES OF THE AREA

Flora and Fauna

36. Petitioner's botanical consultant, Char & Associates, conducted a field study of the Property in the fall of 1990. The vegetation on the Property consists primarily of grassland with scattered trees and shrubs on the hillsides, thickets of kiawe trees in the gulch areas, and buffel grass and koa-haole on the level areas bordering Farrington Highway.

37. Of the 103 vascular plant species found during the survey, 91 (or 88.3%) are introduced or alien species and 12 (or 11.7%) are native to Hawaii. Of the 12 native species of plants found, 3 are endemic meaning they only occur in the Hawaiian Islands. These three endemic species are the kumu-niu fern, nehe, and pua-kala. However, these species are found on the steep, rocky gulch slopes where no development is planned because of the rugged terrain.

38. While native species were present, none of the plants were found to be officially listed, proposed, or candidate endangered or threatened species. The Project should not have a significant negative impact on the botanical resources.

39. Petitioner's botanical consultant expressed concern about soil erosion and recommended that landscaping of disturbed areas be undertaken as soon as possible.

40. In the summer of 1990, Petitioner's biological consultant, Professor Phillip L. Bruner of BYU Hawaii,

conducted a field survey of the bird and mammal species occurring on the Property. The survey found that the variety of habitats on the Property is relatively limited.

41. No native or otherwise rare or endangered species of birds were recorded during the survey. The only likely endemic species which might occasionally forage in the area is the short-eared owl or pueo. The pueo is listed by the Department of Land and Natural Resources, Division of Forestry and Wildlife, as endangered on Oahu. Sixteen species of introduced birds were observed during the study, the most abundant being the zebra dove and the red-vented bulbul.

42. There does not appear to be any unusual mammal activity in the Project Area. The only feral mammals observed in the Project Area were cats and mongoose.

43. There appears to be no significant negative impact on the fauna caused by the Project and no mitigative measures were recommended.

Archaeological and Historical Resources

44. Petitioner's archaeological consultant, Cultural Surveys Hawaii, conducted a survey and site inventory of the archaeological resources located at the Property. The survey, conducted over a period of 25 days in the fall of 1990 and updated in April of 1991, recorded 34 archaeological and/or historical sites, including habitation structures, rock shelters, petroglyphs, ahu(s), and agricultural features relating to sugarcane cultivation and cattle ranching.

45. Eighteen of the recorded sites are considered likely to yield important historical and prehistorical information. Of these eighteen, four sites are considered excellent examples of site types and are being given strong consideration for preservation.

46. With respect to all of the sites recorded, Petitioner has indicated that data recovery and preservation plans will be prepared and submitted to the Department of Land and Natural Resources ("DLNR") for review and approval. Petitioner represents that adjustments to the development project will be made to accommodate the plans approved by the DLNR and appropriate monitoring and evaluation procedures will be utilized to address any unknown archaeological features discovered during development.

Scenic and Visual Resources

47. Petitioner enlisted the assistance of a landscape architect, Michael S. Chu, to prepare a visual assessment of the Property and the Project.

48. Existing views from within the Property include panoramic, unobstructed vistas of Barbers Point Harbor, the Ko Olina Resort and shoreline, and the expansive landscape of the Ewa Plain. However, these onsite views are not currently available to the public. Currently, the public is most familiar with mauka views of this area from Farrington Highway, which are less significant because the line of sight from the highway is relatively shallow.

49. Construction of the Project will change the open, undeveloped character of the Property to a suburban environment. Petitioner represents that these changes are not inconsistent with changes in the visual character of the Ewa District over the past few years.

50. Greater portions of the Property will become usable and visible for public enjoyment through the development of the onsite roadway system and possible passive recreational developments in the Preservation areas, such as hiking trails and other outdoor uses. Even after development, panoramic views of the Ewa Plain and the coastline from within the Property are expected to continue to be dramatic, and in some instances enhanced by planning and design measures including setbacks, appropriate site layout and building design, landscaping features, and planned open space and recreational areas.

Air Quality

51. Petitioner's air quality analyst, J. W. Morrow, prepared an impact report for the Project. The report concludes that there will be short-term air quality impacts associated with site preparation and construction. The greatest long-term air quality impact in the region will be generated by increased motor vehicle traffic as a result of not only the Project, but the rest of Ewa-area development.

52. Dust levels associated with construction activities may be mitigated by frequent watering of exposed

soil areas and the soonest possible landscaping and roadway paving. In addition, the use of dust screens may be employed when construction activities occur in close proximity to already developed areas.

53. There will be short-term air quality impacts associated with asphalt and concrete batch plants, which provide the material for roads and building foundations. However, these plants will have Department of Health permits and will be in compliance with air pollution control rules.

54. Even without the Project, there will continue to be an increase in carbon monoxide levels along the Farrington Highway/H-1 Freeway corridor. However, even in the worst case meteorological conditions that may occur during peak traffic hours, the state and federal air quality standards will generally continue to be met. Further, mitigation measures to be encouraged by the Petitioner would include development and use of a public transit system, increased bus service to the area, carpooling, and development of in-home or near-home employment opportunities.

55. Other existing sources of air pollution which may affect air quality in the Ewa region include the Campbell Industrial Park, Kahe Power Station and Waimanalo Gulch Landfill. However, under prevailing wind conditions Makaiwa Hills is upwind from these sources. Only during less frequent southerly (kona) winds might emissions affect Makaiwa Hills

residents. Petitioner indicates that future buyers at Makaiwa Hills will be advised of this possibility.

Noise Impacts

56. Petitioner's environmental noise study was conducted by Darby & Associates under the direction of acoustical engineer, David L. Adams. The study determined that apart from locations near Farrington Highway, most of the project site is currently exposed to relatively low noise levels. Wind is usually the dominant noise source, although aircraft and distant traffic are at times audible.

57. With respect to aircraft, all but a small area near the mauka/Diamond Head corner of the site is exposed to noise levels associated with the Honolulu International Airport and the Naval Air Station at Barbers Point ("NASBP"). Noise levels as high as 77 DBA were recorded at a portion of this site. The State Department of Transportation stipulates an aircraft exposure limit of 60 Ldn for residential buildings. The closing of the NASBP may have a mitigating effect on aircraft noise, but the future use of the NASBP is presently uncertain.

58. The State Department of Transportation comments that there is potential for aircraft overflights.

59. Some of the residential areas of the Project near Farrington Highway will be exposed to traffic noise levels in excess of Department of Housing & Urban Development limits. Effective noise mitigation measures in this area may include,

among other things: walls or landscaped earth berms next to the highway; limiting the use of jalousie windows to non-critical areas, such as bathrooms and laundries; sound absorbing materials and treatments in bedrooms; and orienting homes so that bedroom windows do not face the highway or, if this is not possible, providing air-conditioning so that bedroom windows may be closed.

60. Noise from the planned commercial area of the Project, Hawaiian Electric's Kahe Power Station, and the Waimanalo Gulch Sanitary Landfill should not have a significant impact on the Project because of shielding provided by the intervening landscape and the prevailing wind direction blowing mauka to makai away from the project site. In addition, use of the same measures employed in the areas near Farrington Highway may be used where necessary to acceptably mitigate noise levels.

Agricultural Resources

61. Petitioner's economic and financial consultant, Dr. Bruce Plasch of Decision Analysts Hawaii, Inc., prepared an analysis of the agricultural impacts of the Project, which concluded that the majority of the Property is poorly suited for agricultural uses.

62. Approximately 100 acres of land within the Project Area is rated as "prime" agricultural land according to the Agricultural Lands of Importance in the State of Hawaii ("ALISH") system. These 100 acres consist primarily of flatland along the H-1 Freeway in the southeast portion of the

Project Area. The land was formerly used for sugarcane production and, more recently, was used as a pasture for grazing cattle and horses.

63. Aside from these 100 acres, the balance of the Project Area is poorly suited for growing crops because the soils are rocky, the slopes are steep, and low-cost water is not available. It is currently used as part of a 3,800 acre ranch for grazing cattle.

64. It appears that only about a dozen agriculturally-related jobs will be affected by the Project development. Of these agricultural jobs, the sole operator of one livestock grazing operation holds another full-time job and the nine part-time jobs associated with Rocker G. Livestock Company's operation on the Property are not expected to be eliminated by that company.

65. The release of the Property from agricultural uses will not significantly affect Hawaii's diversified agriculture or cattle industries because ample agricultural lands continue to be freed from plantation agriculture and there is a sufficient supply of available grazing land in the State.

66. Since the Project will not affect any sugar or pineapple operations, it will not conflict with State and County plans which call for the preservation of the economic viability of plantation agriculture. The Project is also consistent with the State Department of Agriculture's position

in support of developing homes in the foothills of the Waianae Mountains rather than on the fertile plains below.

Water Resources

67. Petitioner estimates that the average daily potable water demand for the Project will be about 2.15 million gallons per day (MGD). The average daily nonpotable demand for irrigation is estimated at 0.25 MGD.

68. Petitioner has represented that it is participating in the following efforts to satisfy the increased regional demand for potable water for Makaiwa Hills and other Ewa/Kapolei developments:

a. Development of a well field in upper Honouliuli, which currently has six wells that can supply approximately 6.7 MGD of potable water;

b. A pilot project desalinization plant which can be expanded to provide as much as 10 MGD of desalinated potable water;

c. Securing from Hawaiian Electric Company a potable water allocation from the Waiau shaft; and

d. Reducing the potable water requirements for the Project by planning a dual water system using potable and nonpotable water (nonpotable water being used to irrigate the planned commercial area, school and park).

e. Studying wastewater reuse, whereby the sewage effluent from Honouliuli Wastewater Treatment Plant might be utilized through a treatment process for irrigation purposes.

69. Petitioner, also a member of the Ewa Plain Water Development Corporation, has represented that the revised draft of the Ewa Water Master Plan will include the Project.

ADEQUACY OF PUBLIC SERVICES AND FACILITIES

70. To assist in its analysis of drainage, water distribution, wastewater management, solid waste removal, and power and communications, Petitioner used the firm of Engineering Concepts, Inc. ("ECI").

Drainage

71. There are no existing drainage improvements on the Property. Fifteen drainage culverts along Farrington Highway convey runoff under the highway to down stream drainage systems.

72. Development of Makaiwa Hills is expected to increase the rate of peak runoff and runoff volume by about 17 percent. Peak runoff and runoff volume for the 10-year storm are estimated to be 4,330 cfs and 275 acre-ft., respectively. For the 50-year storm these figures increase to 5,243 cfs and 337 acre-ft., respectively.

73. Plans for drainage systems at neighboring Honokai Hale, Ko Olina, and Kapolei Business and Industrial Park have considered the future development of Makaiwa Hills and, therefore, drainage impacts of Makaiwa Hills on these downstream developments is not expected to be adverse. Analysis of these downstream drainage systems shows that these systems will accommodate peak storm runoff from Makaiwa Hills.

74. Petitioner represented that a master plan for drainage improvements for Makaiwa Hills will be prepared and submitted to the City and County Department of Public Works.

Water Service

75. The Board of Water Supply ("BWS") distribution system does not currently extend onto the petition area.

76. The Project will require onsite potable water storage and transmission improvements. Because of site topography, two separate potable water distribution systems are planned by the Petitioner.

77. The proposed eastern distribution system, which will service 80 percent of the project's demand, will require eleven reservoirs and ten booster pumping stations. The western distribution system will service one developed ridgeline and will require four reservoirs and four booster pumping stations.

78. Petitioner represented that the proposed water system will be designed in accordance with BWS standards and will be dedicated to the BWS for operation and maintenance.

79. Petitioner further represented that, in an effort to reduce the potable water requirements for the Project, a dual water system using potable and nonpotable water is planned. Nonpotable water would be used to irrigate the planned commercial area, school and park.

80. The BWS states that water demands for the Project should be met with new sources and water facilities provided

and installed by the Petitioner, through the Ewa Plains Water Development Corporation.

Wastewater Management

81. Petitioner's engineering consultant ECI, estimates that wastewater generated by the Project is expected to be of typical domestic composition with a total average flow rate of about 1.55 MGD.

82. The Project will require development of an onsite collection system, including gravity sewers, force mains and sewage pumping stations, which Petitioner represented will be designed in accordance with City and County Sewer Standards. In addition, construction of a 21-inch offsite sewer will be required to convey wastewater to the existing Ko Olina interceptor.

83. The existing Ko Olina and Makakilo interceptors do not have the capacity for future wastewater flows from Makaiwa and other planned developments. To address this problem, proposed improvements include relief sewers for the Ko Olina and Makakilo interceptors.

84. Petitioner recommended that the wastewater collection system for the Project be connected to the municipal sewer system for conveyance to the Honouliuli Wastewater Treatment Plant. Capacity expansion of the Honouliuli treatment plant will be required to accommodate increased flows from area development. According to Petitioner, planned

capacity expansion of the plant is expected to precede the Makaiwa Hills development.

85. Implementation of the proposed improvements and sewer connection is subject to approval of the City and County Division of Wastewater Management ("DWM"). A regional wastewater plan for Campbell Estate lands in the Kapolei and Makaiwa areas has been reviewed and approved by DWM, subject to approval of individual applications for sewer connections for each project in the study area.

86. Petitioner plans to submit a sewer master plan and connection application for the Project to DWM.

Solid Waste Disposal

87. Once the Project is complete, Petitioner estimates that solid waste generation from Makaiwa Hills is expected to be about 33 tons/day.

88. Petitioner expects that residential refuse will be collected by the City and County, and private collection companies will service the commercial area of the Project.

89. Landfill capacity on the leeward side of Oahu is not a problem at present since most combustible refuse is deposited at the City and County's H-POWER waste energy recovery facility. Refuse from the Project is expected to be typical for a municipal source and should not have a significant impact on leeward Oahu solid waste disposal facilities.

90. The State of Hawaii has established mandated waste diversion and recycling rates of twenty-five percent by the year 2000. The City and County's waste diversion and recycling goals are more stringent than the State's. The State Department of Health recommends that the Petitioner commit to implementing the goals for waste reduction before the land use district boundary amendment is granted.

Power and Communications

91. Petitioner anticipates that Hawaiian Electric Company and Hawaiian Telephone Company will provide power and phone service to the Project.

92. The diversified power demand for the entire Project is estimated to be 16.8 MVA. Power supply is planned to come from existing substations at Kahe Point, Makakilo, and the future Kapolei B Substation.

93. Petitioner also anticipates possible implementation of energy efficient building designs in an effort to minimize energy consumption.

Roadway and Highway Services and Facilities

94. The main highways presently serving the Ewa region are the H-1 Freeway and Farrington Highway. Kalaeloa Boulevard provides access to Barbers Point Harbor and Campbell Industrial Park.

95. Petitioner's traffic engineers, Pacific Planning & Engineering, Inc. ("PP&E"), conducted a study to identify and assess future local and regional traffic impacts generated by

the Project. PP&E's written report contains a detailed analysis of existing and projected future traffic volumes, trip generation for Makaiwa Hills and other projects in the area, and a level-of-service analysis of travel speeds, density and flow rates for affected highway segments and access ramps.

96. The Project along with other developments in the Ewa region, including Ko Olina, The City of Kapolei, Barber's Point Harbor and Kapolei Business-Industrial Park, will significantly impact traffic conditions on Farrington Highway and the H-1 Freeway. The Project exacerbates the traffic conditions along Farrington Highway and the H-1 Freeway.

97. Major improvements to the existing highway system would be required to accommodate the traffic generated by the Project and others. Regional traffic impacts will likely require the following improvements in the vicinity of Makaiwa Hills:

a. Construction of the Kapolei Parkway;
b. Construction of additional ramps to the Palailai Interchange;
c. Relocation or deletion of the connection of Farrington Highway to Kalaeloa Boulevard;
d. Increasing the capacity of Farrington Highway and the H-1 Freeway by widening those roads in certain locations; and
e. The promotion of alternative modes of transportation, such as a mass transit system, increased bus service to the area and carpooling programs.

The following improvements will likely be necessary to mitigate local traffic impacts from the Project:

f. Widening Farrington Highway from four lanes to six in the Project Area;

g. Construction of the Kapolei Parkway from the North-South Road to the Ko Olina Development; and
h. Construction of appropriately designed interchanges to connect Makaiwa access roads to Farrington Highway.

98. Petitioner indicates that the new interchanges will be built to State Department of Transportation design and level-of-service standards.

99. Most of these roadway improvements are included in the present draft of the Ewa Region Highway Transportation Master Plan, which was completed in January 1992 and recently updated in November 1992.

100. Petitioner, along with other area developers, provided funding for the Ewa Region Highway Transportation Master Plan. Together with the State Department of Transportation, the City and County Department of Transportation Services and other State and City and County planning agencies, Petitioner participated in development of the Master Plan.

101. The purpose of the Ewa Region Highway Transportation Master Plan is to coordinate future land use and transportation planning activities by forecasting future traffic in the region, identifying necessary improvements, and determining a fair distribution of costs for those improvements.

102. The Oahu Metropolitan Planning Organization ("OMPO") has adopted the Ewa Region Highway Transportation Master Plan as part of its long-range plan. The State Department of Transportation and the City and County Department

of Transportation Services are now initiating actions to fund the 1997 phase of the plan, including fair cost sharing agreements with the major developers.

103. Petitioner is also coordinating improvements to the existing Makakilo and Palailai Interchanges with the State Department of Transportation and the Federal Highways Administration.

104. OSP has expressed concern over bicycle, pedestrian and other alternative transportation modes, and appropriate access between the Project and The City of Kapolei.

105. With respect to access between the Project and The City of Kapolei, roadway planning includes grade-separated interchanges along Farrington Highway. Such grade-separated interchanges will not only provide access to Makaiwa Hills from the highway, but will also allow automobile, bicycle and pedestrian traffic to pass under the highway where they can link up with roadway systems and bikeways planned for The City of Kapolei.

106. With respect to bikeways, Petitioner has developed the Kapolei Regional Bike Plan with approximately 55 miles of planned bikeways serving the City of Kapolei, with extensions throughout the Ewa region.

107. Petitioner is also a founding member of the Leeward Oahu Transportation Management Association ("LOTMA"). LOTMA is an organization of area landowners and developers, whose goal is to provide leadership in addressing regional

transportation and mobility issues through the member's combined resources and unified efforts of the public and private sectors. Some of LOTMA's achievements include implementation of an express commuter bus service to the Kapolei area, and the Ride Share Hawaii and Beat the School Jam programs.

Schools

108. Petitioner's Social Impact Assessment ("SIA") of the Project was prepared by Earthplan and included an analysis of the Project's impacts on public education facilities.

109. It is estimated that the Project will generate approximately 870 elementary students, 230 intermediate students, and 345 high school students.

110. Schools in the vicinity of Makaiwa Hills are Makakilo Elementary, Ilima Intermediate and Campbell High Schools. School officials predict that these schools will be operating beyond capacity at the time the Project is completed. The State Department of Education cannot assure the availability of classrooms to accommodate the students from this development.

111. Four new public schools are planned for the Ewa region, including a second Ewa Elementary School, Kapolei Elementary School, and Kapolei Intermediate and High Schools. There is also a proposed elementary school at Makaiwa Hills, which will help mitigate that project's impacts on offsite schools.

112. The State Department of Education requests that Petitioner make a contribution to the satisfaction of the Department of Education for needed school facilities attributable to this project. For elementary school sites, DOE requires eight acres of usable land next to a four-acre public park or a site of 12 usable acres, if a park is not available.

113. Seagull Schools, Inc. has committed to build the State's largest child care center in the City of Kapolei.

Recreation Facilities

114. The parks nearest the Property are Kamokila Park, Makakilo Community Park, Mauka Lani Neighborhood Park, and Makakilo Playground.

115. Petitioner intends to meet some of the recreational needs of the Makaiwa Hills residents by providing 25 acres for park use (i.e., ballfields). Some of the steeper lands in the petition area, which have been designated for preservation, may be used for passive recreation, such as hiking.

116. The OSP and the DLNR's Division of State Parks, have stated that lands mauka of the Property and Makakilo are possible natural resource areas and are potential sites for state parks that would benefit the entire Ewa community as well as visitors and other residents.

117. Petitioner supports the idea of establishing a mountain park on the lands mauka of the petition area and is

working with the Division of State Parks and the Office of State Planning on how that can be accomplished.

118. Petitioner does not have any current plans to include golf course uses in the Project.

119. The City and County has proposed that a major recreational complex known as Ewa Central Park be established outside of the Property along Kunia Road.

Police Protection

120. Police protection for the Ewa region is currently handled by the Pearl City Police Station.

121. Development in the Ewa/Kapolei region, including the Project, will increase the need for public services such as police protection.

122. The regional planning for this increased need should include a full-service police station in the City of Kapolei, with proposed substations in Ko Olina and Ewa Beach.

Fire Protection

123. First responses to fire alarms at the Project Area are provided by the engine company at the Makakilo Fire Station and the engine and ladder companies at the Waipahu Fire Station.

124. To meet the increased demand for regional fire protection, plans include new fire stations in Campbell Industrial Park, Ko Olina, and Tenny Village. In addition, an on-site fire station is planned for Makaiwa Hills to mitigate local impacts of the Project.

Emergency Medical Services and Health Care Facilities

125. The existing or additional planned medical and child care facilities for the region will service the Project.

126. Currently, residents in the Ewa region receive medical services from St. Francis-West Hospital, Moanalua Kaiser Medical Center, Pali Momi Medical Center and numerous medical clinics and doctor's offices in the region.

127. St. Francis-West Hospital is presently seeking approval from the State and the City and County to increase its land area and further develop the hospital according to its five-year master plan, which calls for research and wellness facilities, an office building, day care and skilled nursing facilities, and other support facilities.

128. Emergency ambulance services are provided to the area by City ambulances in Aiea, in addition to ambulance units at the Waipahu and Makakilo Fire Stations.

Civil Defense

129. The Office of the Director of Civil Defense, State Department of Defense states that the Project Area may be exposed to high winds due to its topography and location on the slopes of the Waianae Mountains. Structures built in the Project Area should be designed and constructed to withstand the force of winds resulting from orographic amplification.

130. The Office of the the Director of Civil Defense recommends that new siren alerting devices be purchased and

installed by the Petitioner in the Project Area in accordance with Civil Defense instructions.

SOCIAL AND ECONOMIC IMPACTS

131. Development of the Project will meet some of the residential and commercial needs of the growing Ewa population, which currently are not being addressed by other projects.

132. The Project contributes to a diversified residential inventory that not only provides affordable units, but is also attractive to a target market sect or that would otherwise be lost in the Ewa/Kapolei region. This balanced residential inventory will assist in making the Ewa region desirable as a location for business ventures.

133. The commercial aspect of the Project will be supported by the growing consumer demands of the region and will create many job opportunities for area residents.

134. It is estimated that direct employment generated by the Project will be about 3,120 jobs, including 2,980 jobs associated with the 78-acre commercial area and another 140 jobs maintaining and refurbishing homes within the Project. Other jobs will be indirectly supported by the Project including approximately 1,700 jobs provided by companies that supply goods and services to the commercial activities, approximately 2,200 jobs supported by consumption expenditures by the Project's residents, and over 600 government jobs supported by State and City and County tax revenues generated by the Project.

135. It is estimated that on the State level, construction activity of the Project will generate about $94 million (1992 Dollars) in State tax revenues, including revenues from excise, corporate income and conveyance taxes. Estimates of State and City and County revenues and expenses are hereinafter expressed in terms of 1992 dollars.

136. Estimated "rollback" taxes of $3.1 million will be due the City and County when the Project Area is withdrawn from agricultural zoning and developed.

137. It is estimated that at full development, State tax revenues from the Project should approximate $67 million per year, primarily from excise and income taxes. The State's primary capital expenditure will be in the area of school improvements at an estimated cost of $20.7 million, with an annual debt service of $1.8 million. In addition, the State will incur annual expenditures of about $20.8 million for general government, health, education, highways and other services. The difference between annual revenues and expenses results in an annual positive net of approximately $44.4 million.

138. It is estimated that the City and County tax revenues from the Project at full development are expected to reach $12.9 million annually, primarily from property taxes and secondarily from other taxes and fees associated with sewers, water, and transportation. Capital improvement costs to the

County of about $5.9 million, with an annual debt service of about $600,000, will be directed toward the City and County's proportional share of a district park, and police and fire stations. City and County expenditures on the services needed to support Makaiwa Hills are projected to be in the range of $8.2 million annually. Annual revenues are thus expected to exceed expenditures, including debt service, by an estimated $4.1 million.

CONFORMANCE WITH URBAN DISTRICT STANDARDS

139. The Property is appropriate for Urban District classification pursuant to §15-15-18 of the Commission Rules for the following reasons:

a. The Project will be characterized by "city-like" concentrations of people, structures, streets, urban level of services and other related land uses.

b. The Property is located in close proximity to such trading and employment centers of Campbell Industrial Park, Barbers Point Harbor, Ko Olina Resort, Kapolei Commercial-Industrial Park, the City of Kapolei and the NASBP. In addition, the approximately 78 acre commercial area planned for Makaiwa Hills will service the new community and create an estimated 2,980 jobs.

c. Petitioner has demonstrated the economic feasibility of the Project and Petitioner's financial capability to carry out the Project.

d. The Property has satisfactory topography and drainage and is suitable for the planned residential, commercial and recreational uses.

e. The Property adjoins or is in the vicinity of areas already classified as Urban, including Makakilo, Ko Olina and the new City of Kapolei.

f. The Property is appropriate for new urban concentrations, consistent with the Hawaii State Plan, the City and County of Honolulu General Plan and the Development Plan for Ewa.

g. Because the Property is in close proximity to urban lands in an area that has been designated for urban expansion, the reclassification will not contribute toward scattered spot urban development. Furthermore, the Project will not require an unreasonable investment in public infrastructure or support services.

h. Slopes as low as 2 percent exist at the southeastern corner of the Project Area. Across the plateaus and ridges, slopes of about 10 percent are common. Slopes are steeper within the gulches on the Project Area, varying from 15 to 50 percent. However, the Project Area is suitable for urban purposes, as discussed above. Further, extensive preservation areas are planned so as to maintain, if not enhance, the value and accessibility of the open space amenities and scenic views at the Project Area.

CONFORMANCE WITH THE HAWAII STATE PLAN

140. The proposed reclassification of the Property addresses the following goals, objectives, policies and priority guidelines of the Hawaii State Plan, HRS Chapter 226:

State Goals

a. A strong, viable economy, characterized by stability, diversity, and growth, that enables the fulfillment of the needs and expectations of Hawaii's present and future generations. (Haw. Rev. Stat. §226-4(1))

b. A desired physical environment, characterized by beauty, cleanliness, quiet, stable natural systems, and uniqueness, that enhances the mental and physical well-being of the people. (Haw. Rev. Stat. §226-4(2))

c. Physical, social, and economic well-being, for individuals and families in Hawaii, that nourishes a sense of community responsibility, of caring, and of participation in community life. (Haw. Rev. Stat. §226-4(3))

The development of Makaiwa Hills is envisioned to be a physical environment characterized by beauty, cleanliness, quiet, stable natural systems and uniqueness. The Makaiwa Hills community, with its full complement of residential and employment opportunities, and commercial and public facilities will help achieve a strong, viable economy characterized by stability, diversity and growth.

Objectives and Policies for Population

141. The proposed reclassification of the Property addresses the following population growth and land resources priority guidelines:

a. Manage population growth statewide in a manner that provides increased opportunities for Hawaii's people to pursue their physical, social, and economic aspirations while recognizing the unique needs of each county. (Haw. Rev. Stat. §226-5(b)(1))

b. Promote increased opportunities for Hawaii's people to pursue their socio-economic aspirations throughout the islands. (Haw. Rev. Stat. §226-4(b)(3))

c. Ensure that adequate support services and facilities are provided to accommodate the desired distribution of future growth throughout the State. (Haw. Rev. Stat. §226-104(a)(3))

d. Encourage urban growth primarily to existing urban areas where adequate public facilities are already available or can be provided with reasonable public expenditures, and away from areas where other important benefits are present,

such as protection of important agricultural land or preservation of lifestyles. (Haw. Rev. Stat. §226-104(b)(1))

e. Make available marginal or nonessential agricultural lands for appropriate urban uses while maintaining agricultural lands of importance in the agricultural district. (Haw. Rev. Stat. §226-104(b)(2))

The Property is located in the Ewa Development Plan Area where State and City and County policies encourage population growth. To help support this projected population growth, the Project will provide a wide variety of job and housing opportunities, including affordable housing units for sale and rent.

142. Existing and planned additional support services can be reasonably provided to the Project. Petitioner is also a member of the Ewa Plain Water Development Corporation. Water system requirements for the Project have been considered in regional water system planning and the Ewa Water Master Plan is being updated accordingly.

143. The Project is also consistent with the State Department of Agriculture's position advocating the development of homes in the foothills of the Waianae Mountains rather than on the fertile agricultural plains below. The soil on the project site is, for the most part, of poor agricultural quality.

Objectives and Policies for the Economy - In General

144. The proposed reclassification of the Property addresses the following objectives and policies for the economy:

a. Increased and diversified employment opportunities to achieve full employment, increased income and job choice, and improved living standards for Hawaii's people. (Haw. Rev. Stat. §226-6(a)(1))

b. A steadily growing and diversified economic base that is not overly dependent on a few industries. (Haw. Rev. Stat. §226-6(a)(2))

c. Seek broader outlets for new or expanded Hawaii business investments. (Haw. Rev. Stat. §226-6(b)(3))

d. Expand existing markets and penetrate new markets for Hawaii's products and services. (Haw. Rev. Stat. §226-6(b)(4))

e. Strive to achieve a level of construction activity responsive to, and consistent with, state growth objectives. (Haw. Rev. Stat. §226-6(b)(6))

f. Stimulate the development and expansion of economic activities which will benefit areas with substantial or expected employment problems. (Haw. Rev. Stat. §226-6(b)(10))

The number of construction jobs required to build the Project is estimated to average about 640 jobs, with an average of over 1,000 construction- related jobs. At full operation, direct employment generated by the Project is projected to be about 2,980 jobs associated with the planned commercial activities, with another 140 jobs to maintain homes. In addition, thousands of consumer-related and government jobs will be indirectly supported by the Project. Further, the balanced residential inventory at the Project will assist in making the Ewa region desirable as a location for business ventures, as there will be attractive housing alternatives for employers in the region.

Objectives and Policies for the Physical Environment

145. The proposed reclassification of the Property addresses the following objectives and policies for the physical environment:

a. Take into account the physical attributes of areas when planning and designing activities and facilities. (Haw. Rev. Stat. §226-11(b)(3))

b. Pursue compatible relationships among activities, facilities and natural resources. (Haw. Rev. Stat. §226-11(b)(8))

c. Promote the preservation and restoration of significant natural and historic resources. (Haw. Rev. Stat. §226-12(b)(1))

d. Promote the preservation of views and vistas to enhance the visual and aesthetic enjoyment of mountains, ocean, scenic landscape, and other natural features. (Haw. Rev. Stat. §226-12(b)(3))

e. Encourage the design of developments and activities that complement the natural beauty of the islands. (Haw. Rev. Stat. §226-12(b)(5))

The proposed development plan for the Project takes into account the hundreds of acres of natural gullies and ravines which transect the Property. These areas will be maintained in a preservation category, which will serve to enhance the visual open space amenity of the community and, in some instances, provide for passive recreational activities. The Project will also make available the panoramic vistas from within the Project Area, which are not currently open to the public. Petitioner also has plans to study and preserve the significant historical and archaeological sites in the project area.

<u>Objectives and Polices for Socio-Cultural Advancement--Housing</u>

146. The proposed reclassification of the Property addresses the following objectives and policies for the socio-cultural advancement of housing:

a. The orderly development of residential areas sensitive to community needs and other land uses. (Haw. Rev. Stat. §226-19(a)(2))

b. Increase home ownership and rental opportunities and choices in terms of quality, location, cost,

densities, style, and size of housing. (Haw. Rev. Stat. §226-19(b)(3))

c. Promote design and location of housing developments taking into account the physical setting, accessibility to public facilities and services, and other concerns of existing communities and surrounding areas. (Haw. Rev. Stat. §226-19(b)(5))

The Project will provide Hawaii's residents with a full service community offering a wide variety of quality homes in a manner that is sensitive to community needs and other land uses in the region. The planned mix of housing types also includes affordable homes and multi-family units for sale and rent, both on and offsite, that will be targeted at people making between 50 and 140 percent of the median income. Petitioner's plan also accounts for preservation and incorporation of the site's important natural features and resources.

<u>Objectives and Polices for Socio-Cultural Advancement--Education</u>

147. The proposed reclassification of the Property addresses the following objectives and policies for the socio-cultural advancement of education:

a. Ensure the provision of adequate educational and accessible educational services and facilities that are designed to meet individual and community needs. (Haw. Rev. Stat. §226-21(b)(2))

b. Assist individuals, especially those experiencing critical employment problems or barriers, or undergoing employment transitions, by providing appropriate employment training programs and other related educational opportunities. (Haw. Rev. Stat. §226-21(b)(6))

The proposed elementary school at Makaiwa Hills, together with the four new elementary, intermediate and high schools planned for the Ewa region, are being planned to ensure the provision of adequate and accessible educational services and facilities to meet the growing needs of the region.

148. Petitioner is a member and is assisting in the funding of the West Oahu Employment Corporation ("WOEC"). WOEC, in cooperation with other organizations, is helping to educate and improve the qualifications of area residents for a variety of employment opportunities from entry-level to management positions.

Objectives and Policies for Facility Systems--Transportation

149. The proposed reclassification of the Property addresses the following objectives and policies for facility systems related to transportation:

a. Design, program, and develop a multi-modal system in conformance with desired growth and physical development as stated in this chapter. (Haw. Rev. Stat. §226-17(b)(1))

b. Encourage a reasonable distribution of financial responsibilities for transportation among participating governmental and private parties. (Haw. Rev. Stat. §226-17(b)(3))

c. Coordinate intergovernmental land use and transportation planning activities to ensure the timely delivery of supporting transportation infrastructure in order to accommodate planned growth objectives. (b)(12) was recently added to this section by Act 149, Session Laws of Hawaii (1993). (Haw. Rev. Stat. §226-17(b)(12))

Petitioner, along with other area developers, provided funding for the Ewa Region Highway Transportation Master Plan and together with the State Department of Transportation, the City and County Department of Transportation Services and other State and City and County planning agencies, participated in its preparation. The purpose of the transportation master plan is to forecast future traffic in the region as it relates to planned land uses, identify necessary improvements, and determine a fair distribution of costs for those improvements. The updated plan has been adopted by the Oahu Metropolitan Planning Organization ("OMPO"), and State and City and County transportation agencies are now initiating actions to fund the 1997 phase of the Master Plan, including fair cost sharing agreements with the major developers.

150. Petitioner has developed the Kapolei Regional Bike Plan which will not only serve The City of Kapolei, but is planned to have far-reaching extensions throughout the Ewa region. Presently, there are approximately 55 miles of planned bikeways. Grade-separated interchanges along Farrington Highway at the Project Area will not only provide access to Makaiwa Hills from the highway, but will also allow automobile, bicycle and pedestrian traffic to pass under the highway and connect with roadway systems and bikeways planned for The City of Kapolei.

151. Petitioner is a founding member of the Leeward Oahu Transportation Management Association ("LOTMA"). LOTMA is an organization of area landowners and developers, whose goal is to provide leadership in addressing regional transportation and mobility issues through the member's combined resources and unified efforts of the public and private sectors. LOTMA efforts has resulted in an increase in transit services to the Kapolei area. LOTMA has also established a subscription bus service in the area and worked with the Honolulu Public Transportation Authority to coordinate programs and new services. LOTMA has been a key participant in the Ride Share Hawaii and Beat the School Jam programs.

CONFORMANCE WITH COASTAL ZONE POLICIES OBJECTIVES

152. The proposed reclassification of the Property for the proposed development generally conforms to the policies

and objectives of the Coastal Zone Management Program, chapter 205A, HRS.

RULING ON PROPOSED FINDINGS OF FACT

Any of the proposed findings of fact submitted by the Petitioner or the other parties not already ruled upon by the Commission by adoption herein, or rejected by clearly contrary findings of fact herein, are hereby denied and rejected.

Any conclusion of law herein improperly designated as a findings of fact should be deemed or construed as a conclusion of law.

CONCLUSIONS OF LAW

Any findings of fact herein improperly designated as a conclusion of law should be deemed or construed as a finding of fact.

Upon consideration of section 205-17, HRS and pursuant to chapter 205 HRS, and chapter 15-15, HAR, the Commission finds upon a preponderance of evidence that the reclassification of the Property, consisting of approximately 1,781.122 acres situated in Honouliuli, Ewa, Island of Oahu, and identified as Oahu Tax Map Key Numbers 9-1-15: Por. 5 and 17 and 9-2-03: Por. 2 and Por. 5, from the Agricultural District to the Urban District for the development of the Makaiwa Hills project, is reasonable, nonviolative of section 205-2, HRS, and is consistent with the Hawaii State Plan as set forth in chapter 226, HRS, the Coastal Zone Management Program as set forth in chapter 205-A, HRS, and conforms to chapter 15-15, HAR.

ORDER

IT IS HEREBY ORDERED that the Property, which is the subject of this Docket No. A92-687 filed by the Trustees Under The Will And Of The Estate of James Campbell, Deceased, consisting of approximately 1,781.122 acres situated in Honouliuli, Ewa, Island of Oahu, and identified as Oahu Tax Map Key Numbers 9-1-15: Por. 5 and 17 and 9-2-03: Por. 2 and Por. 5, as approximately shown on Exhibit "A" attached hereto and incorporated by reference herein, shall be and is hereby reclassified from the State Land Use Agricultural District to the State Land Use Urban District, and the State Land Use District Boundaries are hereby amended accordingly subject to the following conditions:

1. Petitioner shall provide affordable housing opportunities for low, low-moderate, and gap group income residents of the State of Hawaii to the satisfaction of the State Housing Finance and Development Corporation in accordance with the Affordable Housing Guidelines, adopted by the Housing Finance and Development Corporation, effective July 1, 1992, as periodically amended. The location and distribution of the affordable housing or other provisions for affordable housing shall be under such terms as may be mutually agreeable between the Petitioner and the State Housing Finance and Development Corporation. Agreement by the HFDC on the provision of affordable housing shall be obtained prior to the Petitioner applying for county zoning.

* DLNR

2. Petitioner shall provide land for outdoor recreation mauka of the Property, as determined by and to the mutual satisfaction of the Division of State Parks, Department of Land and Natural Resources. Agreement by the Division of State Parks, Department of Land and Natural Resources and Petitioner on the provision of land for outdoor recreation shall be obtained prior to the Petitioner applying for county zoning.

DOT

3. Petitioner shall participate in the funding and construction of local and regional transportation improvements and programs including dedication of right-of-way, on a pro rata basis as a result of the development of the Property, as determined by the State Department of Transportation and the City and County of Honolulu, Department of Transportation Services. Agreement by the State Department of Transportation on the level of funding and participation shall be obtained prior to the Petitioner applying for county zoning.

4. Petitioner shall monitor the traffic attributable to the proposed Project at onsite and offsite locations and shall undertake subsequent mitigative measures that may be reasonably required. These activities shall be coordinated with and approved by the State Department of Transportation.

5. Petitioner, at no cost to the State, shall appoint a permanent transportation manager whose function is the formulation, use, and continuation of alternative transportation opportunities that would optimize the use of

existing and proposed transportation systems. In the alternative, Petitioner may participate in a regional program for transportation management with other developers and/or landowners. This program shall address the transportation opportunities that would optimize the use of existing and proposed transportation systems. Either option will continue to be in effect unless otherwise directed by the State Department of Transportation. The program for either option shall be reviewed by the State Department of Transportation prior to implementation. The transportation manager or Petitioner shall conduct periodic evaluations of the program's effectiveness and shall make reports of these evaluations available to the State Department of Transportation for program review and modification, if necessary.

6. Petitioner shall participate in the funding and construction of adequate wastewater transmission and disposal facilities, necessitated by the proposed development, on a pro rata basis, as determined by the State Department of Health and the City and County of Honolulu.

7. Petitioner shall fund the design and construction of drainage improvements required as a result of the development of the Property to the satisfaction of the appropriate State and City and County of Honolulu agencies.

8. Petitioner shall fund and construct adequate civil defense measures as determined by the City and County of Honolulu and State Civil Defense agencies.

DOE

9. Petitioner shall contribute to the development, funding, and/or construction of school facilities on a pro rata basis as a result of the development on the Property, as determined by and to the satisfaction of the Department of Education (DOE). Agreement by DOE on the level of funding and participation shall be obtained prior to Petitioner applying for county zoning.

10. Petitioner shall prepare a detailed historic preservation mitigation plan which must be approved by the Historic Preservation Division, Department of Land and Natural Resources. This plan shall have two parts: an archaeological data recovery plan (scope of work) for sites determined significant for their information content and a preservation plan for sites determined significant as excellent examples of a type of site. The Historic Preservation Division shall verify in writing that the plan has been successfully implemented prior to the onset of ground altering construction activities that would jeopardize the sites.

11. Should any human burials or any historic sites such as artifacts, charcoal deposits, or stone platforms, pavings or walls be found, Petitioner shall stop work in the immediate vicinity and contact the Historic Preservation Division. The significance of these finds shall then be determined and approved by the Historic Preservation Division, and an acceptable mitigation plan shall be approved by the Historic Preservation Division (if applicable). The Historic

Preservation Division must verify in writing that the fieldwork portion of the mitigation plan has been successfully executed prior to work proceeding in the immediate vicinity of the find. Burials must be treated under specific provisions of Chapter 6E, HRS.

12. Petitioner shall prepare a fire plan approved by the Department of Land and Natural Resources, Division of Forestry and Wildlife, prior to the Petitioner applying for county zoning.

13. Petitioner shall cooperate with the State Department of Health and the City and County of Honolulu Department of Public Works to conform to the program goals and objectives of the Integrated Solid Waste Management Act, Chapter 342G, HRS, as amended, and the City and County's approved integrated solid waste management plans in accordance with a schedule and timeframe satisfactory to the Department of Health.

14. Any plans by the Petitioner to include a golf course within the Property shall be subject to review and approval by the Land Use Commission. Petitioner shall: (a) file an appropriate motion or petition, whichever is appropriate; (b) will provide the necessary evidence; and (c) will seek approval from the Commission for golf course use on the Property.

15. Petitioner shall be responsible for implementing sound attenuation measures to bring noise levels from vehicular

traffic in the Petition Area down to levels acceptable to the State Department of Health and the State Department of Transportation.

16. Petitioner shall attenuate the noise in noise sensitive areas within residential areas exposed to noise levels of 65 Ldn (day-night average sound level) by a minimum of 25 decibels (A-weighted).

17. Petitioner shall not construct residential units within areas exposed to noise levels of 65 Ldn or greater.

18. Petitioner shall grant to the State of Hawaii an avigation (right of flight) and noise easement in the form prescribed by the State Department of Transportation on any portion of the Property subject to noise levels exceeding 55 Ldn.

19. Petitioner shall notify all prospective buyers of property in the Project of the potential odor, noise, and dust pollution resulting from surrounding Agricultural District land, Hawaiian Electric Company's Kahe Power Plant, and the City and County of Honolulu's Waimanalo Gulch Sanitary Landfill.

20. Petitioner shall notify all prospective buyers of property in the Project that the Hawaii Right-to-Farm Act, Chapter 165, Hawaii Revised Statutes, limits the circumstances under which pre-existing farming activities may be deemed a nuisance.

21. Petitioner shall participate in an air quality monitoring program as specified by the State Department of Health.

22. Petitioner shall promptly provide without any prior notice, annual reports to the Land Use Commission, the Office of State Planning and the City and County of Honolulu Planning Department in connection with the status of the project and Petitioner's progress in complying with the conditions imposed.

23. Petitioner shall develop the Property in substantial compliance with representations made to the Land Use Commission in obtaining the reclassification of the Property. Failure to so develop the Property may result in reversion of the land to its former classification, or change to a more appropriate classification.

24. Petitioner shall give notice to the Land Use Commission of any intent to sell, lease, assign, place in trust or otherwise voluntarily alter the ownership interest in the Property covered by the approved petition prior to the development of the Property.

25. The Land Use Commission may fully or partially release these conditions as to all or any portion of the Property upon timely motion, and upon the provision of adequate assurance of satisfaction of these conditions by the Petitioner.

26. Within 7 days of the issuance of the Land Use Commission's Decision and Order for the subject reclassification, Petitioner shall (a) record with the Bureau of Conveyances a Statement to the effect that the Property is subject to conditions imposed by the Land Use Commission in the

reclassification of the Property, and (b) shall file a copy of such recorded statement with the Commission.

27. Petitioner shall record the conditions imposed by the Land Use Commission with the Bureau of Conveyances pursuant to Section 15-15-92, HAR.

28. Petitioner shall coordinate with the Honolulu Board of Water Supply and the Department of Land and Natural Resources to obtain the required water for the project. In the event that water is not available from existing sources due to insufficient supply, Petitioner shall fund and develop the necessary water source, storage, and transmission systems and facilities.

DOCKET NO. A92-687 - THE TRUSTEES UNDER THE WILL AND OF THE ESTATE OF JAMES CAMPBELL, DECEASED

Done at Honolulu, Hawaii, this 28th day of October 1993, per motion on October 21, 1993.

LAND USE COMMISSION
STATE OF HAWAII

By (absent)
JOANN N. MATTSON
Chairperson and Commissioner

By
KAREN S. AHN
Vice Chairperson and Commissioner

By
TRUDY K. SENDA
Vice Chairperson and Commissioner

By
ALLEN K. HOE
Commissioner

By
LLOYD F. KAWAKAMI
Commissioner

By
EUSEBIO LAPENIA, JR.
Commissioner

By (absent)
RENTON L. K. NIP
Commissioner

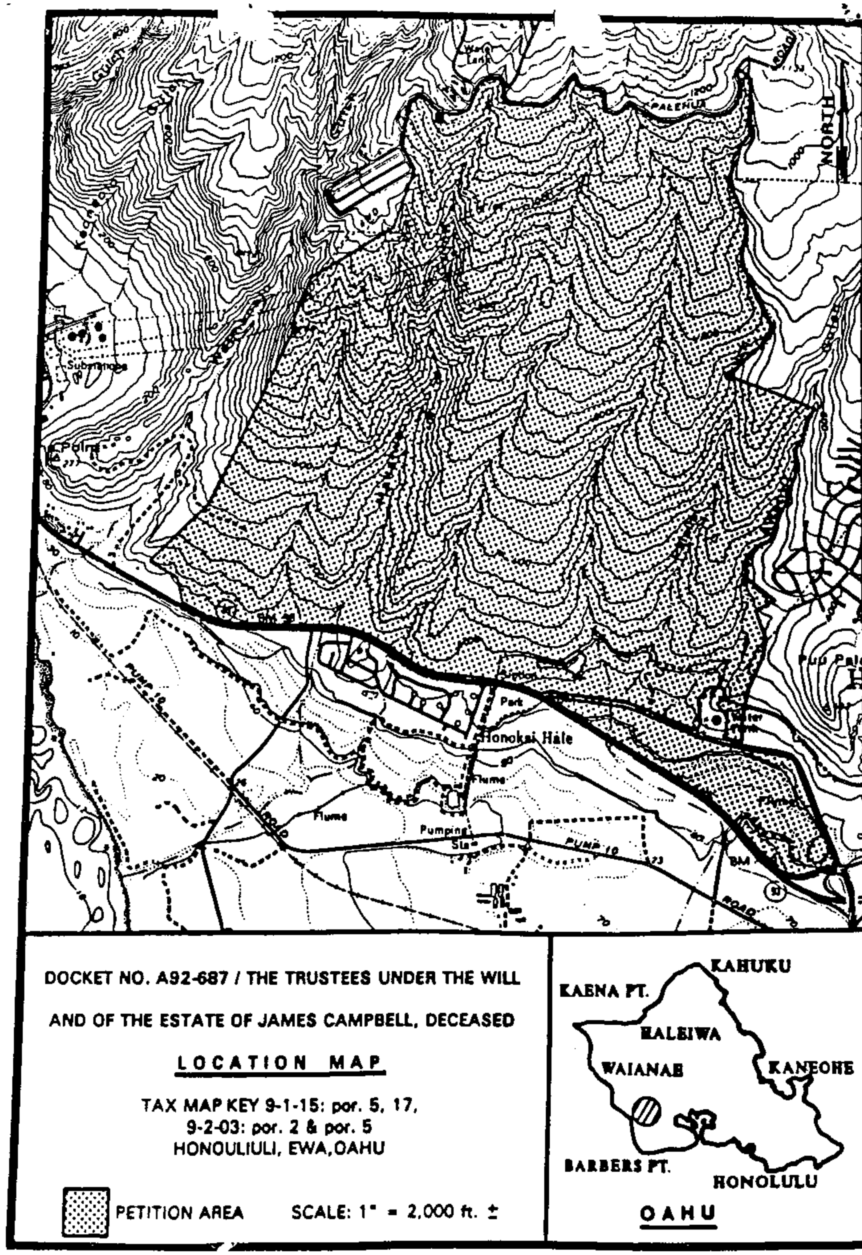
By
ELTON WADA
Commissioner

By
DELMOND J. H. WON
Commissioner

Filed and effective on
October 28, 1993

Certified by:

Executive Officer



DOCKET NO. A92-687 / THE TRUSTEES UNDER THE WILL AND OF THE ESTATE OF JAMES CAMPBELL, DECEASED

LOCATION MAP

TAX MAP KEY 9-1-15: por. 5, 17,
9-2-03: por. 2 & por. 5
HONOULIULI, EWA, OAHU

PETITION AREA SCALE: 1" = 2,000 ft. ±

EXHIBIT "A"

BEFORE THE LAND USE COMMISSION

OF THE STATE OF HAWAII

In the Matter of the Petition of THE TRUSTEES UNDER THE WILL AND OF THE ESTATE OF JAMES CAMPBELL, DECEASED To Amend the Land Use District Boundary of Approximately 1781.122 Acres Situated at Honouliuli, Ewa, Island of Oahu, State of Hawaii from Agricultural to Urban; TMK Nos.: 9-1-15: Por. 5, 17; 9-2-03: Por. 2 and Por. 5	DOCKET NO. A92-687 CERTIFICATE OF SERVICE

CERTIFICATE OF SERVICE

I hereby certify that a copy of the Findings of Fact, Conclusions of Law, and Decision and Order was served upon the following by either hand delivery or depositing the same in the U. S. Postal Service by certified mail:

HAROLD S. MASUMOTO, Director
Office of State Planning
P. O. Box 3540
Honolulu, Hawaii 96811-3540

CERT. ROBIN FOSTER, Chief Planning Officer
Planning Department
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

CERT. IVAN M. LUI-KWAN, ESQ., Attorney for Petitioner
Carlsmith Ball Wichman Murray
Case Mukai & Ichiki
2200 Pacific Tower
1001 Bishop Street
Honolulu, Hawaii 96813

DATED: Honolulu, Hawaii, this 28th day of October 1993.

Esther Ueda

ESTHER UEDA
Executive Officer

Appendix O
Geotechnical Analysis

July 12, 2007
W.O. 5898-00

Mr. Steve Kelly
Makaiwa Hills, LLC
1001 Kamokila Blvd., Suite 250
Kapolei, HI 96707

GEOTECHNICAL ENGINEERING CONSULTATION
PRELIMINARY ROCKFALL POTENTIAL AND SOILS EVALUATION
MAKAIWA HILLS DEVELOPMENT
TMK: 9-1-15: 5 (POR.); 9-2-3: PORTIONS OF 2, 5, AND 84
KAPOLEI, OAHU, HAWAII

Dear **Mr. Kelly:**

This report presents the results of our preliminary geotechnical engineering evaluation performed for the proposed *Makaiwa Hills Development* project in the Kapolei area on the Island of Hawaii. The project location and general vicinity are shown on the Project Location Map, Plate 1.

This letter report summarizes our findings and preliminary geotechnical engineering recommendations resulting from our site reconnaissance, literature review, and engineering analyses. These recommendations are intended to assist in the preliminary planning of the project only. The findings and recommendations presented herein are subject to the limitations noted at the end of this report.

PROJECT CONSIDERATIONS

The proposed project involves the development of various residential and commercial developments on approximately 1,800 acres in the vicinity of Makaiwa Gulch in the Ewa area of the Island of Oahu, Hawaii. Based on the preliminary planning information provided, we understand that the overall development may consist of several residential subdivisions consisting of low density, medium density, high density, and multi-family residential developments. In addition, some commercial development consisting of a shopping center and a town center may be planned. A map showing the preliminary development plan is provided on Plate 2.

In general, the new developments are proposed along the elongated north to south trending topographic ridges and lower foothill regions. Based on the USGS topographic maps, the ridge axes slope down towards the south at average gradients of about 10 to 12 percent. Development is not anticipated within the large topographic gulches encompassed by the project site.

The project site covers an extensive land area consisting mainly of gently to moderately sloping terrain including multiple ridge and gully topographic features. Ground surface elevations range between about +100 and +1,100 feet Mean Sea Level (MSL). We understand that an Environmental Impact Statement (EIS) is underway for the project. Furthermore, we understand the City & County of Honolulu, Department of Planning and Permitting (DPP) has requested a preliminary evaluation of potential rockfall hazards, expansive soils, and slope stability issues which could affect the planning and design of the project.

PURPOSE AND SCOPE

The purpose of this report is to address the comments received from the City & County of Honolulu, Department of Planning and Permitting (DPP) on May 23, 2007 with respect to the Draft Environmental Impact Statement (DEIS). The DPP review comments relevant to geotechnical issues pertain to the possible effect of potential rockfall hazards, expansive soils, and slope stability on the preliminary planning and design.

The purpose of our work was to obtain and evaluate information for the existing surface and near-surface soil/rock conditions at the project site. The information was used to develop a generalized soil and/or rock data set to formulate preliminary geotechnical recommendations for the planning and preliminary design. Our scope of work generally consisted of the following tasks and work efforts:

1. Research and review of available geological and soil survey maps, aerial photos, and in-house soils/rock data from the project vicinity.
2. Performance of a cursory surface field reconnaissance at accessible locations of the project area to record observations of the existing site conditions.
3. Evaluation of the literature and field data to formulate preliminary geotechnical engineering recommendations for the development planning.
4. Preparation of this report summarizing our work on the project and presenting our findings and recommendations.
5. Coordination of our overall work on the project by our project geologist/engineer.
6. Quality assurance of our work and client/design team consultation by our principal engineer.
7. Miscellaneous work efforts such as drafting, word processing, and clerical support.

REGIONAL GEOLOGY

The project site is on the south-southeast facing flank of the Waianae Mountains in the Ewa District of the western (leeward) portion of the Island of Oahu. The Island of Oahu was built by the extrusion of basaltic lavas from the Waianae and Koolau shield volcanoes. The older Waianae Volcano is estimated to be middle to late Pliocene in age and forms the bulk of the western one-third of the island. The younger Koolau Volcano is estimated to be late Pliocene to early Pleistocene (Ice Age) in age and forms the majority of the eastern two-thirds of the island. The Koolau Volcano reached the end of its main shield-building phase about 2 million years ago. Waianae became extinct while Koolau was still active, and its eastern flank was partially buried below Koolau lavas banking against its eastern flank.

The Waianae Range is composed of layered basaltic lava flows and some pyroclastic materials, which are collectively grouped and classified as belonging to the Tertiary age Waianae Volcanic Series. The Waianae Volcanic Series is divided into the lower, middle, and upper volcanic members. The lower member is comprised of lava flows and associated pyroclastic rocks that built the main mass of the Waianae Shield Volcano. The middle member consists of rock that accumulated and gradually filled the vast volcanic caldera. The upper member is a relatively thin capping layer that covered the entire top of the shield volcano late in its history of evolution.

Based on our review of available geological maps, the majority of the project site is underlain by weathered basaltic rock and derived residual and saprolitic soils belonging to the Tertiary Waianae Basalt (Twb) geological mapping unit. The basaltic rock materials consist of sequentially layered lava flows, which dip gently toward the south and southeasterly direction. Based on our site reconnaissance, the near-surface lava flows appear to represent the a'a lava flow type. A'a lava rock is typically characterized as a dense volcanic rock (within the lava flow core) bounded by rubbly clinker lava materials, which were extruded as slow-moving, relatively thick and viscous lava flows.

Due to the arid environmental conditions and the generally slower rate of chemical rock weathering typical of the Kapolei/Makakilo area, the basaltic rock materials exposed at the ground surface have limited surface soil cover. Therefore, a large proportion of the existing ground surfaces at the project site are weathered basaltic rock consisting of hard rock outcrops and remnant surface boulders with some thin surficial soils. The ground surfaces at higher elevations of the project site appear to contain some thicker surface soils overlying weathered basaltic rock; thus, the surface distribution of existing basalt rock outcroppings and surface boulders is somewhat less at the higher elevations of the site.

EXISTING SITE CONDITIONS

The project site encompasses approximately 1,800 acres of undeveloped land, of which portions appear to be currently used for livestock ranching. The project site is bounded by the existing Palehua Road toward the north, existing Makakilo residential

developments toward the east, Farrington Highway and the existing Honokai Hale subdivision towards the south, and Waimanalo Gulch toward the west. Ground surface elevations range from about +100 feet MSL along the southern perimeter to about +1,200 feet MSL at the northern perimeter, as indicated by the Site Plan, Plate 4. The project site is vegetated with dryland grasses, shrubbery, and scattered Kiawe trees. Existing wire fences and some jeep access trails were encountered on the ridgelines within the northern and eastern portions of the project site. Existing power transmission lines and associated timber support towers were encountered traversing across the northern and western portions of the project site.

We conducted a surface reconnaissance of selected accessible areas of the project site on June 25 and 26, 2007. We accessed the property from the existing Palehua Road on the north and the existing Nohona Street on the east. Traverses across the ridge and gulch topography were performed at various elevations to obtain an overview of the typical site conditions and exposures of the existing surface soil and rock materials. At the time of our reconnaissance, we observed the ground surface conditions to be very dry with no stream flow or ponded water within topographic depressions.

The project site encompasses a broad sloping region of parallel ridge and gulch topography on the lower south facing flank of the Waianae Range as depicted on the Site Plan, Plate 4. In general, the stream incised gulches deepen towards the south progressing from the north. Flowing streams were not observed within the gulches at the time of our site reconnaissance. The rocky gulches harbor surface exposures of layered basaltic rock outcroppings that are stepped in character with natural gulch side slope inclinations averaging on the order of about two horizontal to one vertical (2H:1V), which may be characterized as moderately steep. The depth of the gulches (estimated relative to the adjacent bounding ridge axes) appears to range from about less than 40 feet towards the north to over 120 feet towards the south. The deepest unnamed gulch at the western portion of the property reaches a depth of over 200 feet relative to the adjacent high topographic ridges.

The typical slope gradient along the ridge axes is on the order of about 10 to 12 percent, which may be characterized as relatively gentle slope inclinations. Steeper side slopes were encountered along the edges of the ridgelines and on the gulch side slopes.

Surface Soil/Rock Materials

Based on our site reconnaissance, the ground surfaces comprising the majority of the southern half of the property appear to be underlain by weathered, hard basaltic rock formation with some generally thin surficial reddish brown to brown clayey residual and alluvial surface soils. The clayey soil deposits, where encountered, appear to have slight to moderate expansion potential as evidenced by some generally slight desiccation cracking. The lower elevations, adjacent to the mouths of the gulches and along Farrington Highway (the foothill pediment regime), were observed to contain some surface deposits consisting of dark brown clayey alluvial soils, which appear to have at least a moderate expansion potential as evidenced by more moderate desiccation cracking.

In contrast, the ground surfaces within the majority of the northern half of the property appear to be comprised of thicker reddish brown silty and clayey residual and saprolitic surface soils overlying weathered basaltic rock. Based on our observations, the residual soil profile in the uplands appears to be thicker with the surficial soil deposits typically ranging between about 5 and 12 feet thick. The expansion potential of these reddish colored upland soils appears to be generally low based on our observations. Based on our observations, we estimate the approximate transition zone between the thicker upland soil deposits overlying rock formation and the thinner soils overlying surface and near-surface rock material lies somewhere between about Elevation +500 and +600 feet MSL.

Surface basaltic rock outcroppings and individual boulders (erosional remnant rock material) are predominant at the ground surface throughout the entire project site. However, the overall areal distribution of existing surface boulders and rock outcroppings generally increases in the down slope direction toward the south. Additional erosional remnant boulders should be anticipated buried within the near-surface soils. The areal distribution of surface rock outcrops and boulders also increases on the gulch side slopes and towards the margins of the ridge plateaus. Based on our observations, the typical size of loose surface boulders and fractured blocks of rock outcropping averages about 3 to 4 feet in dimension. Occasional larger blocks of rock reached about 6 to 10 feet in dimension on some moderately steep slopes.

Selected photographs of the existing site conditions are presented in Appendix A. The approximate photograph locations are shown on the Site Plan, Plate 4.

Soil Survey Data

Based on our review of the available United States Department of Agriculture Soil Conservation Service data, the project site may contain the following mapped soil types listed in the approximate order of areal coverage. A Soil Survey map depicting the distribution of the various soil types described below is provided on Plate 3.

Soil Type	Generalized Description
rSY: Stony Steep Land	Generally consists of boulders and stones with rock outcrops located on upland bluffs and gulch side slopes. The mapping unit may be encountered on most of the lower and middle hill slopes of the project site, encompassing both the gulch and ridgeline areas.
LPE: Lualualei Extremely Stony Clay	Generally consists of brown and dark brown colored clay soils with many stones located adjacent to drainages. The mapping unit may be encountered at the southern lower elevation foothill pediment and gulch floors near the gulch mouths.
HLMG: Helemano Silty Clay	Generally consists of dark reddish brown silty clay soils located on upland bluffs and gulch slopes. The mapping unit may be encountered on the exposed upper elevation slopes at the northern half of the project site.
MBL, McC2, and McD2: Mahana Silty Clay Loam	Generally consists of reddish brown silty clay loam soils located on upland terrain and believed to have developed from weathered volcanic ash. The mapping unit may be encountered on eroded and exposed slopes (badlands) at the northern portion of the project site.
HXA, HXB: Honouliuli Clay	Generally consists of red and brown sticky, plastic clay located on alluvial plains. The mapping unit may be encountered as localized exposures on flat to gently sloping terrain at the southeastern corner of the project site.
LvB: Lualualei Stony Clay	Generally consists of brown and dark brown colored clay soils with stones located adjacent to drainages. The mapping unit may be encountered as localized exposures at the south eastern corner of the project site.
EwC: Ewa Stony Silty Clay	Generally consists of dark reddish brown silty clay soils with stones located on relatively flat alluvial surfaces. The mapping unit may be encountered as localized exposures at the southeast corner of the project site.

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DISCUSSIONS AND RECOMMENDATIONS

The City and County of Honolulu, Department of Planning and Permitting requested the performance of a preliminary geotechnical engineering review of the possible expansive soil conditions, potential rockfall conditions, and slope stability conditions that could affect the planning and design of the proposed development.

Based on our evaluation of the existing site conditions with respect to the proposed development, we conclude that expansive soil conditions and rockfall hazard effects can be mitigated by proper grading and foundation design. Additionally, it is our opinion that slope instability is not a concern for properly designed and constructed grading at the site. The following presents our preliminary findings and recommendations resulting from our study.

Expansive Soils

Based on our previous experience in the project vicinity, a limited site reconnaissance, and a review of available in-house soils information, we anticipate that the project site may contain various clay and silty clay surface soils having a range of expansion potential primarily between slight and moderate. Isolated areas with the dark brown and some of the reddish brown clay soils appear to have high expansion potential when subjected to moisture fluctuations. These high expansion soils may be encountered with greater frequency at the southern half of the project site, with the highest occurrence on the relatively flat to gentle slopes along the southern perimeter of the project site. These variable soil expansion conditions are common in the Makakilo and Kapolei areas as well as many other sites on Oahu.

A detailed geotechnical exploration will be conducted. As part of the exploration, the on-site clay soils will be tested and characterized with respect to the expansion (swell) potential. A schedule of the various soil types and degree of swell potential will be developed to assist in the characterization and use of the on-site soils. Shallow rock formation is anticipated; therefore, some expansive soil conditions may be mitigated by removal during earthwork grading. Other mitigation methods may include special subgrade preparation/moisture conditioning, special foundation design, and importation of select fill to reduce the effects of the potentially expansive soils on new foundations, concrete slabs, and pavements. These are mitigation methods commonly used on residential projects on Oahu.

Rockfall Potential

Our observation of the existing ground conditions at the project site indicates that an appreciable volume and areal coverage of surface basalt rock outcroppings and boulders exists. Potential rockfall hazards are a safety concern for the gulch regions adjacent to the ridgeline rockfall source areas. However, since the proposed development will be limited to the bluff tops and ridgelines and no new development is planned for the interior of the gulches, the rockfall hazard is minimal.

Engineered grading design may be employed to reduce the potential for future rockfall hazards within the interior of the development. Mass grading for the project may include the removal of exposed rock outcroppings and surface boulders at the finish grades. To reduce the potential for the development of future rockfall hazards on sloping terrain within the grading limits, hill slope surfaces steeper than 3H:1V may be swept of loose surface boulders and rock fragments larger than about 1.5 feet in dimension. Furthermore, the development of high rock cut slopes should be minimized to reduce the potential for future rockfall hazards on the cut slopes as natural weathering of the slope progresses. Where cut slopes are necessary for grade separation, the slopes should be designed using appropriate inclinations and rock catchment structures.

Based on our reconnaissance, some existing large block rock outcroppings (potential rockfall hazards) exist on some of the moderately sloping terrain just below and along the existing Palehua Road corridor at the top limit of the project site. Because some future lots may be developed below and adjacent to these large scattered rock outcrops, the hillside region containing the outcrops (upslope of the development footprint) may require grading or other means of rock stabilization to reduce the potential for rockfall hazards.

Another area of potential rockfall hazard concern encompasses the lower elevation foothills composed of rock formation adjacent to the flatter foothill pediment. The lower elevation foothills were observed to contain substantial rock outcrops with limited surface soil cover. Based on the preliminary development plan, some future commercial and public facility development may be sited on the flatter terrain at the foot of the rocky hills. Appropriate rockfall safety measures such as the establishment of rockfall buffer zones, setback of developments, or construction of rockfall barriers may be considered to address rockfall safety in these areas.

In summary, the rockfall hazard to the gulches adjacent to the development is minimal. Rockfall hazard within the development can be mitigated by proper grading design to remove the source rock/boulders.

If required, other conceptual rockfall hazard mitigation schemes that could be implemented in the design of the project include:

- Rock catchment ditch
- Designated dwelling, structure, and development setbacks from rock slopes
- Rockfall impact barrier fencing
- Individual rock removal and/or stabilization
- Cable or wire mesh drapery

Slope Stability

Based on our preliminary evaluation of the site conditions and the preliminary development plan with respect to slope stability, we believe the project site is suitable for development from a geotechnical engineering standpoint.

We did not encounter existing slope instability during our preliminary site reconnaissance. The majority of the sloping terrain at the project site appears to be underlain by residual and saprolitic soils overlying basaltic rock formation at relatively shallow depths. Furthermore, we believe that by implementing appropriate engineering grading controls, the post development slope stability should not be a concern.

LIMITATIONS

The analyses and recommendations submitted herein are based, in part, upon information obtained from site reconnaissance and visual observations. Variations of conditions between and beyond our site observations may occur, and the nature and extent of these variations may not become evident until construction is underway. If variations then appear evident, it will be necessary to re-evaluate the recommendations presented herein.

This report has been prepared for the exclusive use of Makaiwa Hills, LLC for specific application to the *Makaiwa Hills Development* project in accordance with generally accepted geotechnical engineering principles and practices. No warranty is expressed or implied.

This report has been prepared solely for the purpose of assisting the planner and design engineer in the preparation of the design and construction drawings for the proposed project. Therefore, this report may not contain sufficient data, or the proper information to serve as a basis for construction cost estimates or contract bidding. A contractor wishing to bid on this project should retain a competent geotechnical engineer to assist in the interpretation of this report and/or performance of site-specific exploration for bid estimating purposes.

The owner/client should be aware that unanticipated soil conditions are commonly encountered. Unforeseen soil conditions, such as perched groundwater, soft deposits, hard layers or cavities, may occur in localized areas and may require additional probing or corrections in the field (which may result in construction delays) to attain a properly constructed project. Therefore, a sufficient contingency fund is recommended to accommodate these possible extra costs.

This geotechnical engineering evaluation conducted at the project site was not intended to investigate the potential presence of hazardous materials existing at the site. It should be noted that the equipment, techniques, and personnel used to conduct a geo-environmental exploration differ substantially from those applied in geotechnical engineering.

CLOSURE

We appreciate the opportunity to provide our services to you on this project. If you have questions or need additional information, please contact our office.

Respectfully submitted,

GEOLABS, INC.

By ______
Steven F. Carr, R.G.
Project Geologist

By ______
Clayton S. Mimura, P.E.
President

CLAYTON S. MIMURA
LICENSED PROFESSIONAL ENGINEER
No. 4176-C
HAWAII, U.S.A.

THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION.

SIGNATURE 4-30-08
EXPIRATION DATE OF THE LICENSE

CSM:SC:mj

Attachments: Project Location Map, Plate 1
Preliminary Development Plan, Plate 2
Soil Survey Map, Plate 3
Site Plan, Plate 4
Appendix A – Site Condition Photographs, Plates A-1 thru A-5

(6 Copies to Addressee)

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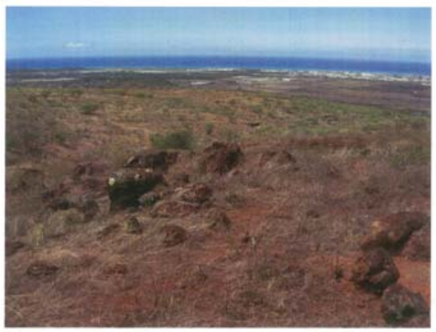
APPENDIX A

Site Condition Photographs

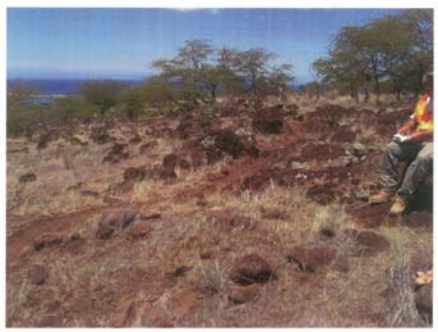
Photograph No. 1: Typical exposure of reddish brown silty and clayey soils with scattered erosional remnant boulders and very few surface rock outcrops. Soil depths in the vicinity of the photograph location appear to range on the order of about 8 to 12 feet based on observation of existing erosion features. (photo 0127)

Photograph No. 2: View towards the northeast showing typical ground surface conditions of reddish brown and light brown silty and clayey soils with scattered surface boulders and some low relief surface rock outcroppings. (photo 0128)

Note: Photograph location is shown on the Site Plan, Plate 4.



Photograph No. 3: View toward the southeast showing typical ground surface conditions consisting of light brown silty and clayey soils with scattered surface boulders and rock outcroppings, which are generally more numerous in occurrence as the top edge of the gulch is approached. (photo 0130)



Photograph No. 4: View toward the southwest showing the typical ground surfaces composed of thinner surface soils mixed with low relief basalt rock outcroppings and scattered loose boulders. (photo 0139)

Note: Photograph location is shown on the Site Plan, Plate 4.

Photograph No. 5: View towards the southwest of the larger gulch at the western side of the project site. Note the large area of high relief surface rock outcropping on the lower elevation foothill (at about Elevation +180 feet MSL) above the pediment fronting Farrington Highway. (photo 0141)

Photograph No. 6: View towards the north showing the typical ground surface condition consisting of brown and reddish brown silty and clayey soils with scattered cobbles/small boulders with occasional low relief rock outcroppings. Thicker reddish brown soils with very few boulders and rock outcroppings are visible in the background near the utility pole. (photo 0147)

Note: Photograph location is shown on the Site Plan, Plate 4.

Photograph No. 7: View towards the northeast across the gulch showing typical ledge rock outcroppings near the top edge of the gulch side slope. (photo 0151)

Photograph No. 8: View towards the north of a section of hill slope below Palehua Road where large block type rock outcroppings were observed. The rock outcroppings may be located upslope from potential development. Large fallen boulders were observed below the existing power line alignment. (photo 0153)

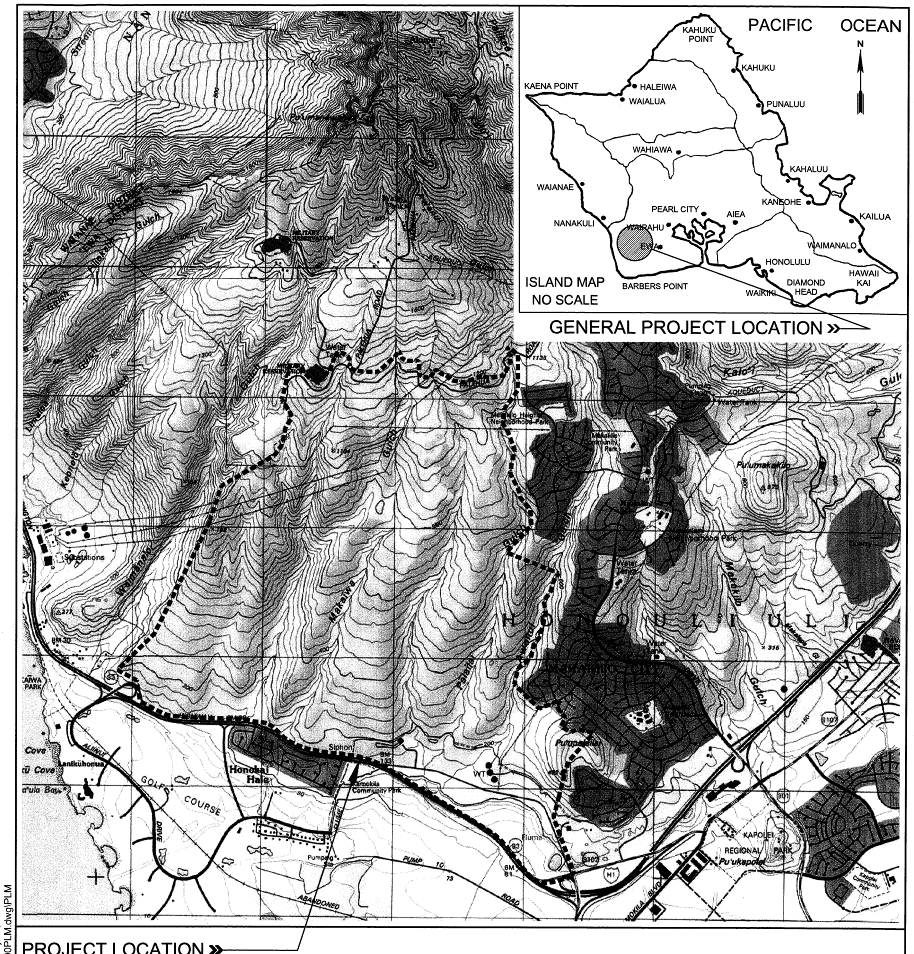
Note: Photograph location is shown on the Site Plan, Plate 4.

Photograph No. 9: Typical dark brown clayey surface soil showing a friable and fractured soil texture indicative of expansive soil. (photo 0158)

Photograph No. 10: View towards the west showing the typical gently sloping ground surface of the lower elevation ridgelines and the surface exposure of scattered basaltic rock outcrops. (photo 0166)

Note: Photograph location is shown on the Site Plan, Plate 4.

PLATES



2000 1000 0 2000 FT.

GRAPHIC SCALE

N

REFERENCE: MAP CREATED WITH TOPO!® ©2001 NATIONAL GEOGRAPHIC (WWW.NATIONALGEOGRAPHIC.COM/TOPO).

User: JJP File Created: July 05, 2007 File Last Updated: July 05, 2007 9:14:05am
File: T:\Drafting-9904\Working\5898-00MakaiwaHills\5898-00PLM.dwg\PLM

PROJECT LOCATION MAP

MAKAIWA HILLS DEVELOPMENT
KAPOLEI, OAHU, HAWAII

GEOLABS, INC.
Geotechnical Engineering

DATE	DRAWN BY	PLATE
JULY 2007	JRP	
SCALE	W.O.	1
1" = 2,000'	5898-00	

REFERENCE: DRAFT SITE PLAN TRANSMITTED BY GROUP70 INTERNATIONAL ON 6/28/07.

N

PRELIMINARY DEVELOPMENT PLAN

MAKAIWA HILLS DEVELOPMENT
KAPOLEI, OAHU, HAWAII

GEOLABS, INC. Geotechnical Engineering		
DATE: JULY 2007	DRAWN BY: JRP	PLATE
SCALE: NOT TO SCALE	W.O. 5898-00	2

APPROXIMATE PROJECT LOCATION

REFERENCE: SOIL SURVEY OF ISLANDS OF KAUAI, OAHU, MAUI, MOLOKAI, AND LANAI, STATE OF HAWAII BY THE UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE IN COOPERATION OF WITH THE UNIVERSITY OF HAWAII, AGRICULTURAL EXPERIMENT STATION. ISSUED 1972. PAGE 44.

0 1000 2000 4000 6000 FT.
GRAPHIC SCALE

N

SOIL SURVEY MAP

MAKAIWA HILLS DEVELOPMENT
KAPOLEI, OAHU, HAWAII

GEOLABS, INC. Geotechnical Engineering		
DATE: JULY 2007	DRAWN BY: JRP	PLATE
SCALE: 1" = 2,000'	W.O. 5898-00	3

APPROXIMATE PROJECT LOCATION

P-1 ● APPROXIMATE LOCATION OF PHOTOGRAPH IN APPENDIX A

REFERENCE: PROJECT LOCATION OUTLINE TRANSMITTED BY GROUP70 INTERNATIONAL ON 6/28/07 AND MAP CREATED WITH TOPO!® ©2001 NATIONAL GEOGRAPHIC (WWW.NATIONALGEOGRAPHIC.COM/TOPO).

0 750 1500 3000 4500 FT.
GRAPHIC SCALE

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SITE PLAN

MAKAIWA HILLS DEVELOPMENT
KAPOLEI, OAHU, HAWAII

GEOLABS, INC.
Geotechnical Engineering

DATE	DRAWN BY	PLATE
JULY 2007	JRP	
SCALE	W.O.	
1" = 1500'	5898-00	4