Second
Draft Environmental Impact Statement

Kaloko Makai

Kaloko and Kohanaiki, North Kona, Island of Hawai'i
Volume 2 of 2 Appendices

Prepared For:
SCD-TSA Kaloko Makai, LLC

Prepared By:
Wilson Okamoto Corporation and
Ho'okuleana LLC

August 2013

Second
Draft Environmental Impact Statement

Volume 2 of 2 – Appendices A through S

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Prepared For:
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and

Ho‘okuleana LLC

August 2013

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Market Assessment for Kaloko Makai
Mikiko Corporation
April 2012

MARKET ASSESSMENT FOR KALOKO MAKAI

North Kona, Island of Hawaii

Prepared for:
SCD-TSA Kaloko Makai, LLC

FINAL REPORT

April 2012

Market Assessment for Kaloko Makai

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Market Assessment for Kaloko Makai

Report Text

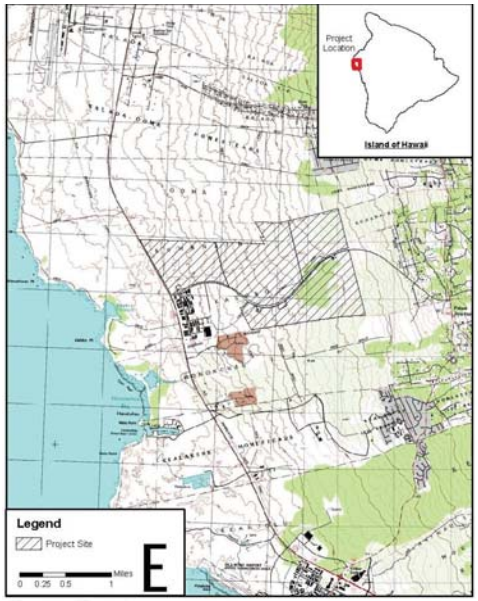
1 – Introduction and Executive Summary

Project Overview

Kaloko Makai Site and Location Characteristics (Exhibit 1-1)

SCD-TSA Kaloko Makai, LLC (SCD-TSA) proposes to develop a 1,142-acre site in North Kona, Hawaii as a master-planned community called Kaloko Makai (the Project.) It is in a rapidly developing area, a few miles south of Kona International Airport at Keahole (Kona Airport) and adjacent to and north of the well-established commercial and light industrial-service centers of North Kona and Kailua-Kona.

Location and Vicinity of Kaloko Makai



Source: SCD-TSA Kaloko Makai, LLC, 2007.
See Exhibit 1-1 for copy at a larger scale.

The site ascends from Queen Ka'ahumanu Highway, to about two-thirds of the way *mauka* to Mamalahoa Highway. Its slope affords excellent ocean and regional views from most of the site.

Along Queen Ka'ahumanu Highway, Kaloko Makai extends from Huliko'a Drive to Hina Lani Street. At this *makai* edge, the site is bordered on the north by the Kohanaiki Industrial Park, and on the south by the Kaloko Industrial Park. Beyond that is the site of the planned West Hawaii Business Park. Also along its southern border on Hina Lani Street, the County is developing a 96-unit affordable project known as Kaloko Housing Project.

Across the highway are The Shores at Kohanaiki, a private golf and luxury second home project now under development, and the Kaloko-Honokohau National Historical Park.

Alongside the *mauka* portions of the site, Kaloko Makai is bordered by residential uses including SCD-TSA's planned Kaloko Heights community, Kula Nei (single-family lots) and Kona View Estates.

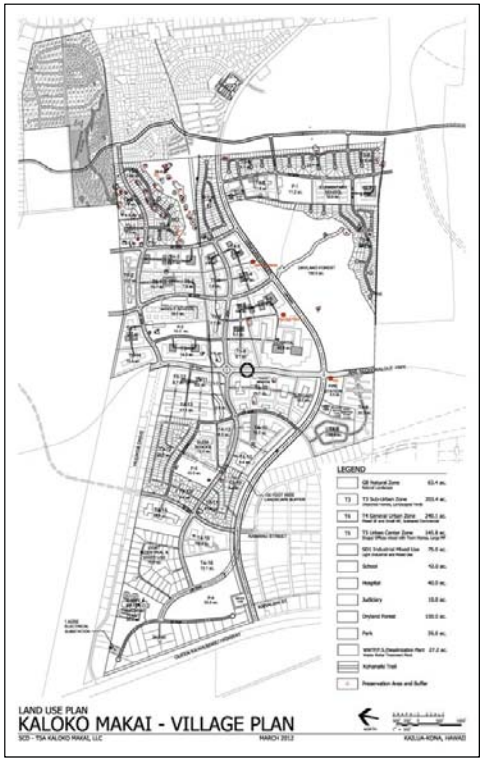
Meeting Community Desires (Exhibit 1-2)

Kaloko Makai has been planned to respond to its community's desires regarding future growth, as expressed in the Kona Community Development Plan.[1] The Kona CDP directed growth to compact, higher density "villages" mostly located north of Kailua-Kona Town along the Ane Keohokalole Highway transit corridor. These growth centers were directed to 10 Transit-Oriented Development (TOD) Urban Villages, of which Kaloko Makai is identified as one.

Kaloko Makai's plan supports many of the Guiding Principles of the Kona CDP:

- **Directs future growth patterns towards compact centers** – Kaloko Makai is planned around a compact urban center.

Kaloko Makai Land Use Plan



Source: SCD-TSA Kaloko Makai, LLC, 2012.
See Exhibit 1-2 for copy at a larger scale.

[1] Wilson Okamoto Corporation, for the County of Hawaii Planning Department, "Mapping Kona's Future: Kona Community Development Plan," September 2008.

- **Provides connectivity and transportation choices** – Kaloko Makai will be transit-ready and is located along key alignments for regional transportation. Developer SCD-TSA would also contribute to the development of Ane Keohokalole Highway. The Project itself is planned to offer walking and biking trails in addition to vehicular roads.

- **Provides housing choices** – Kaloko Makai would offer a broad range of housing types including affordable as well as "market-priced" housing units. Offerings would range from traditional single-family homes to mid- and higher-density multifamily homes, and may include live-work and mixed use developments.

- **Provides recreation opportunities** – Kaloko Makai features a 150-acre dryland forest preserve, as well as numerous community parks and trails.

- **Provides infrastructure and essential facilities concurrent with growth** – In addition to the recreational and transportation contributions noted above, Kaloko Makai is planned to include a hospital and medical complex, two elementary schools, a middle school and a small lodge to accommodate visitors attracted by the other uses.

Kaloko Makai has also been planned to conform to calibrated standards recommended by the Kona CDP Action Committee, a citizens' group formed by the County of Hawaii,[2] with its compact residential settings in a transit-ready, mixed-use community. As noted, the urban core of this community would be centered on the new "mid-level" Ane Keohokalole Highway, and residential densities and other specific development characteristics have been developed in conformance to the various "transect zones" define in the Design Guidelines.

Kaloko Makai Development Elements (Exhibit 1-2)

In addition to the schools, parks and trails, the Project's key development elements are:

- **Residential** – up to 5,000 residential units;

- **Commercial** – up to 600,000 square feet of retail and office developments, including space within medical office buildings;

- **Light industrial/ business park** - 75 acres, of which about 25 have been identified by the State Department of Transportation (DOT) as an area to be reserved for their

[2] Based on PlaceMakers, LLC, "Kona Village Design Guidelines" (calibrated for the County of Hawaii,) Final Draft, October 10, 2010.

proposed highway interchange at the main Project entrance on Queen Ka'ahumanu Highway[3]; and

- **Lodge and Business Center** – up to 120-rooms at a kama'aina- and business-traveler oriented lodge with business support facilities and services.

- **Medical complex** – A public hospital and a separate outpatient or urgent care center is proposed.

Together, these developments would support a substantial civic and employment center, generating opportunities in professional, business, service and retail fields.

Study Background

SCD-TSA is working with Wilson Okamoto Corporation (Wilson Okamoto) to seek State of Hawaii (State) and County of Hawaii (County) entitlements for the Project, including a State Land Use District Boundary Amendment (SLUDBA), and County zoning. In this respect, SCD-TSA asked Mikiko Corporation (Mikiko) to prepare market, economic and fiscal impact assessments for the Project.

This report covers Mikiko's market assessment for the residential, commercial and light industrial/business park uses noted above. A specialized medical facilities expert, Cattaneo & Stroud, Ltd. has prepared the market assessment for the hospital/medical center. Their report is presented separately.

Mikiko's economic and fiscal impact assessment for the Project is also in a separate report.

Study Objective and Report Conditions (Appendix 6)

Mikiko's objective was to describe the market support for the residential, commercial, light industrial/business park and Lodge/Business Center uses proposed at Kaloko Makai, in terms of:

a) Evidence of the demand and competitive supply for each development element;

b) Assessment of market shares and/or supportable market absorption;

c) For residential units, assessment of supportable unit pricing; and

d) For the Lodge and Business Center, assessment of average daily room rates and occupancy.

[3] Therefore, long-term, there would be some 50 gross acres of light industrial/business park lands.

Our evaluations are based in part on information and planning parameters provided by Wilson Okamoto and SCD-TSA.

The remaining sections of this chapter summarize the market conclusions. The rationale behind these conclusions, as well as documentation of the study methodology and supportive data, may be found in the subsequent chapters and appendices.

At the end of this report, Appendix 6 presents a statement of important report conditions.

Community Context and Need

Area Character

The North Kona area is appropriately seeing urban infill development and proposals, consistent with the 2008 Kona CDP and the 2010 draft Kona Village Design Guidelines noted above. To date, this development has concentrated along the major regional traffic corridor Queen Ka'ahumanu Highway, between the town of Kailua-Kona and the Kona Airport.

This rapidly developing area comprises the northwestern portion of the North Kona District, and is contained within Census Tract 215.01 (also referred to herein as "North Kona-North".)[4] It already is the commercial and industrial heart of West Hawaii, serving the Kona Airport and the needs of the visitor, agriculture, ranching, technology and other industries of the western half of the Island. The area also has a long-standing and growing residential base. This area will continue to be the focus of such development as the Island's population grows, given its proximity to the Kona Airport and other existing infrastructure.

Need for Residential Realignment and Development

Together with the coastal portion of the adjacent South Kohala District (CT 217.01, also referred to herein as "South Kohala-Waikoloa")[5], North Kona-North was estimated to provide 23% of the Island's employment in 2009.[6] However, as of 2010, this center of employment supported residences for only about 12% of the Island's population. This imbalance of jobs and housing leads to crowding among area households, and a tremendous amount of commuting into the region by persons who live in distant areas.

[4] See Appendix 1 for a map of this census tract.

[5] See Appendix 2 for a map of this census tract.

[6] Based on the estimated number of employees at establishments located in CTs 215.01 and 217.01 compared to total employees at all Island establishments, as of 2009, according to Claritas, Inc. Note that "employees" on the Island exceed the "civilian labor force," since labor force members may hold more than one job. The area's dominance of Island employment appears to be increasing: in 2006, this figure was 21% of Island employees.

A relative lack of resident-oriented shopping, entertainment, and other services in the South Kohala-Waikoloa area also adds to traffic headed into the Kailua-Kona area from the north.

Kaloko Makai is one of a relatively small group of area properties that could offer a substantial solution for this imbalance of primary resident-oriented housing, services, and the area's existing and anticipated jobs base.[7]

Kaloko Makai Residential Market

Need for Housing in the Area

The two census tracts 215.01 and 217.01 are considered Kaloko Makai's Competitive Regional Market Area (CRMA) for residential market conditions. It is considered possible and desirable that housing opportunities in the CRMA begin to approach the magnitude of employment opportunities. Thus, while current economic conditions have dampened actionable pent-up demand, the CRMA should be poised for a significant share of the Islands' anticipated future population growth, and this will lead to growing demand for homes in the region.

Mikiko's research concludes that even with aggressive and unprecedented levels of future development, the CRMA could still experience a shortfall of some 9,600 primary homes by 2045 if no more lands are entitled and planned for this market.

Supply and Demand for New Resident Housing Units in the Competitive Regional Market Area, 2010 to 2045

Future Demand	Pent-up demand, 2010	0*
	Future need, 2011-2045	17,800
	Total need	17,800
Future Supply	Planned and entitled (8,600 less 5% vacancy), rounded	8,200
Shortage	**As of 2040**	**9,600**

* Assumed to be zero due to current economic environment.
Source: Mikiko Corporation, 2012. See Exhibit 3-5 for further information.

[7] While there are numerous area properties that seek to develop in the future, many are already designated Urban by the State, and therefore are already accounted for as future supply. See discussion immediately ensuing.

Residential Development Proposal

Kaloko Makai's plan features a transit-ready Urban Center (Transect zone T5) on Ane Keohokalole Highway, with lower density General Urban (T4) and Sub-Urban (T3) areas outlying. Based on the Kona Village Design Guidelines, the T4 and T5 areas would be predominantly multifamily (or high density single family within T4), while the T3 areas would include single-family residences. A Special/Mixed Use district in the lower portion of the site may also include some multifamily housing.

A conceptual maximum development scenario for the Project is as follows:

Conceptual Mix of Residential Units at Kaloko Makai
Maximum development at buildout

Predominant unit type	Transect zone	Total planned units	Example density (units per acre)
Multifamily ("affordable")	T4 and T5	700 to 1,000	8 to 16
Multi- or single-family ("market")	T4 and T5	3,014 to 3,314	8 to 16
Single-family ("market")	T3	986	3 to 6
Total		**5,000**	**3 to 16**

Sources: Place Makers, LLC, 2010; SCD-TSA Kaloko Makai, LLC, 2012; Wilson Okamoto Corporation, 2011.

While some of the housing could be developed as rentals, residential market support is evaluated herein in terms of units offered for sale.

Residential Buyer Mix and Pricing

Considering the location, characteristics and types of residential developments proposed, about 85% of Kaloko Makai homes are anticipated to be used as primary homes, most for established Island residents. The planned units would include senior housing, affordable housing as well as a wide variety of less specialized housing options.

Supportable pricing for the market-priced units is estimated as shown on the following table.

Market Unit Price Conclusions for Kaloko Makai
2010 dollars

	Average sales price*	Approximate average density (units/gross acre)
T3 – single-family	$475,000	3 to 6
T4 & T5 – multi- or single-family	$370,000	8 to 16
Overall, market homes	**$396,000**	**3 to 16**

* For market-priced units only.
Source: Mikiko Corporation, 2012. See Exhibit 4-2 for further information.

The production and pricing of affordable units at the Project would be set in accordance with County and/or State guidelines to be determined in consultation with government agencies. The units would be priced with specific shares catering to households earning less than 80%, 80 to 100% and 100 to 120% of the County median income.[8]

Also according to County guidelines in effect as of September 1, 2010, conforming affordable housing prices for such housing could range from $202,500 to $366,200 for two-to four person households. The price guidelines also show one- to two-bedroom rental units priced from $1,037 to $1,500 per month, including utilities, and offered to households earning 80% to 100% of the median income.[9]

Projected Residential Sales Absorption

The first residential product at Kaloko Makai is projected to be available for sale in 2015. Thereafter, it is anticipated that the 5,000 maximum proposed homes could be absorbed over 31 years at an average rate of about 160 units per year.

[8] See Hawaii County Code, Chapter 11. If additional affordable housing is required in conjunction with other nonresidential developments proposed at Kaloko Makai, the developer would comply with the County Code.

[9] County of Hawaii, Office of Housing and Community Development, "Affordable Housing Guidelines for the County of Hawaii," 2010.

Illustrative Summary of Maximum Potential Residential Sales Absorption at Kaloko Makai, 2015 to 2045

	Affordable homes	Market homes	Maximum total housing
Maximum inventory	700 to 1,000	4,000 to 4,300	5,000
Average annual sales*	22 to 32	130 to 140	160 (rounded)

* Assumes several but not all products are marketed simultaneously in any given year.
Source: Mikiko Corporation, 2012. See Exhibit 4-3 for further information.

Actual sales would vary from year to year depending on market and construction cycles, and the types of units available for sale at any given time. At maximum buildout, Kaloko Makai's 5,000 units could provide a solution for about 44% of the anticipated future unplanned and unentitled demand for primary resident housing units (RHUs) in the CRMA through 2045[10].

Kaloko Makai Commercial Market

Primary Trade Area (see Exhibit 2-1)

The Primary Trade Area (PTA) for commercial uses at Kaloko Makai is considered to be the entire North Kona and South Kohala districts of the Island. This is a larger reference area than the CRMA considered in the residential market review, as explained in Chapter 5.

Commercial Development Proposal

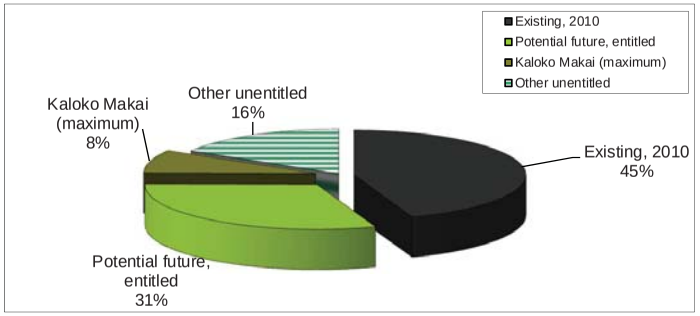
SCD-TSA proposes up to 600,000 square feet of various commercial uses at Kaloko Makai, including retail and office. This would include spaces in shopping centers, restaurant and retail establishments, four proposed medical office buildings, other office complexes, and various mixed-use developments. As for residential development, the first finished commercial building products are assumed to be available for use in about 2015.

[10] Considering 85% of Kaloko Makai's units become used as primary residences, it could yield 4,250 RHUs, or 44% of the projected 9,600 RHU shortfall in 2045, based on currently entitled and planned residential lands.

Commercial Market Conclusions

If developed to the full-proposed capacity of 600,000 square feet, Kaloko Makai's commercial spaces could represent up to 8% of the PTA's total 2045 inventory. It could also represent a venue for about one-third of the currently unplanned but future supportable commercial space in the PTA.

Potential PTA Commercial Space Distribution and Fair Market Shares: 2045



Source: Mikiko Corporation, 2012. See Chapter 5 and Exhibit 5-8 for further information.

Development and lease-up of the proposed commercial areas are anticipated to be supported by future market conditions in the PTA as follows:

Projected Supportable Commercial Market Absorption and Kaloko Makai Share of the PTA
Cumulative gross leasable square feet

	2025	2035	2045
Kaloko Makai potential development phasing	430,000	560,000	600,000
Total supportable commercial areas in PTA	5,500,000	6,800,000	7,200,000
Kaloko Makai as share of future PTA	8%	8%	8%

Source: Mikiko Corporation, 2012. See Chapter 5 and Exhibits 5-7 and 5-8 for more information.

Kaloko Makai Light Industrial/Business Park Market

Primary Trade Area and Analytical Approach

Light industrial areas can support business parks, manufacturing, energy production, research & development, wholesale, office, retail and other uses. They often serve a super-regional or Island-wide market. This analysis profiles market trends within the North Kona and South Kohala Districts (the Primary Trade Area, or PTA.) However, the realized demand for such lands at Kaloko might be stronger than presented herein because it could derive from a larger market sphere.

This analysis does not consider industrial-uses or industrial-designated lands at military bases, harbors, universities or airports.

Light Industrial/Business Park Development Proposal

The Kaloko Makai plan designates 75 acres of light industrial or business park land uses in the Special District located at its makai end fronting Queen Ka'ahumanu Highway.

Approximately 25 acres of these lands have been identified by the State Department of Transportation (DOT) for an eventual highway interchange at the entrance to the Project. Thus, industrial/business activity in that area will be characterized by interim uses and the lands are expected to be marketed as leasehold. The other 50 gross acres are seen as long-term light industrial land uses and are expected to be marketed as fee-simple lands.

Light Industrial/Business Park Market Concept

The Special District is an appropriate area for the proposed uses because:

- Its location on the Island is clearly established as a light industrial zone that serves regional and even Island-wide needs and benefits from proximity to the Kona Airport, Honokohau Harbor and the well-developed visitor infrastructure of the region.
- Kaloko Makai, and in particular its Special District area, is surrounded by other existing and planned light industrial land uses, at both Kaloko Industrial Park to its north, and West Hawai'i Business Park to its south.
- Within Kaloko Makai, the Special District area is less attractive for residential and certain commercial uses because of its Waste Water Treatment Plant, its frontage along a very busy highway, and its relative lack of views due to its lower elevation.
- Light industrial uses could represent a relatively low-investment interim source of income from those lands that would ultimately be taken for public use as a highway interchange.

Light Industrial/Business Park Market Conclusions

In conclusion, the Project's Special District is considered a very appropriate area for light industrial/business park uses. The lands set aside in the Kaloko Makai master plan are expected to be supported by businesses benefitting from the area's general economic growth, as follows:

Projected Supportable Kaloko Makai
Light Industrial/Business Park Land Absorption
Gross acres

	2016-2025	2026-2035	2036-2045	Total	Notes
Net unentitled demand at end of period (PTA)	100	120	50		As shown in Exhibit 6-3
Kaloko Makai absorption, in period:					
Leasehold areas	25	0	0	25	10- to 20-year terms
Fee-simple areas	0	25	25	50	
Total absorption in period	25	25	25	75	
Less DOT taking	0	-25	0	-25	Timing of taking is hypothetical
Kaloko Makai areas in use:					
Maximum during period	25	50	50		
Maximum at end of period	**25**	**25**	**50**		**Compare to net unentitled demand above**

Source: Mikiko Corporation, 2012.

Kaloko Makai Lodge and Business Center Market

Development Concept and Target Markets

The Kaloko Makai Lodge and Business Center was proposed to cater to business and leisure demands generated by other uses in Kaloko Makai and its region, such as the community's medical complex, and its residences as well its proximity to Kona Airport.

The Lodge is envisioned to offer up to 120-rooms, a business center, and meeting and conference spaces.

Target markets would include value- and convenience oriented travelers who do not require resort-like amenities and would prefer a compact, conveniently located and easily accessible place of accommodation. For instance:

- Primary targets:
  - Persons visiting family and friends in Kaloko Makai or neighboring areas;
  - Families and friends visiting or accompanying patients of the hospital;
  - Visiting medical staff involved with the hospital or related medical facilities;
  - Persons coming from off-island for proceedings at the planned new Kona Judiciary complex; and
  - Airline crews and commuters needing accommodations near to Kona Airport.
- Additional targets:
  - Other budget- and convenience-oriented travelers wishing to avoid the congestion, unneeded amenities and higher price points of resort areas; and
  - Athletic teams or other group travel seeking affordable and easily accessible accommodations away from resort the areas.

Substantial shares of the targeted markets are expected to be kama'aina.

Analytical Approach

The market assessment is framed by visitor and hotel market characteristics and trends for the Island as a whole and for Kona and particular. It is noted, however, that the visitor data available for such analysis does not consider inter-island kama'aina travel.

Because of the relatively small property size (which would represent a less than 1% addition to the Island's visitor inventory) and its nontraditional targeted markets, the analysis also considers selected comparison hotel properties in Kona that are known to serve portions of the visitor markets envisioned for Kaloko Makai.

Conformance to Public Policy

The current County General Plan was developed under the assumption that the "County will continue to pursue the development of a strong multi-market base for the visitor industry that includes integrated product development for local products that can generate a healthy small business economic base. The County's visitor industry will continue to successfully grow and expand."[11]

Likewise, the Kona CDP provides for hotels and other lodging facilities within T5 zones such as proposed for Kaloko Makai.

The Lodge and Business Center at Kaloko Makai is planned to be in alignment with these goals and standards.

Lodge and Business Center Market Conclusions

According to the Hawaii Tourism Authority (HTA), 14% of visitors to Kona in 2010 traveled there to conduct business (other than for meetings, conventions or incentive travel, or MCI), to visit friends and relatives, attend sporting events or for other miscellaneous purposes including those traveling on government, military or school business. This "non-pleasure" and "non-MCI" market could theoretically require some 1,000 accommodation units per day[12], a good share of which is likely to be with friends and relatives or in other nontraditional or noncommercial accommodations. However, the remainder of this sizeable market patronizes area hotels and other commercial accommodations for their overnight stays, and is representative of the markets being targeted by the Subject. Inter-island kama'aina business and other travelers are not counted in the HTA data and represent a significant expansion of this potential market.

The target markets appear to be underserved by Kona's current offerings. Review of Kona hotels outside of golf resorts and known to cater to and attract these local and alternative market segments yields only four aging properties (36 to 51 years old), all located in relatively congested Kailua-Kona town. Palamanui, a proposed development to the north of Kaloko Makai, could provide up to 70 such units if it is to be developed as initially planned. While conceived to serve the university to be associated with Palamanui, that new hotel facility could provide a limited offering for some of the markets targeted.

Based on the research conducted and assessment of current and potential future area market alternatives, the Kaloko Makai Lodge and Business Center is estimated to be supportable by 2025, and to achieve an average daily room rate of about $120 to $130 (in 2010 dollars), at stabilization. This considers that it would be a modern, purpose-built

[11] County of Hawaii, County of Hawaii General Plan, February 2005, pg.1-11.

[12] Total visitor days of 6,796,000 x 14% market share x 6/7 (conversion of days to nights) / 365 days / 2.1 persons per room.

and conveniently located facility, better suited to its targeted markets than existing options, and possibly competitive with a future lodge facility at Palamanui.

Given its small size and the potential size of the relatively underserved kama'aina and business market segments targeted, average annual occupancy at the Kaloko Makai Lodge and Business Center is projected at 65% at stabilization.

2 - Economic and Demographic Trends

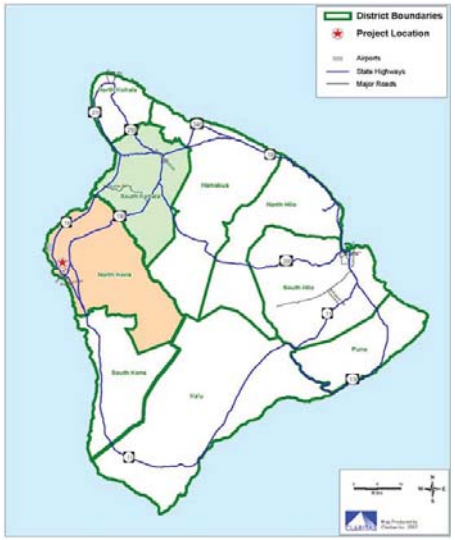
Geographic Areas of Analysis

Judicial Districts

The island of Hawaii (the Island) is divided into nine judicial districts. The Kaloko Makai property is in the North Kona District, which extends from Kealakekua in the south, past Kiholo Bay in the north. It includes the Kona International Airport at Keahole (Kona Airport) as well as the resort communities of Keauhou, Kailua-Kona, Hualalai and Kukio.

Adjacent to and north of this district is the South Kohala District, which includes most of the rest of the Island's visitor and second home infrastructure in the resort areas of Waikoloa Beach, Mauna Lani, and Mauna Kea. Other major communities in South Kohala are Waikoloa Village and Waimea Town. These offer both primary and second homes.

Island of Hawaii Districts



Source: Claritas, Inc., 2007. See Exhibit 2-1 for copy at a larger scale.

West Hawaii

The island of Hawaii is often considered in just two parts, East Hawaii and West Hawaii. Although there is a great deal of commuting from East to West Hawaii, this is in large part a reflection of the lack of appropriate housing opportunities for local families in West Hawaii, rather than an integration of the two divisions' economies.

West Hawaii is commonly defined as the districts of North Kohala, South Kohala, North Kona and South Kona. Within West Hawaii, the North Kona and South Kohala Districts contain the primary drivers of the region's economy, which is currently anchored in the visitor, construction, and related service industries.

Areas of Market Evaluation

- For purposes of **commercial and industrial market assessment,** Kaloko Makai's "Primary Trade Area" (**PTA**) is considered to encompass all of North Kona and South Kohala, the colored areas of the map on the prior page. While this broad area may be considered to generate the majority of demand for commercial and industrial development at Kaloko Makai, most of the supply that serves this demand is concentrated in the northern parts of the North Kona District.

- For purposes of **residential market assessment,** a tighter area is evaluated, reflecting the need for additional residential supply in the midst of the North Kona and South Kohala Districts, where the majority of West Hawaii's jobs are located. This smaller "Competitive Residential Market Area" (**CRMA**) for residential uses is defined herein to consist of Census Tracts 215.01 and 217.01:

Census Tract 215.01 – Portion of North Kona District

Source: Claritas, Inc., 2007. See Appendix 1 for copy at a larger scale.

Census Tract 217.01 – Portion of South Kohala District

Source: Claritas, Inc., 2007. See Appendix 2 for copy at a larger scale.

- "North Kona-North," or Census Tract (CT) 215.01. This area extends from approximately Henry Street in the south to the northern border of the North Kona District. It includes the Kaloko Makai site but excludes Kailua-Kona Town and Keauhou Resort.

- "South Kohala-Waikoloa," or CT 217.01. This area extends from the southern border of the South Kohala District up past Kawaihae in the north. Its major residential community is Waikoloa Village; it excludes Waimea Town.

Island and Statewide Trends and Outlook

Projected Island of Hawaii Population (Exhibit 2-2)

Hawaii Island had approximately 149,000 residents in 2000 and 185,000 in 2010, according to the U.S. Census. Four sources are considered in estimating how population has grown in the interim, and how it is likely to grow over the coming decades.

- **The U.S. Census** provides annual population estimates for counties as of July of each year. The Census counted the Island's 2010 resident population at 185,079 persons, representing an annual average rate of increase of 2.2% since 2000.

- **Claritas**[1] provided this study with 2010 population estimates and a 5-year projection to 2015. Claritas' figures were prepared based on the Census' 2009 estimate and represent a 2.0% rate of growth since 2000, and 1.6% from 2010 to 2015. This would result in an Island population of 195,460 in 2015.

- **The State of Hawaii, Department of Business, Economic Development and Tourism (DBEDT)** issued its long-term population and economic projections for the state and counties of Hawaii, its "2035 series" in January 2008. The County of Hawaii has adopted this series for its planning purposes, and did not release estimates of population by district as it had with previous DBEDT projections.

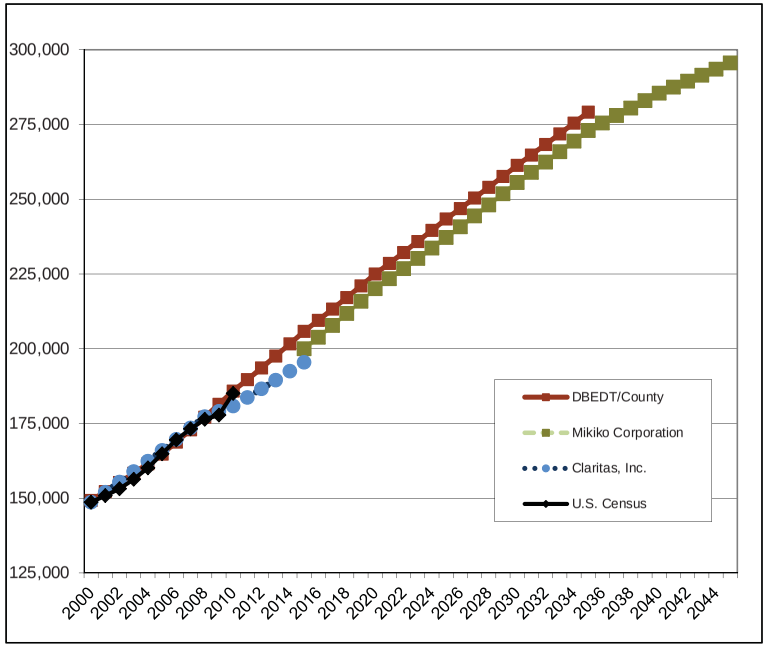
  This latest DBEDT/County series anticipates 279,150 residents on the island of Hawaii by 2035, or 261,340 in 2030, as shown on the chart on the following page. This would represent a 1.6% average annual rate of growth from 2010 to 2035. DBEDT and the County assume that growth is faster in the short-term, at 1.9% per annum from 2010 to 2020, and slower in the longer term, at 1.3% per annum from 2030 to 2035.

- **Mikiko's** projections are informed by 2010 and subsequent census estimates and extend to 2045, the planning horizon for Kaloko Makai. Mikiko's projections were developed as a more conservative view of the long-term future after the 2035 series, with the Island's population growth rate set at 0.9% per annum between 2035 and 2040 and 0.7% between 2040 and 2045. This would result in a 2045 resident population of 295,600 persons.

[1] Claritas derives its information from the U.S. Bureau of the Census, State and local governmental planning and forecasting entities, its proprietary Business-Facts ® database and other sources.

This more conservative view is considered appropriate so as not to overstate demand for residential and commercial uses in the long-term.

Projected Resident Population – Island of Hawaii



See Exhibit 2-2 for sources and further information.

Aging of the Population (Exhibit 2-3)

The changing age-composition of Hawaii's population will have an enormous impact on home-buying and other consumer spending patterns locally as elsewhere in the nation. While long-term projected age-cohort data is not available by county or sub-areas, the U.S. Census prepares decennial projections by state.

Viewed in an age pyramid, a most notable feature is the aging of the Baby Boomers, whose members ranged from about 45 to 64 years old in 2010, and will be mostly 55 to 74 by 2020, and 65 to 84 by 2030.

- **2000 to 2010** - As the dominant consumers in the overall marketplace, Baby Boomers fueled a move-up home-buying market consistent with their middle-aged, peak earnings status.

  Age groups showing the most population gains in the 2000 to 2010 period in Hawaii were all over 45:

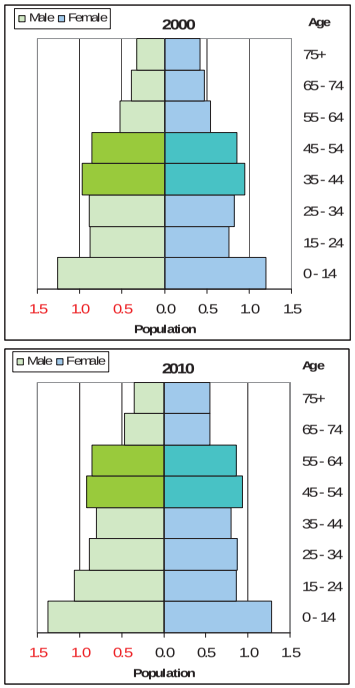
  - 45 to 54: +14,000 persons
  - 55 to 64: +64,000 persons
  - 65 to 74: +16,000 persons
  - 75+: +15,000 persons

- **2010 to 2020** – In the current decade, Baby Boomers will continue to exert strong influence in the housing market. This will be reflected in rapidly growing demand for downsized, retirement and/or other specialized housing types that support their empty nester and retiree stages of life. Also notable in this decade will be renewed growth in the entry and the early move-up housing markets, represented by persons aged 25 to 34.

  Age groups projected to show the most gains in the 2010s include both early and older homebuyers:

  - 25 to 34: +22,000 persons
  - 65 to 74: +52,000 persons
  - 75+: +21,000 persons

Age Pyramids – State of Hawaii: 2000 and 2010



Note: Each unit on horizontal axis represents 100,000 persons. Highlighted bars include the Baby Boomer cohort.
See Exhibit 2-3 for sources and further information.

- **2020 to 2030** – The last decade for which age-forecast information is available will be characterized by rapid growth of the elderly population, necessitating specialized and age-catered housing solutions.

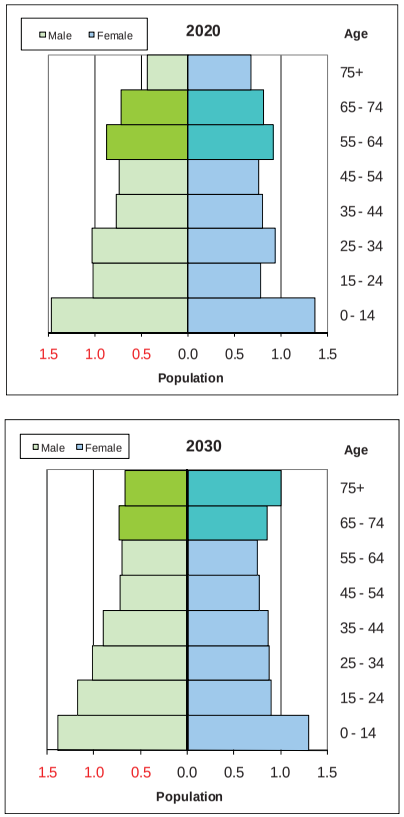
  The second most rapidly growing potential housing market during this period will consist of those aged 15 to 24, an age that usually encompasses household formation, often in rental housing.

  The third most rapidly growing group would be those aged 35 to 44, typically a home-buying or early trade-up housing market.

  Cohorts expected to gain population in the 2020s include:

  - 15 to 24: + 27,000 persons
  - 35 to 44: + 19,000 persons
  - 75+: +56,000 persons

Age Pyramids – State of Hawaii: 2020 and 2030



Note: Each unit on horizontal axis represents 100,000 persons.
Highlighted bars include the Baby Boomer cohort.
See Exhibit 2-3 for sources and further information.

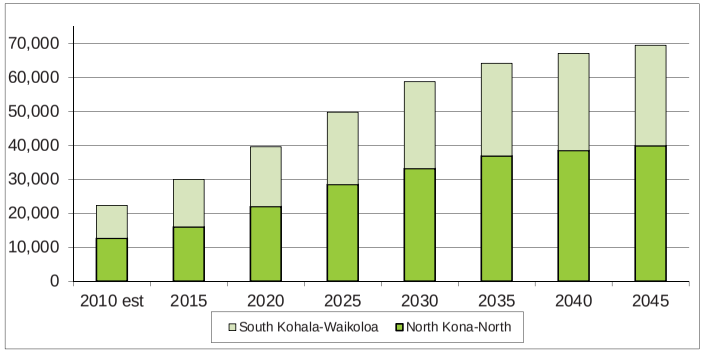
Competitive Residential Market Area Trends and Outlook

Resident Population (Exhibit 2-4)

Mikiko prepared population projections for the CRMA based on its own relatively conservative population projections for the island. These projections assume it is possible and desirable from a policy standpoint that residential opportunity in the CRMA approach the level of employment opportunity in the CRMA.

As of 2010, the CRMA appeared to offer 23% of employment positions on the Island, while housing only about 12% of the Island population.[2] The area includes all seven of the largest nongovernment employers on the Island, including the Hilton Waikoloa Village, Wal-Mart (with locations in Kona and Hilo), KTA Super Stores (with locations throughout the island), the Four Seasons Resort Hualalai, the Fairmont Orchid, Mauna Lani Resort (Mauna Lani Bay Hotel & Bungalows, golf courses and resort operations), and the Hapuna Beach Prince Hotel.[3] Other employers headquartered in the CRMA that rank among the island's largest include the Mauna Kea Beach Hotel, Roberts Hawaii, and Hawaiian Airlines.

Resident Population –
Competitive Residential Market Area



See Exhibit 2-4 for sources and further information.

[2] This discrepancy appears to be widening: in 2006, Claritas, Inc. estimates suggest the CRMA offered 21% of island jobs, while still housing 12% of its population. This is based on estimates for employees of establishments located in CTs 215.01 and 217.01 in comparison to total employees island-wide. Note that "employees" exceed the "civilian labor force" discussed in a later section, since labor force members may hold more than one job.

[3] As of December 31, 2009, as published by Pacific Business News, "Book of Lists," December 24, 2010: "Big Island Employers – Nongovernment," originally published October 15, 2010.

Additionally, clusters of new development and employment are planned within the CRMA at:

- The University of Hawaii Center at West Hawaii (UHCWH) and its associated community, Palamanui;
- The Natural Energy Laboratory of Hawaii (NELHA);
- Already zoned commercial areas in Keahuolu and elsewhere; and
- Kaloko Makai itself.

Mikiko assumed that the CRMA population reaches its 2010 share of Island jobs within 20 years (achieving 23% of Island population in 2030) and that it tends to stabilize as a center of employment and population thereafter (achieving 23.5% of the Island population by 2035).

This would result in a 2025 population of some 49,800 persons in CTs 215.01 and 217.01, and a 2045 population of about 69,500. These would represent a doubling of the CRMA's population by 2025 and a 3.3% rate of increase for the 2010 to 2045 period as a whole. These rapid growth rates would contrast with those for the island as a whole, at some 1.3% over the 35-year period.

Number and Age Distribution of Households (Exhibit 2-5)

In terms of households, the CRMA accounted for an estimated 11% of the island total in 2010, according to Claritas. Some 4,200 or 6% of the total were in North Kona-North, while some 3,600 or 5% of the island total were in South Kohala-Waikoloa.

CRMA households tend to be of workforce age, with 80% to 81% headed by a person aged 25 to 64, compared to 73% Island-wide that fell in these age groups.

Average household sizes in these areas of interest were estimated as follows:

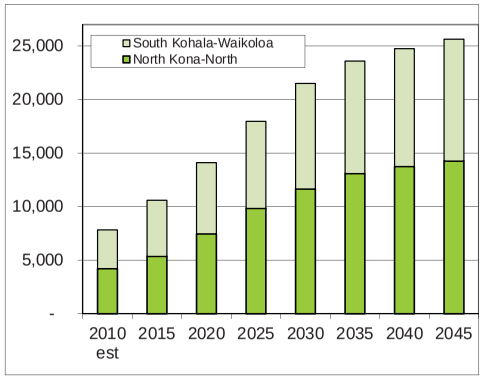
- North Kona-North: 3.00
- South Kohala-Waikoloa: 2.67
- Hawaii County: 2.68

Projected Households (Exhibit 2-6)

More housing opportunities as well as jobs in the CRMA would enable the uncoupling of some currently doubled up households. Together with age profile changes over time, this will lead to declining household sizes in the CRMA as well as the Island as a whole.

Considering historical factors and the anticipated growth in workforce population in the CRMA, Mikiko projected future households in the area based on slowing rates of decline in household size. Overall, the projected changes in household size represent a 0.2% per annum decline in North Kona-North, a 0.1% per annum decline in South Kohala-Waikoloa and 0.1% per annum decline in the County as a whole.[4]

Projected Households – Competitive Residential Market Area



See Exhibit 2-6 for sources and further information.

It is concluded that the CRMA could accommodate some 25,600 households by 2045, assuming its future housing opportunities are allowed to approach its future employment opportunities. This would represent a need to house some 17,800 more households over the next 35 years, considering 7,800 households in the region in 2010.

Households by Income (Exhibit 2-7)

North Kona-North and South Kohala-Waikoloa show a higher household income profile than the Island as a whole, with only 33% of households earning $50,000 or less in 2010, compared to 45% for the County as a whole. Likewise, 30% of CRMA households are estimated to earn between $100,000 and $249,000, while only 24% are in this range for the County as a whole.

Claritas estimates the median 2010 household income is approximately $70,000 in North Kona-North, $69,000 in South Kohala-South, and $67,000 for the Island of Hawaii.[5]

Per capita income in the CRMA was estimated at about $32,000 in 2010.

[4] These factors are similar t those developed by SMS, Inc. in its 2006 housing policy study prepared for the State and Counties of Hawaii, with input from the various housing directors.

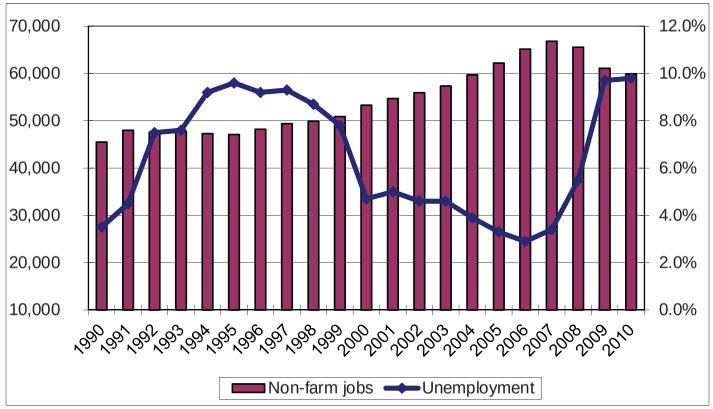
[5] These do not reflect the substantially higher incomes of the region's part-time residents.

Employment Trends (Exhibit 2-8)

Unemployment averaged 9.8% in 2010 for Hawaii County, minimally unchanged from 2009, according to the State of Hawaii, Department of Labor and Industrial Relations (DLIR). This compares to 5.5% in Honolulu County, 8.2% in Maui County and 8.8% on Kauai. Hawaii Island's December 2010 figure was 8.7%, the lowest monthly recording of the year.

However, the favorable unemployment trend has been achieved by a declining civilian labor force, since both employed persons and non-farm wage and salaried jobs have declined in recent years. Non-farm jobs have dipped back to approximately their 2004 level.

Island of Hawaii Labor Force Trends



See Exhibit 2-8 for sources and further information.

3 - Residential Market Environment

Existing and Historical Conditions

Hawaii County – 2009/2010 Inventory Estimates

- **Total units** - Hawaii County had some 80,600 housing units in July 2009, representing 16% of the State's supply, according to the U.S. Census. This was a 7% increase from the 75,000 units reported in July 2006 (Census housing data prior to 2006 may not be comparable)[1].

- **Occupancy and tenure** - The Census update does not provide housing characteristics by County, but recent survey data can be obtained from the Census' American Community Survey (ACS.) The most recent ACS survey, taken in 2007-2009,[2] finds that some 81% of Hawaii County units were occupied and 19% vacant.[3]

  Among occupied units, 66% were owner-occupied and 34% renter-occupied, a slightly lower ratio of owner-occupancy than evidenced a few years prior.

- **Primary resident vs. non-resident uses** – Most of the County's vacancies are among non-resident units; they do not represent homes available to primary residents. In the ACS survey, 51% of vacant units were held for seasonal, recreational or occasional use, while only 32% were available for rent or for sale (or rented or sold but not yet occupied.)[4] Even this 32% includes some units being marketed to visitor or other off-island consumers.

  Additionally, data from previous ACS surveys show that among occupied housing units, a minimum of 5% are occupied by persons whose usual place of residence was outside of the County[5].

[1] U.S. Census Bureau, Population Division, release date June 2010, as published by County of Hawaii, Data Book at http://www.co.hawaii.hi.us/databook_current/section16.htm . Since 2006, the Census housing estimates include units for group quarter populations, rather than household populations only.

[2] U.S. Census Bureau, American Fact Finder, at http://www.factfinder.census.gov/, as accessed February 25, 2011.

[3] This vacancy rate encompasses units held for occasional and seasonal use (see below) and therefore is much higher than the conservative 5% vacancy assumed to be desirable within the primary housing market later in this chapter.

[4] This finding is consistent with 2000 Census data, which showed 53% of the island's housing vacancies attributable to units held for seasonal, recreational or occasional use, per U.S. Census Bureau, Census 2000, Table DP-1. The remaining 17% of units remained vacant for "other" reasons, according to ACS 2007-09.

[5] Updates of this information do not appear to be available since the 2006 ACS survey.

Applying the 19% vacancy and the 5% nonresident occupancy to the estimated 80,600 total units in 2009 suggests some 61,700 Big Island units occupied by primary residents.

- **RHU vacancy rates** - The 2007-09 ACS survey suggests homeowner and renter-occupied vacancy rates of 3% and 14%, respectively, both slightly up from their ranges two years ago. Weighting these by the mix of owner- and renter-occupied units and considering the minimum 5% of units believed to be occupied by persons who customarily live off-Island, we derive a maximum 6% vacancy rate applicable to primary resident housing units (RHUs) in the County in recent years.

  This is considered a maximum vacancy because both the owner and the rental vacancy rates include units marketed to off-islanders. Also, the 5% share of units estimated to be occupied by persons who normally live off-Island is considered a minimum.

Estimated Vacancy Rate for Resident Housing Units – High Indicator

	Vacancy rate	Mix	Comments
Owner-use	3%	63%	Includes part-time resident owners
Renter-use	14%	32%	High vacancy attributed to part-time use; mix adjusted to exclude 5% as noted below
Occupied units (off-Island residents)	0%	5%	Minimum share of units occupied by off-Islanders
Overall	**6%**	**100%**	**High vacancy indicator for RHUs**

Source: Mikiko Corporation, 2011.

- **RHU inventory** – Finally, the 2009 inventory of **RHUs in the County is estimated at fewer than 65,600 units**. This is derived from the 6% vacancy on top of the 61,700 estimated occupied units available for long-term use by primary residents.

North Kona-North and South Kohala-Waikoloa Inventories

While the ACS does not break out housing supply by area, according to data obtained from Claritas, about 10,300 or an estimated 13% of the Island's 2009 gross housing stock (including non-resident units) was located in the CRMA.[6] About 24% of these area units were vacant in 2010, according to Claritas.

The CRMA's very high vacancy rate reflects its many resort second home communities including Mauna Kea, Mauna Lani, Waikoloa Beach, Hualalai, Kukio and Kaupulehu. Because of its visitor orientation, the CRMA has a far greater share of units held for seasonal, recreational or occasional use than the County as a whole. While current Census or ACS data is not available on this point, it is well established by observation and the previous Census:

- An April 2009 survey by Mikiko identified more than 2,400 resort residential units at just the above-noted six golf resort communities. Many other units in off-ocean settings such as at Waikoloa Village and developments throughout the Kaloko area are also known to include disproportionate shares of units purchased as second or vacation homes.

- The 2000 Census indentified 1,604 units held for seasonal, recreational or occasional use in CRMA areas; these represented 82% of all housing vacancies in these areas.

Considering these factors together, **RHUs in the CRMA were estimated at no more than 7,800 units as of 2010**, representing an estimated 76% of the area's total estimated housing stock.

This conclusion corroborates the 24% vacancy rate among the area's 10,300 gross housing units (including non-resident units) in 2010; the great majority of those vacancies are understood to be outside of the primary housing sector.

Residential Building Permits (Exhibit 3- 1)

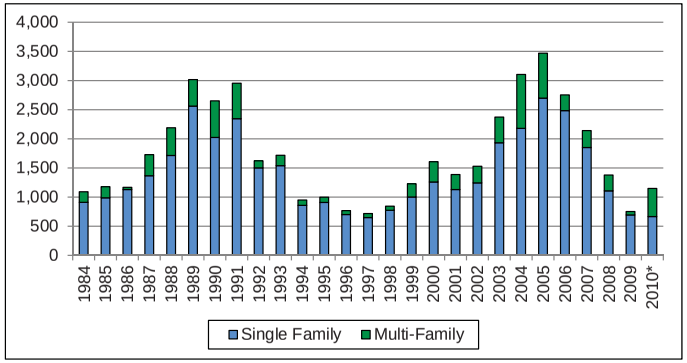
Hawaii County residential permitting is dramatically cyclical and evidenced a trough from 1994 to 1998. Within two years thereafter, permitting activity increased rapidly, culminating in a record 3,469 residential permits obtained in 2005. Activity has plunged since then, with fewer than 800 permits obtained in 2009, a level matching the prior trough of 1996-1997.

According to the County, moreover, the majority of the 2009 permitting activity was in Puna and South Hilo; only 17% of it was in the South Kohala or North Kona districts.

[6] Note Claritas data is estimated for 2010, while total island data is estimated for 2009.

The year 2010 may have marked an upturn to a new cycle, with total residential permits reaching 1,149[7]. The positive results in 2010 were driven principally by development activity in the multifamily market.

Building Permits – Hawaii County



* Annualized based on data through November 2010
See Exhibit 3-1 for sources and further information.

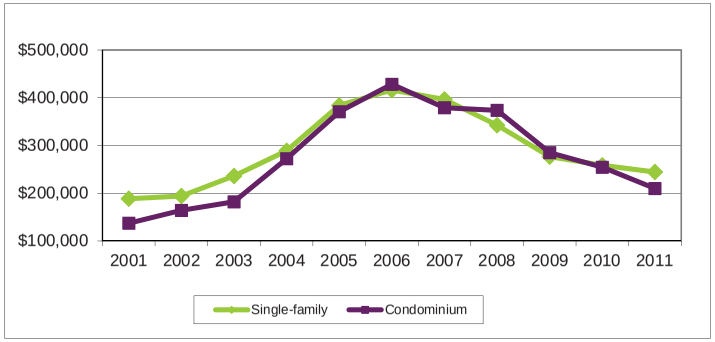
Residential Market Trends

Island-wide Resales (Exhibit 3-2)

Rapidly rising County home prices through 2006 reflected a strong local economy and labor market, as well as favorable financing conditions. However, in subsequent years, prices fell for both single-family homes and condominiums.

[7] Based on 1,149 new housing units as of November 2010, annualized. County of Hawaii: Department of Research & Development - County of Hawaii Statistics; http://www.hawaii-county.com/info/stats.html

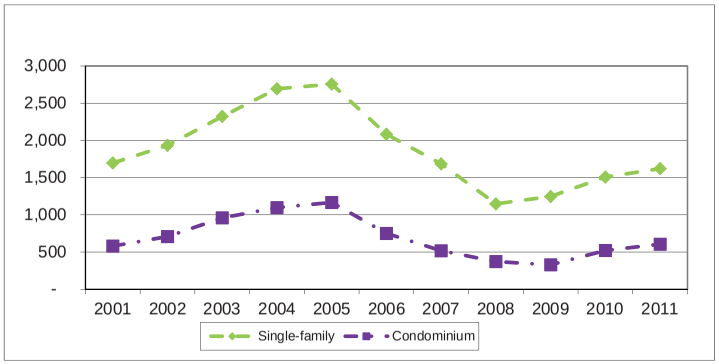
Hawaii Island Resales – Median Prices



See Exhibit 3-2 for sources and further information.

After 2009, conditions appeared to be stabilizing, with still declining prices but more sales recordations. The ongoing price impairment is attributed to lingering softness in the local economy, as well as distress sales that continue to suppress the overall market.

Hawaii Island Resales – Number of Transactions



See Exhibit 3-2 for sources and further information.

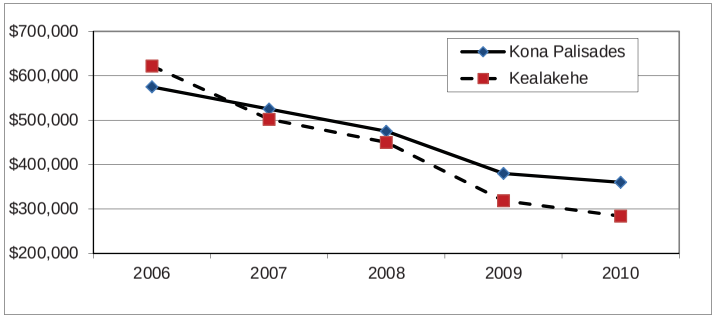
The short-term outlook is for solidifying sales activity, while prices may continue to decline in the near-term due to distress sales, local labor market weakness, ongoing real estate market softness in Hawaii's off-island source markets, and more stringent credit standards. However, longer-term, ongoing population growth, household formation and pent-up desires over the past few years will fuel demand for new housing throughout the County and especially in economically developing areas such as West Hawaii.

Sales in Selected Areas, North Kona-North (Exhibit 3-3)

Residential sales in the Kona Palisades and Kealakehe communities of North Kona-North are examined in further detail because of their locational similarities to Kaloko Makai. However, at the present time, both these areas are well-established primary residential communities with a predominance of single-family product; they offer fewer insights to new built product and to the potential market for multifamily primary homes.

Like the Island-wide trend, prices in the indicator neighborhoods have declined since 2006. As of October 2010, Kona Palisades showed median prices of $360,000 for single-family sales and $325,000 for condominium sales, although there were only 11 of the latter. In Kealakehe, the median single-family home sold for $284,000, reflecting only 16 sales, most of which are believed to be DHHL sales. There were no condominium sales recordations in Kealakehe as of October 2010.

Residential Sales in Kona Palisades and Kealakehe – Median Price, Single-Family Homes



See Exhibit 3-3 for sources and further information.

The number of sales has also generally declined or held steady since 2006, with some rebound in 2007, especially in the multifamily market (Kona Palisades).

Housing Market Outlook

Potential New RHUs in the CRMA (Exhibit 3-4)

Mikiko conducted a survey of planned residential projects within the CRMA, or CTs 215.01 and 217.01. This survey targeted projects of 100 units or more for which State Land Use Commission (LUC) Urban designation was in place as of December 2010, and/or for which the landowner may be exempt from LUC governance.[8] The planned units reported are the maximum allowed by existing entitlements, and/or the maximum currently planned for development, whichever is lower. As such, these counts likely overstate future production, since most projects are not built to their ultimate entitled or planned capacity. Planned totals were also adjusted according to the share of development anticipated to be used in the primary residential market, as opposed to a second home or other non-resident market.

At the time of the survey, many projects were reported to be on hold, but even where previous development agreements may have expired or current borrowers may be in default, the underlying land entitlements would permit similar development plans once the market begins to recover.

The survey did not consider emergency shelters, dormitory beds, or other group living quarters.

- **North Kona-North** - Some 6,300 future RHUs on LUC-Urban lands were identified at 12 projects in CT 215.01, not including Kaloko Makai. The largest projects involve State lands and include significant restrictions by income and/or Native Hawaiian ancestry. The five largest projects in the district were:
  - **Kamakana Villages** by Forest City on State HHFDC lands – 2,330 units, estimated at 2,210 RHUs;
  - **Kaloko Heights** by SCD – 1,362 units, estimated up to 1,020 RHUs;
  - **Villages of La'i 'Opua** by DHHL – 872 more units (in a community of over 1,000 at completion), or some 830 potential future RHUs;
  - **Keahuolu,** adjacent to La'i 'Opua and also proposed by DHHL, but longer-term – 750 units or up to 710 RHUs; and
  - **Palamanui** by Hunt Development Group and Charles Schwab – 1,116 units or some 890 potential future RHUs in association with a new University of Hawaii Center at West Hawaii (UHCWH) campus.

[8] The inventory excludes potential residential developments on Queen Lili'uokalani Trust lands in Keahuolu, where some Land Use Commission-Urban designations may already be in place, but could be stalled and/or designated for uses no longer contemplated. QLT is preparing a petition to the LUC for review of the uses of these lands.

Also in the immediate vicinity of Kaloko Makai is Kula Nei, a proposed 216 to 220 lot (plus affordable housing) development which is reportedly experiencing financing problems.

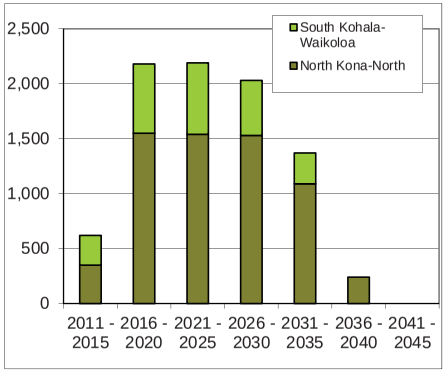
Nearby Kohanaiki, a luxury golf and second home development on the makai side of Queen Ka'ahumanu Highway, is notable but not included in the inventory of RHUs used in this assessment because of its market orientation. Even if Kohanaiki were to be replanned in the future, its ocean orientation and high-end golf and other infrastructure are likely to ensure that it remains a resort/second home- rather than a primary housing community.

- **South Kohala-Waikoloa** shows some 2,300 future units entitled and planned, at seven projects. The largest in terms of potential future RHUs are:
  - **Kamakoa Nui**, a workforce housing project initiated by the County of Hawaii in Waikoloa Village – up to 1,200 total units, estimated at 1,140 RHUs;
  - **Keolalani at Waikoloa** by Keolalani Investment Partners – potentially up to 2,000 units but only 500 or so considered likely to ever be developed as RHUs; and
  - **Wehilani,** Castle & Cooke's master-planned community in Waikoloa Village, where some 700 more units, or an estimated 490 more RHUs are planned.

While most units at these projects could be expected to be developed by 2035, development or conditions specific to certain sites or projects could delay some even further, and preclude others altogether.

As also noted, these potential inventories are likely generous since they consider current zoning or plan maximums and active development schedules. Often projects are developed at less than their permitted or planned densities, and/or experience delays that push inventory further into the future.

Potential New Resident Housing Units – Competitive Residential Market Area



See Exhibit 3-4 for sources and further information.

Summary of Island Demand and Supply (Exhibit 3-5)

- **Current and future demand** – As presented previously in Exhibit 2-6, in order to begin to address the Island's imbalance of jobs and primary resident housing, the number of households in the CRMA would have to nearly double from the estimated 7,800 in 2010, to more than 14,000 in 2020, and then continue to increase to some 25,600 by 2045. This suggests a need to provide housing for some 17,800 new households over the next 35 years.

  While there is likely current pent-up desire for household formation within the region, this has not materialized as significant demonstrable market demand in recent years due to the currently soft economic conditions in the County. Therefore, current pent-up demand is assumed to be zero.

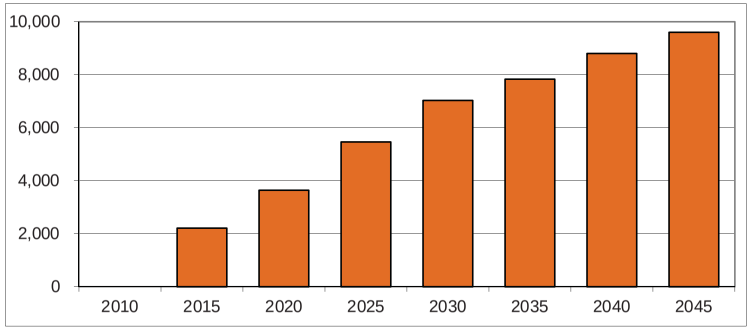
- **Current supply** – The current supply of RHUs in the CRMA is estimated at 7,800 units, as presented at the beginning of this chapter.

- **Future supply** – Future supply estimates are based on a hypothetical schedule of LUC-entitled maximum developments in the CRMA. The identified projects could potentially produce up to 8,600 new units by 2040, as shown previously in Exhibit 3-4. From this figure a 5% vacancy allowance is deducted, resulting in some 8,200 new units available for resident housing use.

Taken together, the outlooks for RHU demand and entitled potential supply indicate a growing shortfall in permitted housing opportunities. Even hypothesizing aggressive and sustained housing production efforts, without further State entitlement of additional housing developments in the CRMA, the unmet demand for housing could trend up to more than 9,600 homes by the year 2045.

This deficit could materialize as a steady increase in the amount of pent-up demand as current inventories of State-entitled residential properties expected to serve primary housing markets become developed and absorbed, while demand increases steadily. Without further entitlement, today's imbalance between the locations of Island employment and housing opportunities will only be magnified, with likely social repercussions.

Resident Housing Unit Deficit in the CRMA
After Development of All Currently State-Entitled Lands



Source: Mikiko Corporation, 2011. See Exhibit 3-5 for further information.

4 - Residential Market Assessment

Future Housing Market Setting

Demand Generators (reference Exhibit 3-5)

SCD-TSA anticipates Kaloko Makai's first housing units could be available for occupancy in 2015. While today's economy is still in transition, the recent years of minimal household formation and housing development are expected to result in substantial pent-up demand for primary resident housing in the near future. Mikiko estimates that by 2015, RHU supply in the CRMA might be more than 2,200 units short of what could be desired by Island residents, even in the unlikely event that there is aggressive development in the interim.

Demand generated during subsequent years of the Project's marketing will originate from new household formation as well as from existing Island households wishing to move into the area. This new demand can be characterized as:

- **Downsizers** – The Baby Boom generation should be in its peak "downsizing mode" between 2010 and 2020; after 2020, a larger share will be entering their mid-60s than their mid-50s. Many members of this older generation can be expected to seek to live closer to town centers as their children move out from home, they enter retirement and/or as they no longer care to maintain a large home.

  Also after 2020, the 55 to 64 age cohort could decline as Baby Boomers move into their 70s. This may also fuel downsizing (see "senior markets," below.)

- **Entry level markets** – Hawaii's next most rapidly growing cohort between 2010 and 2020 is likely to be persons aged 25 to 34, the "Echo Boom" generation. Households are typically formed during one's mid-20s to early 30s, and one's first rental or home purchase is often made during this phase of life. Since affordability is key to this market and many do not yet have spouses or children, this market also tends to accept smaller units.

- **First move-ups** – A strong move-up market could emerge after 2020, as the Echo Boom cohort ages into its mid-30s and early 40s.

- **Retirement/senior markets** – The retiree/senior market will show significant gains between 2010 and 2030. Typically one or two persons per household, this market may be amenable to more dense housing, and often must move to meet specialized housing needs.

Several of these household types are expected to be willing to accept more dense living environments and to value accessibility to community amenities. Kaloko Makai's location could be attractive to these growing market segments because of its proximity to

existing and future anticipated Island jobs, future transit routes, the shoreline and regional parks, shopping and entertainment, the Kona Airport and the many planned investments in public and private infrastructure throughout the CRMA region.

Housing Demand and Supply (reference Exhibit 3-5)

Currently entitled projects are estimated to yield up to 8,200 of the potentially demanded 17,800 RHUs in the CRMA by 2045, if they are built out within this time frame and developed to the maximum levels of their respective current plans and entitlements.

Despite an assumed strong and sustained rate of new RHU home production throughout the study period, entitlements within the CRMA account for less than half the projected need. Therefore, without further land entitlement, the area could still face an approximately 9,600-unit shortage by 2045:

Supply and Demand for New Resident Housing Units - Competitive Regional Market Area, 2010 to 2045

Future Demand	Pent-up demand, 2010	0*
	Future need, 2011-2045	17,800
	Total need	17,800
Future Supply	Planned and entitled (8,600 less 5% vacancy), rounded	8,200
Shortage	**As of 2045**	**9,600**

* Assumed to be zero due to current economic environment.
Source: Mikiko Corporation, 2012. See Exhibit 3-5 for further information.

The anticipated area housing shortage appears to be particularly acute beginning in the late 2020s, when many of today's planned projects could have already delivered most of their entitled inventory.

Kaloko Makai's Proposal

Meeting Community Desires

Kaloko Makai has been planned to respond to its community's desires regarding future growth, as expressed in the Kona Community Development Plan.[1] The Kona CDP directed growth to compact, higher density "villages" mostly located north of Kailua-Kona Town along the Ane Keohokalole Highway transit corridor. These growth centers were expressed as 10 Transit-Oriented Development (TOD) Urban Villages, of which Kaloko Makai is identified as one.

[1] Wilson Okamoto Corporation, for the County of Hawaii Planning Department, "Mapping Kona's Future: Kona Community Development Plan," September 2008.

The County of Hawaii has subsequently established more concrete guidelines for these TOD areas in its Kona Village Design Guidelines.[2]

Kaloko Makai's residential plan, like its community plan as a whole, begins with these community and public guidelines.

Development Concept

Kaloko Makai is planned to respond to the market and demographic trends as well as the community desires discussed above. It will serve a County population that is changing rapidly in terms of size, geographic dispersion, age profile and lifestyle. It will deliver needed homes in a diverse, planned community.

Thanks to the gradual slope of much of the site, Kaloko Makai will offer ocean and/or regional views from a substantial share of its residential, parks and other areas. From a housing standpoint, the plan concept features a transit-ready Urban Center (Transect zone T5) on Ane Keohokalole Highway, with lower density General Urban (T4) and Sub-Urban (T3) areas. Based on the Final Draft Kona Village Design Guidelines, the T4 and T5 areas would be mostly multifamily, while the T3 areas would be single-family or duplex residences. A Special/Mixed Use district in the lower portion of the site may also include some multifamily housing.

Residential Product Mix

Although exact outcomes will depend on the agreements to be reached with the County, some 700 to 1,000 units, or up to 20% of Kaloko Makai's homes are assumed to be built as "affordable" housing, based on current County guidelines. The number of units to be provided will depend on the buyer income levels targeted, based on County guidelines. Affordable housing could be offered as for-sale or rental units, but has been addressed in this report as for-sale units.

The balance of homes at Kaloko Makai will be its 4,000 to 4,300 "market" homes, ranging from traditional single-family homes to mixed use, mid- and higher-density multifamily units. A conceptual maximum development scenario for the Project is as follows:

[2] Based on PlaceMakers, LLC, "Kona Village Design Guidelines" (calibrated for the County of Hawaii), Final Draft, October 10, 2010.

Conceptual Mix of Residential Units at Kaloko Makai
Maximum development at buildout

Predominant unit type	Transect zone	Total planned units	Example density (units per acre)
Multifamily ("affordable")	T4 and T5	700 to 1,000	8 to 16
Multi- or single-family ("market")	T4 and T5	3,014 to 3,314	8 to 16
Single-family ("market")	T3	986	3 to 6
Total		**5,000**	**3 to 16**

Sources: PlaceMakers, LLC, 2010; SCD-TSA Kaloko Makai, LLC, 2012; Wilson Okamoto Corporation, 2011.

The majority of homes at Kaloko Makai would be offered in compact or multifamily settings, in adherence with the Kona Design Guidelines noted previously. The conceptual plan shows the maximum proposed inventory of 5,000 units. The exact total number and mix of units by type will be determined upon finalizing agreements with government agencies and during the years of build-out, as market conditions and preferences materialize.

Comparison Project Characteristics (Exhibit 4-1)

In order to develop market conclusions regarding the proposed product types, several North Kona and South Kohala projects were identified and evaluated in terms of their development densities, pricing and absorption. Today's market pricing is highly impacted by foreclosures and short sales, as well as tighter lending and the fact that many developers are simply trying to liquidate the standing inventory they were left with when market conditions deteriorated. Thus, price indicators gathered for the same projects in previous years are also considered.

The survey results are presented in Exhibit 4-1, and are tied to the proposed market products at Kaloko Makai as follows:

- **Suburban T3 Zone – Single-family and duplex** (proposed at 3 to 6 units per acre):
  - South of Kailua-Kona, D.R. Horton-Schuler Division's Pualani Estates development offers single-family homes on lots of 5,000 to 8,000 square feet. Recently recorded prices range from $315,000 to $528,000, and averaging $403,000. This is down from historical average indicators of $489,000 (2008-09) to $557,000 (2007).
  - Castle & Cooke's Kikaha development in Waikoloa Village provides a recent example of single-family development at 3 units per acre, or an average of 10,000 square feet per lot. In 2010, Kikaha units sold for $380,000 to $568,000, averaging $453,000; in 2009 they ranged from $379,000 to $450,000 with an average of $424,000.
- **Urban T4 and T5 Zones – Multi- and single-family market units** (proposed at 8 to 16 units per acre):
  - The CRMA has seen few if any primary housing products that straddle the multifamily and single-family development concepts. The Pines at Kailua-Kona, a condominiumized, zero-lot line single-family detached home project developed in 1989 and 1990 appears to be the best such comparable, at 6.8 units per acre. The few recorded sales in 2010 averaged $277,000, but these units have recently shown average prices in the range of $369,000 (2008-09) to $425,000 (2006-07).
  - Castle & Cooke's Makana Kai at Wehilani is the only market priced, mid-density, multifamily RHU property recently marketed in the CRMA. Five recorded sales in 2010 all appear to be bank foreclosures and subsequently discounted REO sales, and are thus considered less representative of a longer term trend in pricing. (Developer sales at the project were completed in 2009.) Recent historical prices at Makana Kai range from $337,000 to $400,000+ in 2006-07, or $225,000 to $295,000 in 2008-09.
  - Two Kailua-Kona projects were also evaluated, Alii Cove and Alii Park Place. Both of these developments are in a visitor region and appear to allow short-term rentals. However, they are located mauka of Alii Drive, are relatively new, and at 11 units per gross acre, are some of the highest-density multifamily projects in West Hawaii that were not built as affordable housing but still include a substantial share of primary residents. In 2010, sales at Alii Cove and Alii Park Place averaged $306,000 to $331,000, respectively. In 2008-09, the same projects showed averages of $415,000 to $427,000.

Assessment for Kaloko Makai

Anticipated Buyer Markets

The proposed products respond to the market opportunities identified above as follows:

- **Entry-level markets** – Those units designated as affordable units, as well as many of the multifamily market units are conceived to appeal to entry-level markets, typified by the rapidly increasing 25- to 34-year-old Echo Boom cohort in the 2010 to 2020 period.
- **Move-up markets –** Kaloko Makai's single-family products could appeal to move-up markets and growing families.
  - The first level move-up market, typified by persons aged 35 to 44, is projected to grow particularly rapidly in the 2020 to 2030 period as the Echo Boomers mature.
  - A more affluent move-up market could also be attracted to the views, convenient location and lifestyle offerings at Kaloko Makai.
- **Downsizers** – Kaloko Makai's more compact single-family and some of its multifamily units are seen to appeal to the Baby Boomer cohort that is looking to simplify its lifestyle, lessen homeowner commitments and enhance access to town amenities. This market may overlap with the retiree segment described below.
- **Retirement/senior markets** – All of the multifamily units and some of the single-family product could appeal to retiree markets. The age 70+ population will be a rapidly increasing age classification especially towards the latter years of Kaloko Makai's marketing.

Based on the Project location, development concept and the comparison projects surveyed, some 85% of Kaloko Makai residents are anticipated to be primary Island residents. However, some product types could also appeal to second home buyers or investors that may come from off-Island.

Projected Sales Prices (Exhibit 4-2)

The pricing conclusions for Kaloko Makai are presented in Exhibit 4-2 and summarized as follows:

Market Unit Price Conclusions for Kaloko Makai
2010 dollars

	Average sales price*	Approximate average density (units/gross acre)
T3 – single-family	$475,000	3 to 6
T4 & T5 – multi- or single-family	$370,000	8 to 16
Overall, market homes	**$396,000**	**3 to 16**

* For market-priced units only.
Source: Mikiko Corporation, 2012. See Exhibit 4-2 for further information.

The preceding does not consider the affordable units that would also be developed on-site. Their pricing would be set in accordance with County or State guidelines to be determined. Likewise, rental rates, assuming some affordable housing units are developed as rentals, would also be based on County rules then in effect.

For illustrative purposes, according to County guidelines in effect as of September 1, 2010, conforming prices for such housing could range from $202,500 to $366,200 for two-to four person households with incomes ranging from less than 80% up to 120% of the County median. County price guidelines also show one- to two-bedroom rental units priced from $1,037 to $1,500 per month, including utilities, and offered to households earning 80% to 100% of the median income.[3]

Projected Supportable Sales Absorption (Exhibit 4-3)

It is concluded that Kaloko Makai's 5,000 homes could be absorbed over about 31 years at an average long-term rate of 160 units per year. Actual sales from year to year would vary depending on market cycles and the types of units available for sale at any given time. The Project's inventory could represent a significant solution for the anticipated future unmet demand for some 9,600 new housing units in the CRMA through 2045, based on currently LUC-entitled projects and their plan maximums.

[3] County of Hawaii, Office of Housing and Community Development, "Affordable Housing Guidelines for the County of Hawaii," 2010.

These conclusions consider:

- A variety of product types at varying prices (including affordable units) to be offered simultaneously at Kaloko Makai;
- The near-town location, good views, resident-oriented pricing and community amenities planned for Kaloko Makai;
- The experience of other product types at the selected comparison projects;
- The strong future demand for new housing in the CRMA, which is projected at an average of more than 500 units per year through 2045 (see Exhibit 3-5).

An illustrative mix of the overall Project absorption is as follows:

Illustrative Summary of Maximum Potential Residential Sales Absorption at Kaloko Makai, 2015 to 2045

	Affordable homes	Market homes	Maximum total housing
Maximum inventory	700 to 1,000	4,000 to 4,300	5,000
Average annual sales*	22 to 32	130 to 140	160 (rounded)

*Assumes several products are marketed simultaneously in any given year.
Source: Mikiko Corporation, 2012.

Alternatively, if the community develops at less than its maximum plan of 5,000 units, or if some of the units are developed as rental products, the residences could be absorbed more rapidly.

5 - Commercial Market Environment and Assessment

Background

Analytical Approach

This chapter presents a review of area retail and office market conditions and a market assessment for commercial facilities proposed at Kaloko Makai. As proposed, Kaloko Makai would also include a new regional hospital and related facilities. While these elements are significant to the land planning and conceptualization of market opportunities, this commercial market assessment does not assume their development.

While the proposed hospital complex may create myriad employment and enterprise opportunities not already evident in the region, the commercial market assessment is based on a more conservative view of retail- and office-based factors as evidenced within a defined competitive area in 2010. To the extent that a new hospital attracts private commercial demand, that demand is considered a portion of the overall commercial demand that is assessed.

Additionally, although many retail shopping centers include substantial office space, and office buildings often include retail, comparison properties are classified as one or the other based on the predominant use or representation of type by property managers.

- **Retail** - The market assessment for retail space compares retail supply to area daytime populations. Daytime population consists of residents of an area, less those who may be away during the daytime for work or other purposes, plus those who may live elsewhere but are in the area during the daytime, such as those employed in the area. The Census estimates daytime population for primary residents of the area; to this Mikiko adds average daily visitors. Daytime population is a better indicator of commercial demand in West Hawaii than resident population because of the strong influences of visitor spending and commuting workers on area commercial markets.[1]

- **Office** – Demand for office space is related to civilian employment among residents of the region. Government office buildings are not considered, since their development and placement is often a matter of policy and budget processes rather than market characteristics.

  Therefore, this assessment would not include doctors' and other offices that may be located within the hospital structure.[2]

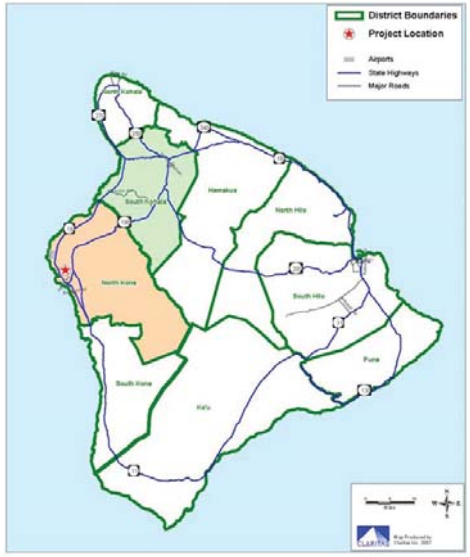
[1] Part-time residents of the region are another potentially very significant market segment, but this source is not evaluated quantitatively here.

[2] The hospital and related medical facilities are assessed separately, in a market study being prepared by Cattaneo & Stroud.

Primary Trade Area

The Primary Trade Area (PTA) for commercial uses at Kaloko Makai is considered to be the entire North Kona and South Kohala districts of the Island. This is a larger reference area than the CRMA considered in the residential market review. This larger area of interest for commercial purposes is appropriate because:

Primary Trade Area



See Exhibit 2-1 for sources and further information.

- Commercial establishments in North Kona, and particularly its northern half, CT 215.01, serve broad regional markets on the Island that extend far beyond this CT. Obvious examples of this are Costco and The Pottery Terrace, the latter being the largest office building on the Island.

- There is evidence of significant commuting within North Kona and South Kohala, meaning that residents travel within the area for work, children's schooling or other activities. Hence, they may shop or patronize businesses within a broad area.

- There is a large daily visitor population in the PTA, mostly accommodated along the coastline. A significant share of this population is likewise considered quite mobile within the region, since they are at leisure.

North Kona and South Kohala also serve commercial markets that originate outside their borders. These sources of market demand are not addressed quantitatively in this analysis, and hence the conclusions expressed could be considered conservative.

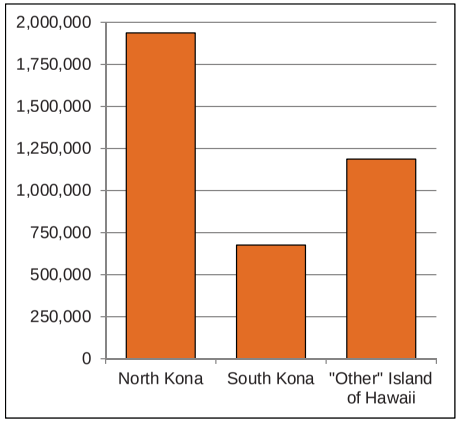
Commercial Supply

Existing Retail Supply in the PTA (Exhibit 5-1)

The PTA had over 2.6 million square feet of retail space in place as of December 2010. About 74% or 1.9 million square feet of this was located in the North Kona District. The PTA accounts for about 68% of the Island's entire retail-based commercial gross leasable area (GLA), which was estimated at 3.8 million square feet.

In late 2010, Hawaii Island's retail market showed an 8% average vacancy. The PTA exhibited softer conditions, with an average vacancy of about 10% as of November 2010[3]. Within the PTA, vacancies are slightly higher in South Kohala, where the Queen's Marketplace and additional space at the Villages at Mauna Lani recently opened.

Existing Retail GLA – Island of Hawaii
(square feet)



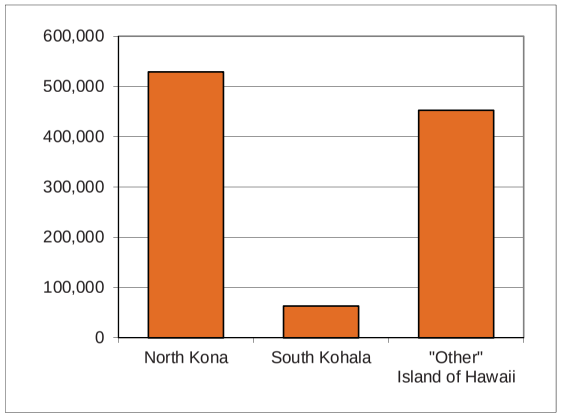
See Exhibit 5-1 for sources and further information.

[3] Colliers Hawaii Consulting, A Division of Colliers Monroe Friedlander, Inc., custom report, December 2010.

Existing Office Supply in the PTA (Exhibit 5-2)

Office supply and demand are evaluated in terms of rentable building area (RBA), also expressed in square feet. As for retail, North Kona dominates the office-based supply in the PTA, with an estimated 529,000 square feet of RBA, compared to only 63,000 in South Kohala and some 450,000 elsewhere on the Island. The PTA as a whole is estimated to support about 57% of the County's office-based RBA.

Existing Office RBA – Island of Hawaii
(square feet)



See Exhibit 5-2 for sources and further information.

Office vacancies were about 18% in North Kona, 21% in South Kohala, and 13% for the Island as whole, as of late 2010.[4]

Planned and Future Space in the PTA (Exhibit 5-3)

A total of 2.2 million square feet of planned commercial inventory was identified in North Kona and South Kohala, not including Kaloko Makai.

[4] Colliers Hawaii Consulting, A Division of Colliers Monroe Friedlander, Inc., custom report, December 2010.

Within the PTA, North Kona is the focus of commercial development interest, with an estimated 1.8 million square feet of potential retail- and/or office-based commercial spaces proposed on lands that are entitled and planned for commercial development, as of December 2010[5].

- The largest potential site identified is on lands being marketed by the State of Hawaii, **Department of Hawaiian Home Lands**, across from the Kona Airport. Net of likely light industrial uses, these lands are anticipated to support some 400,000 square feet of future commercial spaces. Another 245,000 square feet of commercial lands could materialize on other DHHL lands in the area, within the Villages of La'i 'Opua.

- Also notable is buildout of the **Kona Commons**, where some 305,000 square feet could be added to the approximately 295,000 square feet that opened in 2008 and 2009. This "lifestyle" center sits on lands leased from Queen Lili'uokalani Trust Estate in the Keahuolu area.

South Kohala has some 400,000 square feet of commercial area proposed at two locations: the proposed Kohala Place at Waikoloa, and in Waimea Town, where prior plans are under review.

Specific projects from which these estimates were derived are presented in Appendix 4.

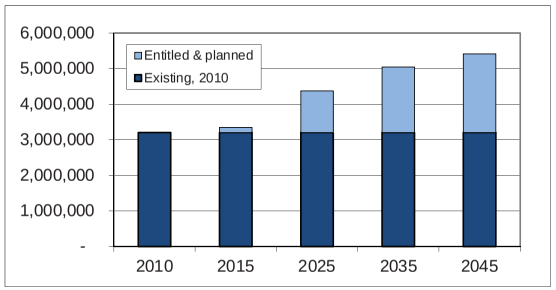
[5] As for residential developments, this analysis considers only those proposals on lands designated Urban by the LUC as of December 2010, and/or those that are exempt from LUC governance. Among the potential developments thus considered are 286,000 square feet on Queen Lili'uokalani Trust (QLT) lands that are currently LUC-Urban but that QLT is understood to be preparing to petition the LUC for review of these land uses. It is not known at this time how that petition might change commercial plans for these lands, nor whether it will be successful. QLT also owns the lands underlying the Kona Commons development, on which a further 305,000 square feet of development is reportedly possible; that potential future inventory is also accounted for.

Additionally, commercial developments within projects designated for industrial use are not considered. These would include the West Hawaii Business Park and Kaloko Industrial Park.

Future Trade Area Inventory
(Exhibit 5-3)

If all of the planned and entitled projects identified were developed to their full capacity, and no existing retail- or office-based centers were demolished, the PTA's commercial inventory would increase by some 40% by 2045, to 5.4 million square feet.

Potential Future Commercial Space - PTA (cumulative square feet)



See Exhibit 5-3 for sources and further information.

Commercial Supply and Demand Relationships

Area Resident Profiles (Exhibit 5-4)

The PTA was home to some 55,300 persons, representing an estimated 31% of the island's population in 2010. Claritas estimated that the PTA population grew 2.9% per year after 2000, compared to 2.0% for the Island as a whole.

North Kona's median age in 2010 was about 39, somewhat older than South Kohala, where the median age is estimated at 36. North Kona's median age is similar to that of Hawaii County, which was estimated at 38.

Daytime Population Ratios (Exhibit 5-5)

Daytime populations within the Trade Area and benchmark market are estimated based on 2000 ratios prepared by the US Census within Census Designated Places (CDPs)[6]. The PTA is evaluated by means of four CDPs: Kailua (Kailua-Kona area) and Kalaoa in North Kona, and Waikoloa Village and Waimea in South Kohala. The ratios derived from this source are considered baseline figures for the current analysis, as explained below.

On average, the PTA CDPs showed a daytime to resident ratio of 1.03 persons in 2000, suggesting some in-commuting during the day, especially to the Kailua-Kona area, whose two representative areas averaged 1.14. These figures do not consider the impact of non-Island residents such as visitors staying at area resorts.

[6] US Census Bureau, Census 2000, PHC-T-40, "Estimated Daytime Population and Employment-Residence Ratios: 2000" Journey to Work and Migration Statistics Branch, 2005.

These CDP derived figures are considered baseline indicators of daytime resident population in the PTA.

Commercial Supply in Relation to Population in 2010 (Exhibit 5-6)

Existing retail and office facilities in the PTA are compared to their relevant user populations in Exhibit 5-6.

- **Retail** GLA is compared to daytime population. The latter is estimated based on the above ratios for residents, adjusted as follows:

  - **Daytime residents** –Census data from 2000 shows the number of residents present during the daytime for every resident, within four finite CDPs situated in the PTA. In order to derive estimates of the daytime population within the PTA, the aggregate CDP ratio is increased by 20%, reflecting the larger population and larger number of employment sites located within the PTA as compared to the four CDPs. Hawaii Island residents present within the PTA during the daytime are thus estimated at 1.26 persons for every 1.00 persons who resided in the PTA in 2010, or 69,800 persons.

  - **Visitors –** An allowance for average daily visitors housed within each region is also added as a proxy for the number that might remain there during the daytime. This is based on Hawaii Tourism Authority data on numbers of visitor units, average occupancies and average party sizes. The PTA is thus estimated to have had some 18,600 visitors present on an average day in 2010.

    Utilizing these estimates, the PTA is seen to have offered about 30 square feet of retail area per daytime resident in 2010.

- **Office RBA** is compared to civilian employees residing in the PTA. The PTA's civilian labor force currently accounts for about 59% of its resident population, with insignificant variation between North Kona and South Kohala. The PTA housed a civilian labor force of some 32,400 persons in 2010, and therefore the area's 592,000 square feet of private office spaces represented 18 square feet per resident civilian employee[7]. The supply is relatively greater in North Kona than in South Kohala.

  With the job and career opportunities of the PTA, the area is likely to continue to attract a substantial workforce population, but its age profile will also "gray" as will the rest of the State's.

[7] This may be compared to 35 square feet per employee for Oahu as a whole in 2008.

Supportable Commercial Development in the Primary Trade Area (Exhibit 5-7)

Overview

Additional future retail-and office-based market needs are related to growth in the daytime population of the PTA for retail space, and in the PTA's labor force for office space. The potentially rapidly increasing resident population of the PTA itself would anchor demand in the area. Additionally, the populations of rest of West Hawaii could also contribute significant retail expenditures to the PTA, as it becomes further established as the regional hub for jobs, services, entertainment and shopping. This analysis of supportable commercial area considers only demand that originates within the PTA, and thus may again be considered conservative.

Projected Demand

Assessment of projected supportable commercial areas in the PTA begins with resident population projections as developed previously in Chapter 2 for the CRMA. These figures are adjusted upwards to estimate population in the PTA with an expectation that the CRMA will become the dominant population center of the region over time. Hence the multiplier to adjust CRMA to PTA population declines over the study period, as it in fact has over the 2000 to 2010 period for which historical data or estimates are available.

- **Retail-based demand** is evaluated as follows:

  - This assessment assumes daytime to resident population ratio in the PTA rises from the 1.26 level that was derived for 2010 from year 2000 working patterns, to 1.30 by 2015 and 1.32 by 2025 and beyond. This is considered possibly conservative since the many proposed developments in North Kona reinforce its position as an employment and commercial hub of West Hawaii, and reflect its status as an urban development and infill area.

  - Added to daytime resident population is an estimate of average daily visitors in the area. Visitor population is assumed to grow at 1.5% per annum in the future, including visitors staying in existing hotels and condominiums of the area, as well as those attracted to its increasing timeshare inventory. (See Exhibit 5-7 notes for more information.)

  - These components identify a future PTA retail consumer population of up to 223,900 persons by 2045, reflecting a 2.7% per annum rate of increase from 2010.

- In 2010, the PTA supplied 30 square feet per full-time equivalent (FTE) daytime person. However, after adjusting for the 10% retail vacancies observed in this year, the supportable GLA per person is estimated at 28 as of 2010. This assessment assumes a stagnant or gradually declining ratio of supportable area to population, recognizing ongoing changes in the nature of retailing.

- In conclusion, the PTA is estimated to support up to 5.8 million square feet of retail-based GLA by 2045.

Office-based demand is evaluated as follows:

- Future office-based demand is considered a function of growth in the civilian labor force in the PTA. This can be expected to follow from the establishment of a hospital at Kaloko Makai, relocation and expansion of UHCWH, additional job creation at NELHA and HOST, and from other plans for commercial, second home, and timeshare developments within the area.

- Some of these developments represent expansion of non-service industries and would support more professional and technical opportunities than are available today, leading to more office-based employment. Accordingly, supportable RBA in the PTA could increase from the 16 square feet per civilian employed resident observed in 2010.[8]

- Using these assumptions and considering just the PTA labor force as a demand generator, by 2045, the PTA could require up to 1.4 million square feet of office-based RBA.

[8] As in the retail market, the estimated supportable area for 2010 is reduced from the actual supply, in recognition of currently high vacancies.

Total Commercial Demand

In total, the retail- and office-market analyses indicate support for up to 5.5 million square feet of commercial area by 2025, or 7.2 million by 2045:

Projected Supportable Commercial Areas in the PTA (square feet)

	2025	2035	2045
Retail-based demand	4,500,000	5,500,000	5,800,000
Office-based demand	1,000,000,	1,300,000	1,400,000
Total	**5,500,000**	**6,800,000**	**7,200,000**

Note: Represents total projected supportable areas, including existing and entitled/planned developments. See Exhibit 5-7 for further information.

Assessment for Kaloko Makai (Exhibit 5-8)

Kaloko Makai Proposal

SCD-TSA proposes to offer up to 600,000 square feet of various commercial uses at Kaloko Makai. This would include spaces in shopping centers, mixed-use developments, medical-related and other office complexes. The majority is anticipated in the Project's transit-ready Urban Center (T5 zone) along Ane Keohokalole Highway. This area also includes the proposed medical center, so a portion of the commercial areas would be expected to be medical-support related. These areas could be expected to serve regional or even Island-wide markets, although the analyses undertaken herein were based on the PTA only.

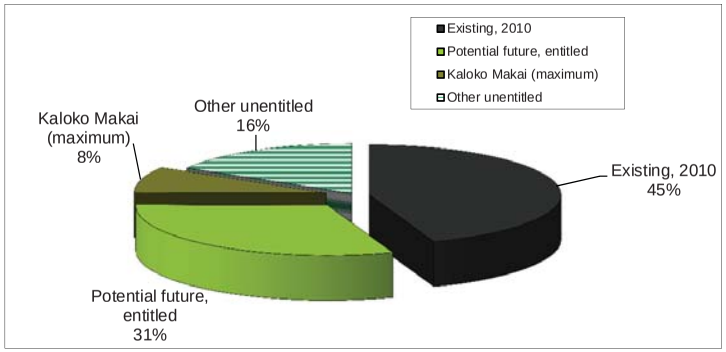
The remaining commercial areas could be within other General Urban areas of the Project (T4 zones). These supportive retail/shopping center areas would be expected to primarily serve community or neighborhood markets.

As for residential development, the first finished commercial building products at Kaloko Makai are assumed to be available for use in 2015.

Projected Supportable Commercial Areas

If developed to the full-proposed capacity of 600,000 square feet, Kaloko Makai's commercial spaces could represent some 8% of the PTA's total 2045 inventory. It could also represent a venue for about half of the currently unplanned but future supportable commercial space in the PTA.

Potential PTA Commercial Space Inventory: 2045



See Exhibit 5-8 for sources and further information.

6 – Light Industrial/Business Park Market Environment and Assessment

Background

Primary Trade Area

Light industrial areas can support business parks, manufacturing, energy production, research & development, wholesale, office, retail and other uses. They often serve a super-regional or Island-wide market. This analysis profiles market trends within the North Kona and South Kohala Districts, the same area referred to as the Primary Trade Area, or PTA, in the commercial market assessment. This is considered a conservative view of the potential market support for light industrial or business park areas at Kaloko since its market support might derive from a larger sphere than just the PTA.

Analytical Approach

This analysis does not consider industrial-uses or industrial-designated lands at military bases, harbors, universities or airports. Often such public lands tend to support heavy industrial or specialized public-purpose uses, which are not envisioned at the Project. Although a government entity, some of DHHL's holdings are counted here, however, because they are planned as income properties which would be leased to the general public.[1]

As in the residential and commercial analyses, the **supply** of light industrial land is evaluated in terms of existing properties that may already be in use and/or are being actively marketed, and State-entitled lands that could be developed in the future. The assessment focuses on industrial land acreage rather than the development thereon, such as warehouse square feet, their occupancies and rents.

On the **demand** side, the long-term need for additional lands to be developed for light industrial or business purposes relates to trends in civilian job creation. Thus the analytical approach employed here is analogous to that employed in the office market assessment presented in the previous chapter.

[1] For instance, DHHL's proposed 152-acre property at Kalaoa is within the inventories used, with a share allocated to future commercial development and a share allocated to future light industrial inventories, based on representations made by DHHL. However, DHHL recently acquired another North Kona tract from the State and potential development on that property is not considered here, because the DHHL manager for this site indicated that there are no plans for these lands at the current time.

Industrial and Business Park Supply

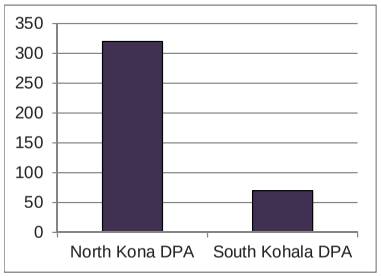
Area Inventory (Exhibit 6-1)

The light industrial lands of the PTA are concentrated in the North Kona DPA, which showed some 400 gross acres of light industrial lands as of December 2010. This represented 82% of the total PTA supply of 490 acres. The majority of these lands are located along Queen Ka'ahumanu Highway and adjacent to the Subject property, at Kaloko Industrial Park to its south and at Kohanaiki Industrial Park to its north. The other major existing industrial area of North Kona is the mature Kona Industrial Subdivision, developed by QLT and located next to Kailua-Kona Town.

Twelve percent of these industrial lands remain unbuilt, according to County tax records. However a share of such "undeveloped" lands is known to be encumbered with ground leases and some are also in use, such as for yard space or surface parking.

Market trends for light industrial warehouse buildings reflect the current economic downturn that was also evident in the residential and commercial markets. The PTA as a whole showed about 14% of warehouse spaces vacant at year-end 2010, according to data provided by CMF. This is up significantly from an estimated 8% in 2008. However, positive space absorption is reported to have resumed in 2010. Net asking rents are available only for a sample of the North Kona properties. At an average $0.95 per square foot, those rents appear to have declined about 11% per annum since 2008.

Existing Industrial Lands
(in acres)



See Exhibit 6-1 for sources and further information.

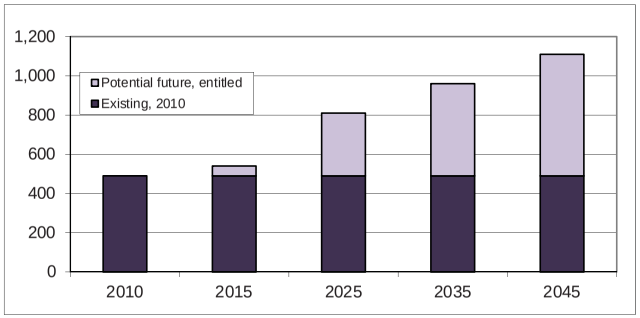
Planned Development and Future Inventory (Exhibit 6-2)

There were about 620 gross acres of land entitled and planned for business park/industrial use in the PTA as of December 2010, excluding lands at government-owned and operated facilities such as the Airport and harbors.

As in the existing inventory, the largest areas of entitled future inventory are also in the immediate vicinity of Kaloko Makai. These include West Hawai'i Business Park, Kaloko Industrial Park Phases III and IV, and DHHL's Kalaoa lands. The list of planned and entitled potential properties is presented in Appendix 5.

Considering the potential future developments plus areas already in use, the PTA could offer some 1,110 gross acres of private business or industrial park lands by 2045, assuming all future projects are effectively marketed and sold out within the projection period. The majority of this inventory would remain in the North Kona District, surrounding the Project, on Queen Ka'ahumanu Highway.

Potential Future Industrial Land Inventory in the PTA (gross acres)



See Exhibit 6-2 for sources and further information.

Industrial and Business Park Demand (Exhibit 6-3)

Demand for future business park/industrial lands in the PTA can be expected to originate from increases in civilian employment in the area, particularly in business and industrial categories such as energy production, construction, wholesaling and research & development.[2]

Of the 490 gross acres supplied in the PTA in 2010, 440 are estimated to have been occupied. This would mean that in 2010, there was excess supply compared to market demand amounting to about 10 acres.[3] Considering a 10% availability factor beyond occupied lands, market balance in 2010 might have been satisfied with about 480 gross acres rather than the

[2] Demand for new industrial properties can also be driven by transition mechanisms, such as when older industrial areas face urban redevelopment pressures. Such mechanisms may come into play in West Hawaii during the study period, possibly because of transitions in the Kailua-Kona outskirts. However, they are not yet evident and so this potential source of additional demand has not been estimated.

[3] This is based on an assumed 10% of lands not in use. This benchmark is derived from the 12% of lands found to be without significant building improvements (based on tax records), less an allowance for undeveloped lands known to be encumbered or otherwise employed.

490 that were in place[4]. This "desirable" level of supply would have represented 67 civilian employed persons per gross acre, as shown in Exhibit 6-3.

The ratio of employees per supportable gross industrial acre is assumed to remain close to historic levels. Given the projected rise in civilian employed persons in the PTA as discussed in Chapter 5, the PTA could be anticipated to support up to 1,160 gross acres of light industrial/business park lands by 2045. Subtracting the existing and entitled potential future supply, the area is seen to be able to support an additional 50 to 120 more acres of light industrial land during the study period, as shown in Exhibit 6-3.

Assessment for Kaloko Makai

Kaloko Makai Proposal

The Kaloko Makai plan designates 75 acres of light industrial or business park land uses in the Special District located at its makai end fronting Queen Ka'ahumanu Highway.

Approximately 25 acres of these lands have been identified by the State Department of Transportation (DOT) for a possible future public highway interchange at the entrance to the Project. Thus, industrial/business activity on those lands will be interim uses and only 50 gross acres are seen as long-term land uses.

Projected Supportable Areas

The Special District is an appropriate area for light industrial uses because:

- Light industrial uses would represent a relatively low-investment interim source of income from those lands that would ultimately be taken for public use as a highway interchange.
- The Special District is surrounded by other existing and planned light industrial land uses, at both Kaloko Industrial Park to its north, and West Hawai'i Business Park to its south.

[4] Significant other properties could have been brought to market if conditions warranted. For instance, the 41 net acres of Phase III of Kaloko Industrial Park, unsuccessfully marketed in 2009, are here considered part of the future, rather than the existing supply, because they do not appear to be actively marketed now. Thus, those 41 acres do not factor into the percent of undeveloped, existing lands as reported here.

- The general locale has been clearly established as a light industrial zone that serves regional and even Island-wide needs and benefits from its proximity to Keahole Airport, Honokohau Harbor and the well-developed visitor infrastructure of the region.
- Within Kaloko Makai, the Special District area is less attractive for residential and certain commercial uses because of its Waste Water Treatment Plant, its frontage along a very busy highway and the proposed interchange, and its relative lack of views due to its low elevation.

In conclusion, the Special District is considered a very appropriate area for light industrial/business park uses, and the lands set aside in the Kaloko Makai master plan are be supported by the area's market outlook, as follows:

Summary of Kaloko Makai Light Industrial/Business Park Market Assessment, in gross acres

	2016-2025	2026-2035	2036-2045	Total	Notes
Net unentitled demand at end of period (PTA)	100	120	50		Throughout the PTA, as shown in Exhibit 6-3
Kaloko Makai absorption, in period:					
Leasehold areas	25	0	0	25	10- to 20-year terms
Fee-simple areas	0	25	25	50	
Total absorption in period	25	25	25	75	
Less DOT taking	0	-25	0	-25	Timing of taking is hypothetical
Kaloko Makai areas in use:					
Maximum during period	25	50	50		
Maximum at end of period	**25**	**25**	**50**		**Compare to net PTA demand above**

Source: Mikiko Corporation, 2012.

7 – Lodge and Business Center
Market Environment and Assessment

Background

Development Concept

The Kaloko Makai Lodge and Business Center is proposed to cater to the business and leisure demands generated by other uses in Kaloko Makai and its surrounding area. It is envisioned to offer up to 120-rooms, a business center, and meeting and conference spaces.

The Lodge and Business Center would be situated on approximately 5 acres of land within a T-5 zone located mauka of the Ane Keohokalole Highway.

Target Markets

While the Lodge and Business Center may attract leisure travelers to West Hawaii, its marketing focus is those who are in the vicinity because of other uses in the area, such as Kaloko Makai's medical facilities, its residential community and in the broader area, the Kona Airport and a new Kona judiciary center.

Target markets for the Kaloko Makai Lodge and Business Center could include:

- Primary targets:
  - Kamaʻainas visiting family and friends in Kaloko Makai or neighboring areas;
  - Families and friends visiting or accompanying patients of the hospital;
  - Visiting medical staff involved with the hospital or related medical facilities;
  - Professionals and other parties to proceedings at the Kona Judiciary; and
  - Airline crews and commuters needing accommodations near to Kona Airport.
- Additional targets:
  - Other budget- and convenience-oriented travelers wishing to avoid the congestion, unneeded amenities and higher price points of resort areas; and
  - Athletic teams or other group travel seeking affordable and easily accessible accommodations away from resort the areas.

Conformance to Public Policy

Hawaiʻi County's economic growth during recent years has been closely tied to the visitor industry. However, as State and County policy makers seek to diversify their economic bases, new business and local service opportunities are highlighted.

The current County General Plan was developed under the assumption that the "County will continue to pursue the development of a strong multi-market base for the visitor industry that includes …. integrated product development for local products that can generate a healthy small business economic base. The County's visitor industry will continue to successfully grow and expand."[1]

Likewise, the Kona Community Development Plan provides for hotels and other lodging facilities within T5 zones such as proposed for Kaloko Makai.

The Lodge and Business Center at Kaloko Makai is planned to be in alignment with these goals and standards.

Analytical Approach

This chapter reviews general supply and demand indicators for visitor accommodations throughout the Island and in Kona. Due to the small size (up to 120 units, representing about a 1% addition to the Island inventory) and non-traditional market orientation of the proposed Lodge and Business Center, the assessment does not rely on a macro supply and demand assessment for the Island or region. Rather, the analysis considers visitor trends in the context of selected comparison hotel properties in Kona that appear to serve visitor markets such as those envisioned for Kaloko Makai.

Hotel Supply Market Conditions

Islandwide Hotel Inventory (Exhibit 7-1)

Just under half of the statewide visitor units in 2010 were located on Oʻahu, according to a survey prepared for The Hawaiʻi Tourism Authority (HTA) by Hospitality Advisors, LLC. The island of Maui continued to have the second largest share of visitor units, followed by Hawaiʻi Island and Kauaʻi.

Of Hawaii Island's 11,595 total visitor accommodation units, hotels continue to comprise the majority, or about 60% of units. While timeshare units are increasing most rapidly, they still represent only 16% of the Island's inventory.

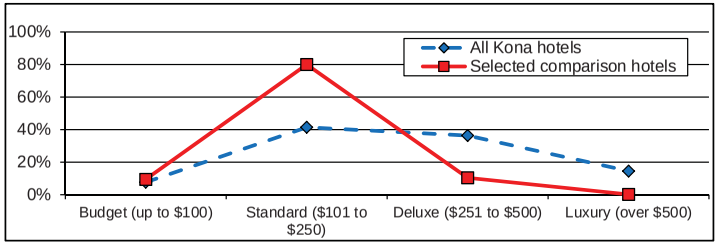
[1] County of Hawaii, County of Hawaii General Plan, February 2005, pg.1-11.

More than half of the Island's visitor units cater to high-spending market segments, with 40% classified the Deluxe price class ($251 to $500 per room night) and another 14% in the Luxury class (more than $500 per room night).[2]

Kona Hotel Inventory and Selected Comparison Properties (Exhibit 7-2)

Within the Island inventory, the HTA distinguishes Kona visitor units from those in South Kohala and elsewhere on the Island. Focusing just on hotel properties, Kona showed 2,519 rooms in the 2010 inventory. These units show a similar price class mix compared to the island as a whole, with 51% classified as Deluxe or Luxury units.

Kona Area Hotel Unit Market Orientation



See Exhibit 7-2 for sources and further information.

Although primarily targeting out-of-State leisure visitors, a handful of Kona hotels also cater to and attract a fair share of the interisland and value-oriented visitor base, particularly those not seeking a resort vacation experience. These include:

- King Kamehameha's Kona Beach Hotel (a Marriott Courtyard, 460 units),
- Kona Seaside Hotel (225 units),
- Royal Kona Resort (436 units), and
- Uncle Billy's Kona Bay Hotel (110 units).

The above hotels are considered the existing comparison set for the proposed Kaloko Lodge and Business Center. However, their characteristics are not necessarily conducive to the convenience- and/or business-oriented traveler that is envisioned at Kaloko. Other than Uncle Billy's Kona Bay Hotel, the properties are large (225 to 460 units), making rooms and facilities less readily accessible than possible in a significantly smaller property. All are located in relatively congested Kailua-Kona Town. In addition, despite recent renovations at the King Kamehameha, the comparison properties tend to be dated: opened between 1960 and 1975, they are now 36 to 51 years old.

[2] These standard rates are based on published or "rack" rates. Actual achieved room rates would be lower, on average.

The selected properties do offer favorable price points for the traveler who does not need a resort vacation experience and prefers convenience and value. Eighty percent of the combined room inventory is within the Standard class ($101 to $200 per room night), and another 9% is listed in the Budget class (up to $100).

Market Orientation of Selected Comparison Kona Hotels

	Budget (Up to $100 per night)	Standard ($101 to $250 per night)	Deluxe ($251 to $500 per night)	Luxury (Over $500 per night)
King Kamehameha's Kona Beach Hotel	0	460	0	0
Kona Seaside Hotel	116	109	0	0
Royal Kona Resort	0	306	128	2
Uncle Billy's Kona Bay Hotel	0	110	0	0
Total	**116**	**985**	**128**	**2**

Source: Hawaii Tourism Authority, 2010 Visitor Plant Inventory.

The proposed development at Kaloko Makai would offer a modern, purpose-built facility in a far more convenient location compared to these existing options.

Planned Competitive Hotels

The proposed Palamanui project, located north of the Kona Airport and Kaloko Makai, also includes a proposed a lodge, with some 70 units. It has been described as being oriented towards the university campus planned at Palamanui, but could also become competitive with some of the market segments targeted by the Kaloko Makai Lodge and Business Center.

There are no other known planned hotel projects in the North Kona or South Kohala areas at this time.[3]

[3] A 75-unit Holiday Inn Express was announced for Kailua-Kona town in March 2012, but development plans were in doubt by early April 2012.

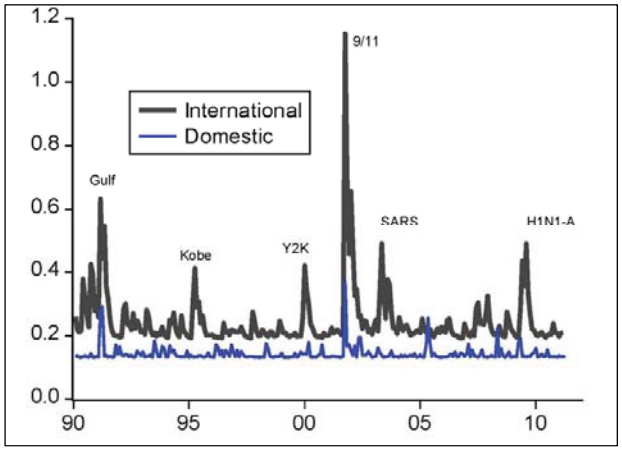
Demand Assessment

Statewide Trends

While Hawai‘i hotel occupancy levels were starting to improve in 2010 and into early-2011, the March 2011 Japan earthquake, tsunami and subsequent aftermath, coupled with on-going global economic weaknesses, have renewed concern for the visitor and hotel industries.

However, Hawaii's experience with external shocks such as 9/11, various recessions, the Gulf War and SARS has been a significant loss of visitor arrivals in the short-term, followed by recovery to more normal levels of volatility within a quarter or so. In particular, the domestic market has been far less sensitive to such events than the international arrivals market. This volatility relationship is reflected in 20 years of visitor arrivals data, as shown in the chart below, prepared by TZ Economics.

Volatility of Annualized, Seasonally-Adjusted Hawaii Visitor Arrivals



Source: TZ Economics, May 2011, reproduced with permission of the author. Raw data obtained from Hawaii Tourism Authority and Department of Business Economic Development and Tourism, seasonally adjusted with conditional estimates through March 2011.

Big Island Outlook

On the Big Island, where international arrivals represent just 12% of the market, industry recovery from the Sendai events is again expected to be full in the medium-term, and certainly by the time of first operations at the proposed Lodge and Business Center.[4] Barring sharp increases in fuel costs or other new shocks, the Economic Research Organization at the University of Hawaii (UHERO) forecasts increasing visitor arrivals to the Island, at +5.1% in 2011, +7.3% in 2012, and +3.4% in 2013.[5]

Airline seat capacity to Hawaii Island has experienced uncertainty but is showing particular strength from westbound routes. In October 2010, Hawaii Island lost its direct air service from Narita via Japan Airlines, but many of these seats were replaced the following month, when Alaska Airlines initiated nonstop service from Portland to Kona, adding to other new routes it had initiated previously in 2010.

Finally, recent HTA surveys concerning visitor satisfaction state that ratings by U.S. visitors who were very likely to recommend Hawai‘i Island to family and friends for future travel improved to 79% (up 7 percentage points) in the third quarter of 2010. When visitors are highly satisfied with the destination they visited, they will be more likely to recommend the place to friends and family[6].

Kona Visitor Trends (Exhibit 7-3)

Exhibit 7-3 presents 2009 HTA data on out-of-State travelers to Kona. Selected statistics of particular interest to the market segments proposed for the Lodge and Business Center are:

- Kona area hosted 6.8 million visitor-days in 2009, of which 88% were domestic travelers and 12% international. This was down 6.4% from 2008.
- The average out-of-State traveler party size was 2.1 persons.
- 39% traveled on group, package or group & package arrangements, while 61% were "true independent" travelers.
- 49% stayed in hotels, while 9% stayed with friends or relatives, and 15% in a rental house, B&B or cruise ship.

[4] Kona did experience direct tsunami damage related to the Sendai events. The 125-unit Kona Village Resort has closed while the Four Seasons Resort Hualalai closed for six weeks for repairs, and reopened April 30, 2011.

[5] UHERO, "UHERO COUNTY FORECAST: Uneven Recovery Continues," May 20, 2011.

[6] HTA, 2010 Visitor Satisfaction Monitoring Report.

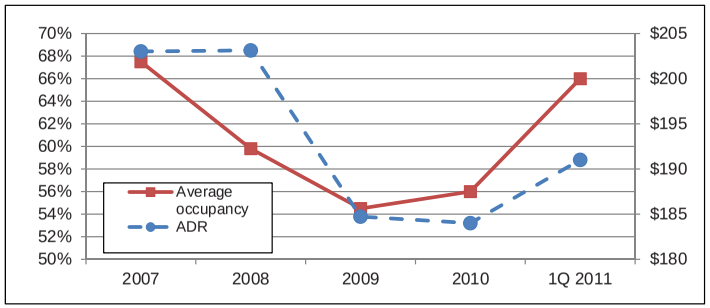
- 14% traveled to conduct business (other than meetings, conventions and incentive business travelers, or MCI), visit friends and relatives, attend sporting events or for other miscellaneous purposes including those traveling on government, military or school business.

In context, this "non-pleasure" and "non-MCI" market could theoretically require some 1,000 accommodation units per day[7], a good share of which is likely to be with friends and relatives or in other nontraditional or noncommercial accommodations. However, the remainder of this sizeable market patronizes area hotels and other commercial accommodations for their overnight stays, and is representative of the markets being targeted by the Subject. Inter-island kama'aina business and other travelers are not counted in the HTA data and represent a significant expansion of this potential market.

Area Hotel Market Trends (Exhibit 7-4)

Hotel occupancy and average daily rates on Hawai'i Island have typically lagged those for O'ahu and Maui and therefore the State as a whole. Within Hawaii Island, average occupancy rates ranging from 55% to 66% have been the norm in recent years, compared to 65% to 77% for the State as a whole. According to data from the Hawai'i Tourism Authority, 2009 reflected a slowing economy and a struggling visitor industry but the Island's 2010 numbers implied a rebound and the first quarter of 2011 continues the growth trend.

Island of Hawaii
Average Occupancy and Average Daily Room Rate



See Exhibit 7-4 for sources and further information.

[7] Total visitor days of 6,796,000 x 14% market share x 6/7 (conversion of days to nights) / 365 days / 2.1 persons per room.

In the first quarter 2011 report from Smith Travel Research and Hospitality Advisors, Hawai'i hotels experienced first quarter gains. While visitor arrivals from Japan were 13% higher through the month of February before dropping sharply following the March 11 earthquake and tsunami, arrivals from the Mainland and Canada pushed the overall market to positive territory during the quarter.

The average statewide hotel occupancy was 77%, up 6 percentage points compared to the first quarter of 2010. The average daily room rate was $191, up 9% from last year, and revenue per available room, or RevPAR, was $147, up 19% from a year ago.

The Big Island's occupancy rate was 66%, up 10 percentage points, and its average daily room rate was $191, up 2%. RevPAR for the Big Island was $126, up 18% from last year.

Assessment for Kaloko Makai

Suggested Facilities and Amenities

Based on the target markets identified at the start of this chapter, the Kaloko Makai Lodge and Business Center is proposed as a relatively compact, efficient property of 120 or fewer rooms. Rooms may tend to be larger than typical at a tourist-oriented hotel, to accommodate larger travel groups, plus a work area within the room. It would likely also offer common amenities such as a front desk, swimming pool and/or workout facility, and on-site parking.

An integral component will be the Business Center. The Business Center could provide "an office away from home," with a range of services and amenities such as:

- Conference or meeting rooms,
- Copying, scanning and digital printing services,
- High-speed internet and Wi-Fi access,
- Equipment rentals,
- Videoconferencing,
- Courier delivery services,
- Send and receive e-mail and facsimiles,
- Full range of ground and express shipping services, and
- Notary service.

Projected Lodge Market Performance

The Kaloko Makai Lodge and Business Center concept is to focus on local, business and other market sources that seek convenient access and value-based rates over resort and recreational facilities. Currently, such markets must find accommodations in aging tourist-oriented hotel facilities in relatively congested Kailua-Kona or in nontraditional or non-commercial (such as with friends and family) venues. Despite their age, standard room rack

rates at the comparison hotel properties are generally priced from about $100 to $170, with achieved rates perhaps 20% to 40% lower.

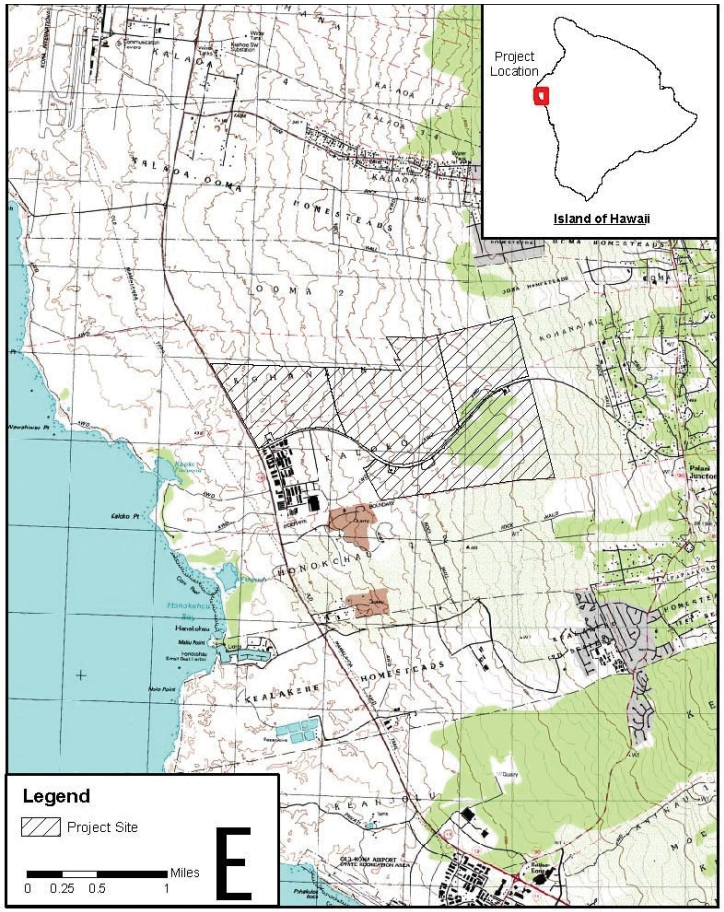
Based on these comparisons, the Kaloko Makai Lodge and Business Center is estimated to be supportable by 2025, and to achieve an average daily room rate of about $120 to $130 (in 2010 dollars), at stabilization of operations. This considers that it would be a modern, purpose-built and conveniently located facility, better suited to its targeted markets than existing options, and possibly competitive with a future lodge facility at Palamanui.

Given its small size and the magnitude of the relatively underserved kama‘aina and business market segments targeted, average annual occupancy at the Kaloko Makai Lodge and Business Center is projected at 65% at stabilization.

Market Assessment for Kaloko Makai

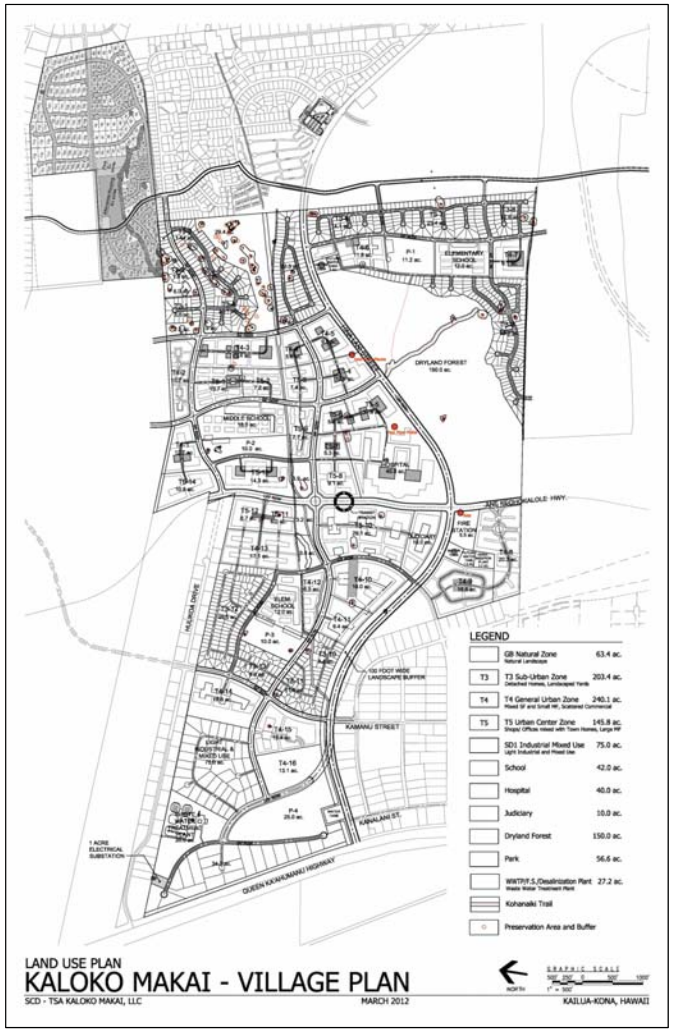
Exhibits

Exhibit 1-1
Kaloko Makai – Site Location



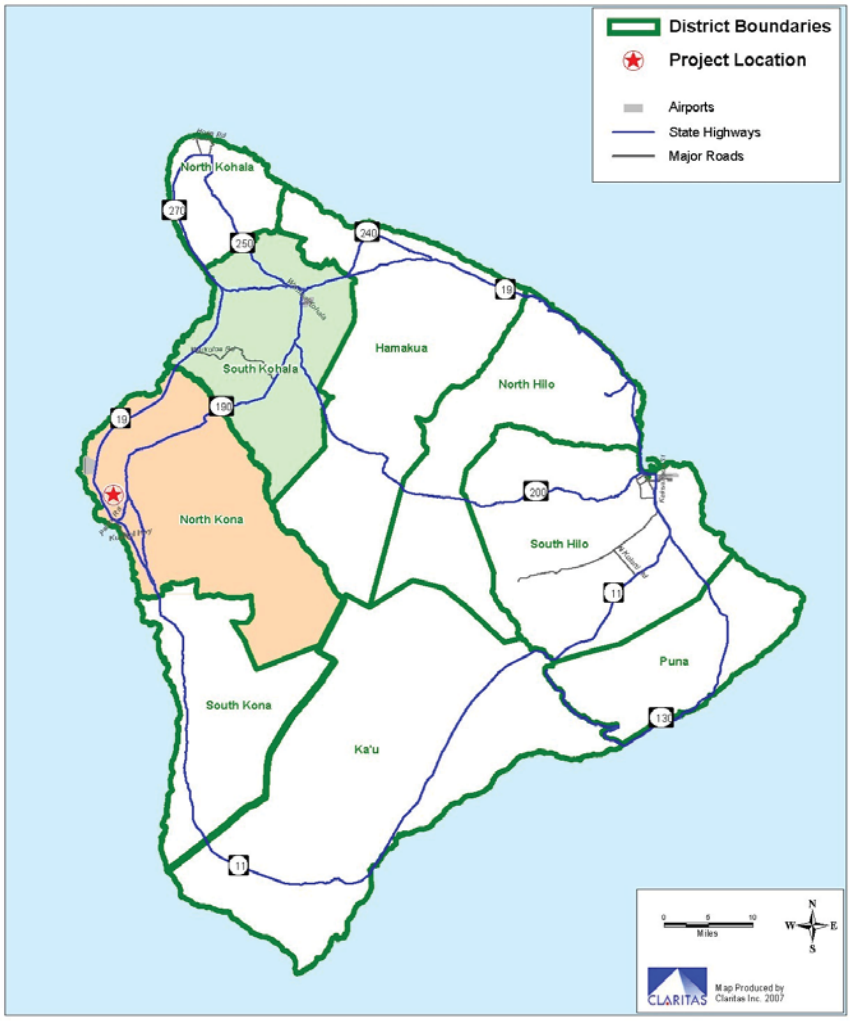
Source: SCD-TSA Kaloko Makai, LLC, 2011.

Exhibit 1-2
Kaloko Makai – Conceptual Land Use Plan



Source: SCD-TSA Kaloko Makai, 2011.

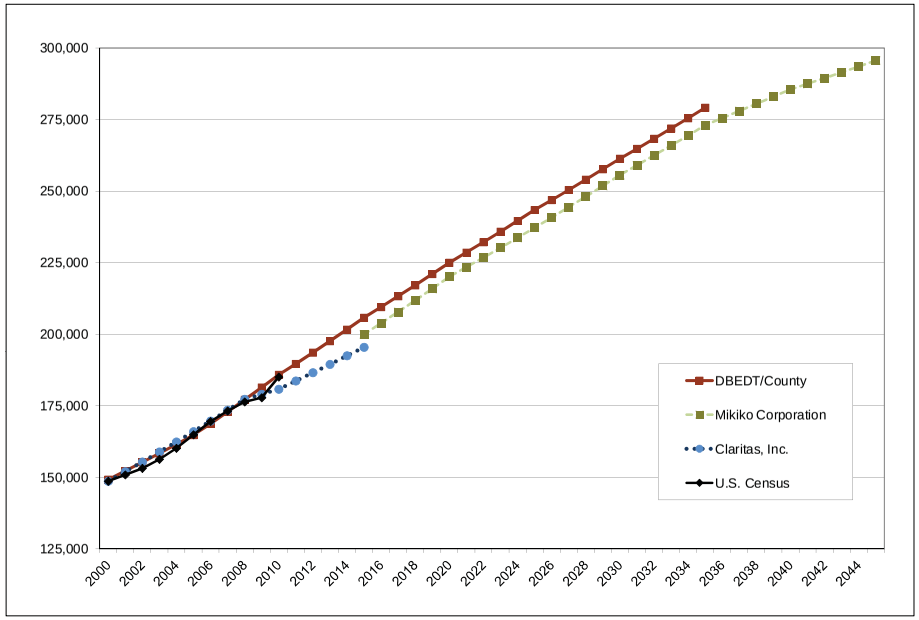
Exhibit 2-1
Kaloko Makai Location and Hawaii Island Districts



Source: Claritas, Inc., October 2007.

Exhibit 2-2
Resident Population - Island of Hawaii
Comparison of Estimates and Projections
2000 to 2045

	Date of study	2000	2010	2015	2020	2030	2040	2045	Average annual growth 2000-2010	2010-2020	2020-2030	2030-2035	2035-2040	2040-2045
DBEDT/County[1]	*2008*	149,261	185,850	205,820	225,000	261,340	INA	INA	2.2%	1.9%	1.5%	1.3%	NA	NA
Mikiko Corp.[2]	*2010*	INA	INA	200,000	220,100	255,600	285,500	295,600	INA	1.9%	1.5%	1.3%	0.9%	0.7%
Claritas[3]	*2010*	148,677	180,820	195,460	INA	INA	INA	INA	2.0%	INA	INA	INA	INA	INA
U.S. Census[4]	*2010*	148,677	185,079	INA	INA	INA	INA	INA	2.2%	INA	INA	INA	INA	INA



INA - Information not available.

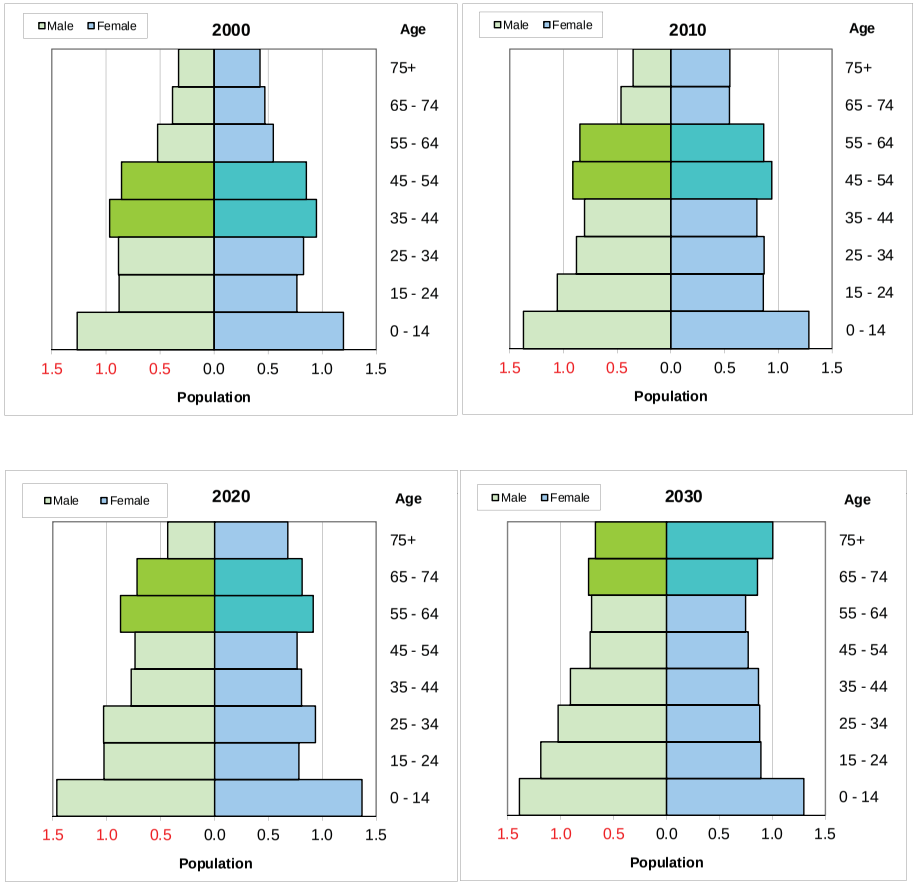
[1] State of Hawaii, Department of Business, Economic Development and Tourism, Research and Economic Analysis Division, "Population and Economic Projections for the State of Hawaii to 2035," (DBEDT 2035 Series), January 2008. Actual and estimates through 2007; projections thereafter presented in 5-year increments. Figures interpolated by Mikiko for years in-between. County indicates that it has adopted DBEDT's projections.

[2] Projections prepared by Mikiko assuming 2015 population at approximately midpoint of Claritas (2010) and DBEDT/County (2008) projections for that year. Projections thereafter based on DBEDT/County projected rates of growth to 2035 and an assumed declining rate therafter as shown.

[3] Claritas, Inc., October 20, 2010; estimate for 2010, projection for 2015, figures interpolated in-between. 2000 to 2009 data shown are estimates prepared by Claritas in previous years.

[4] U.S. Census Bureau, 2011, Summary File, Table P1; Ibid, Population Division, "Table 1. Annual Estimates of the Resident Population for Counties of Hawaii" April 1, 2000 to July 1, 2009," (COEST2009-01-15) March 2010. (Next U.S. Census population update for Hawaii's counties is anticipated in April 2012.)

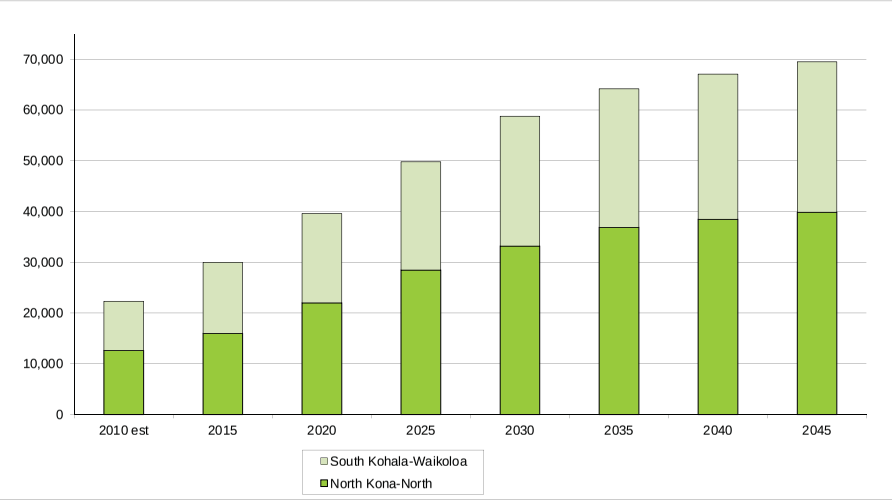
Exhibit 2-3
Projected Population by Age Group - State of Hawaii
2000 to 2030



Notes: Each unit on the X axis represents 100,000 persons. Highlighted bars include the Baby Boom cohort.
Source: U.S. Census Bureau, Population Division, Interim State Population Projections (released 4/21/05), http://www.census.gov/population/www/projections/statepyramid.html.

Exhibit 2-4
Resident Population -
Competitive Residential Market Area and Island of Hawaii
2010 to 2045

	2010 Census/ Estimate	2015	2020	2025	2030	2035	2040	2045	Average annual % increase, 2010-45
Competitive Residential Market Area[1]:									
North Kona-North[2]	12,641	16,000	22,000	28,500	33,200	36,900	38,500	39,900	3.3%
South Kohala-Waikoloa[3]	9,675	14,000	17,600	21,300	25,600	27,300	28,600	29,600	3.2%
Total CRMA	**22,300**	**30,000**	**39,600**	**49,800**	**58,800**	**64,200**	**67,100**	**69,500**	**3.3%**
Island of Hawaii[4]	**185,079**	**200,000**	**220,100**	**237,200**	**255,600**	**273,000**	**285,500**	**295,600**	1.3%
As a percentage of Island:									
North Kona-North[2]	6.8%	8.0%	10.0%	12.0%	13.0%	13.5%	13.5%	13.5%	
South Kohala-Waikoloa[3]	5.2%	7.0%	8.0%	9.0%	10.0%	10.0%	10.0%	10.0%	
Total CRMA	12.0%	15.0%	18.0%	21.0%	23.0%	23.5%	23.5%	23.5%	



[1] As provided by Claritas for 2008. Thereafter, population projected by Mikiko Corporation assuming CRMA's share of Island population should approach alignment with the area's relative share of its jobs base (21% in 2006, 23% in 2010) within the projection period.

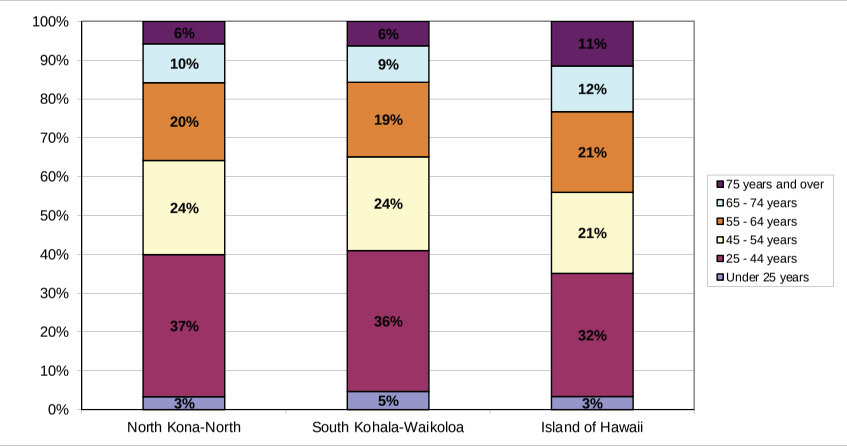
[2] Census Tract 215.01, the northern part of the North Kona District, generally to Henry Road. Excludes Kailua-Kona and areas southward. See Appendix 1 for map.

[3] Census Tract 217.01, the southern part of the South Kohala District, generally from Waikoloa Beach Resort to Mauna Kea Resort, and mauka to Waikoloa Village. Excludes Waimea Town. See Appendix 2 for map.

[4] Mikiko Corporation projections, as shown in Exhibit 2-2.

Exhibit 2-5
Households by Age of Household Head
Competitive Residential Market Area and Island of Hawaii
2010 Estimate

	North Kona-North[1]	South Kohala-Waikoloa[2]	Island of Hawaii	As a percentage of Island of Hawaii: North Kona-North[1]	As a percentage of Island of Hawaii: South Kohala-Waikoloa[2]
Under 25 years	140	169	2,237	6%	8%
25 - 44 years	1,542	1,317	21,046	7%	6%
45 - 54 years	1,022	875	13,853	7%	6%
55 - 64 years	844	697	13,760	6%	5%
65 - 74 years	423	339	7,850	5%	4%
75 years and over	243	229	7,603	3%	3%
Total	4,214	3,626	66,349	6%	5%
Median age	**34**	**37**	**52**		



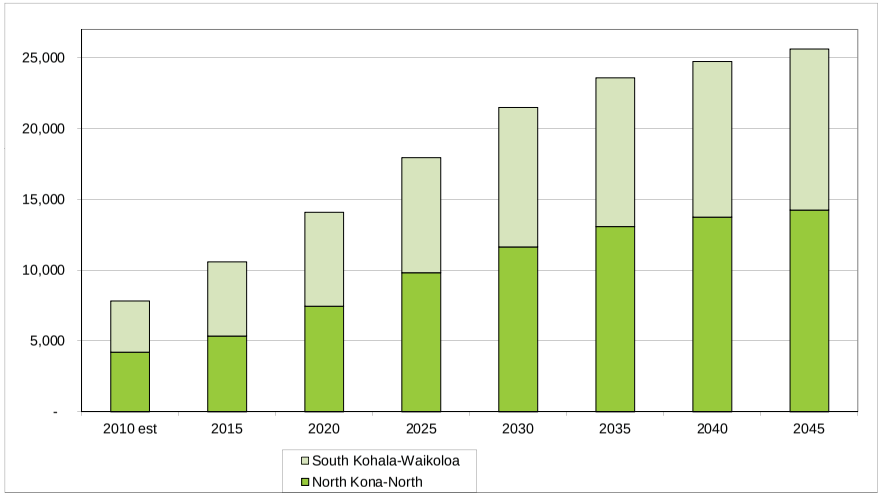
[1] Census Tract 215.01, the northern part of the North Kona District, generally to Henry Road. Excludes Kailua-Kona and areas southward. See Appendix 1 for map.

[2] Census Tract 217.01, the southern part of the South Kohala District, generally from Waikoloa Beach Resort to Mauna Kea Resort, and mauka to Waikoloa Village. Excludes Waimea Town. See Appendix 2 for map.

Source: Claritas, Inc., October 20 and 25, 2010.

Exhibit 2-6
Households - Competitive Residential Market Area and Island of Hawaii
2010 to 2045

	2010 Estimate	2015	2020	2025	2030	2035	2040	2045	Average annual % increase, 2010-45
Number of households:[1]									
Competitive Residential Market Area -									
North Kona-North[2]	4,210	5,350	7,460	9,830	11,650	13,090	13,750	14,250	3.5%
South Kohala-Waikoloa[3]	3,620	5,240	6,640	8,130	9,850	10,500	11,000	11,380	3.3%
Total CRMA, rounded	**7,800**	**10,600**	**14,100**	**18,000**	**21,500**	**23,600**	**24,800**	**25,600**	**3.5%**
CRMA as % of Island	*11%*	*14%*	*17%*	*20%*	*22%*	*23%*	*23%*	*23%*	2.0%
Island of Hawaii	69,100	74,600	83,100	90,200	97,600	104,200	109,000	112,800	1.4%
Average household size:[4]									
North Kona-North[2]	3.00	2.99	2.95	2.90	2.85	2.82	2.80	2.80	-0.2%
South Kohala-Waikoloa[3]	2.67	2.67	2.65	2.62	2.60	2.60	2.60	2.60	-0.1%
Island of Hawaii	2.68	2.68	2.65	2.63	2.62	2.62	2.62	2.62	-0.1%



[1] As provided by Claritas for 2010. Thereafter, based on projected population as shown in Exhibit 2-4 and household sizes as shown.

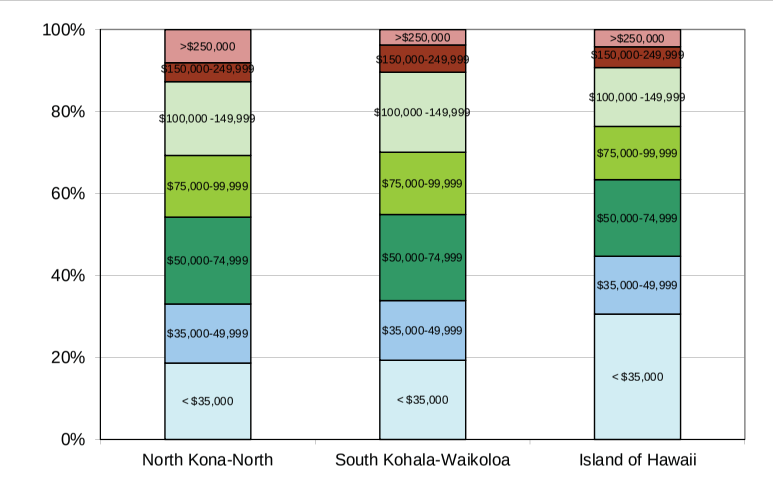
[2] Census Tract 215.01, the northern part of the North Kona District, generally to Henry Road. Excludes Kailua-Kona and areas southward. See Appendix 1 for map.

[3] Census Tract 217.01, the southern part of the South Kohala District, generally from Waikoloa Beach Resort to Mauna Kea Resort, and mauka to Waikoloa Village. Excludes Waimea Town. See Appendix 2 for map.

[4] As provided by Claritas for 2010, with nominal or no changes to 2015 as economic conditions solidify. Thereafter, household sizes projected to decline at a generally diminishing rate. Household sizes within the CRMA as a whole are projected to approach those of the County over time.

Exhibit 2-7
Households by Household Income -
Competitive Residential Market Area and Island of Hawaii
2010 Estimate

	North Kona-North[1]	South Kohala-Waikoloa[2]	Island of Hawaii
Median household income	**$69,958**	**$69,169**	**$67,237**
Per capita income	**$31,529**	**$32,050**	**INA**
Number of households, by income -			
Less than $34,999	787	702	20,322
$35,000 - $49,999	606	528	9,334
$50,000 - $74,999	894	760	12,398
$75,000 - $99,999	634	552	8,637
$100,000 - $149,999	758	708	9,504
$150,000 - $199,999	194	241	3,376
$200,000 or more	341	135	2,778
Total	**4,214**	**3,626**	**66,349**



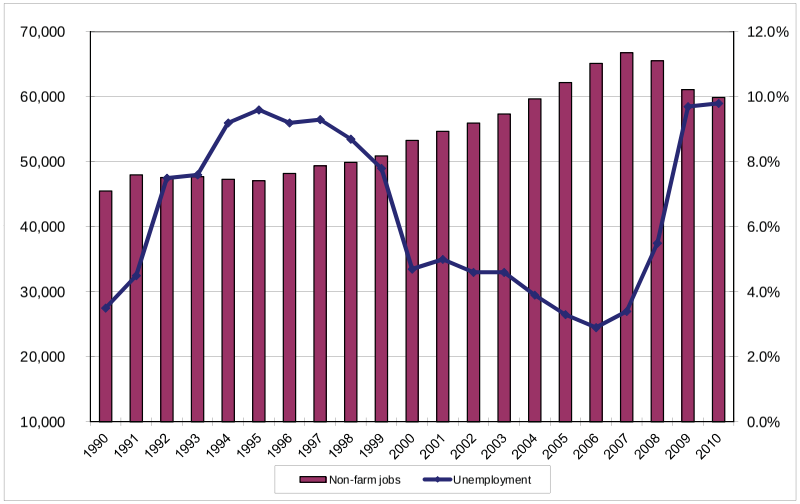
[1] Census Tract 215.01, the northern part of the North Kona District, generally to Henry Road. Excludes Kailua-Kona and areas southward. See Appendix 1 for map.

[2] Census Tract 217.01, the southern part of the South Kohala District, generally from Waikoloa Beach Resort to Mauna Kea Resort, and mauka to Waikoloa Village. Excludes Waimea Town. See Appendix 2 for map.

Source: Claritas, Inc., October 20 and 25, 2010.

Exhibit 2-8
Labor Force Trends - Hawaii County
1990 to 2010

	Civilian labor force	Employed persons	Non-farm wage & salary jobs	Percent unemployment
1990	58,350	56,300	45,500	3.5%
1995	65,400	59,100	47,100	9.6%
2000	74,200	70,750	53,300	4.7%
2005	81,850	79,150	62,200	3.3%
2006	85,050	82,550	65,150	2.9%
2007	85,750	82,850	66,800	3.4%
2008	86,650	81,850	65,550	5.5%
2009	84,250	76,100	61,100	9.7%
2010	83,250	75,150	59,900	9.8%



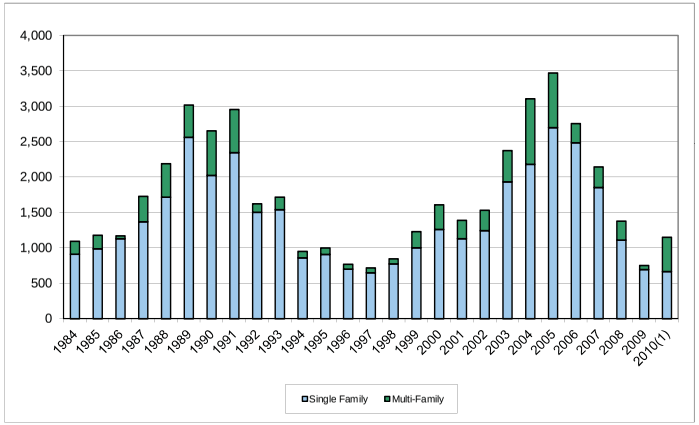
Source: "Hawaii State Department of Labor & Industrial Relations, 2007. Labor force estimates revised by DLIR with new methodology employed by U.S. Bureau of Labor Statistics, as of 2007. As referenced in: www.hiwi.org/admin/uploadedPublications/470_LFHC.PDF, www.hiwi.org/admin/uploadedPublications/1019_URATE.current.pdf and www.hiwi.org/analyzer/qslabforcedata.asp?cat=HST_EMP_WAGE_LAB_FORCE&session=LABFORCE&subsession=99&areaname=.

Non-farm wage and salary job estimates provided by DLIR as referenced in www.hiwi.org/admin/uploadedPublications/700_CESHC00S.PDF and http://www.hiwi.org/gsipub/index.asp?docid=421.

State of Hawaii, Department of Labor and Industrial Relations, Research and Statistics Division, March 2011.

Exhibit 3-1
Residential Building Permits - County of Hawaii
1990 - 2010[1]

	Single Family	Multi-Family	Total
Average	**1,484**	**321**	**1,805**
1990	2,024	627	2,651
1995	908	90	998
2000	1,260	347	1,607
2005	2,698	771	3,469
2006	2,484	270	2,754
2007	1,851	291	2,142
2008	1,108	270	1,378
2009	694	58	752
2010[1]	667	482	1,149



Not seasonally adjusted.

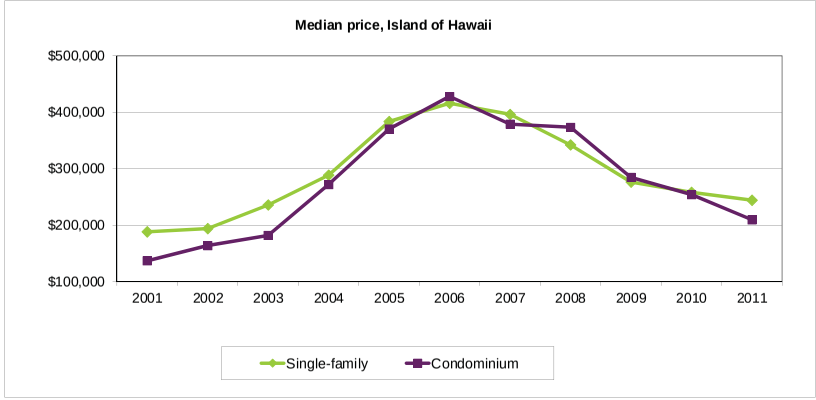
[1] Annualized based on data through November 2010.

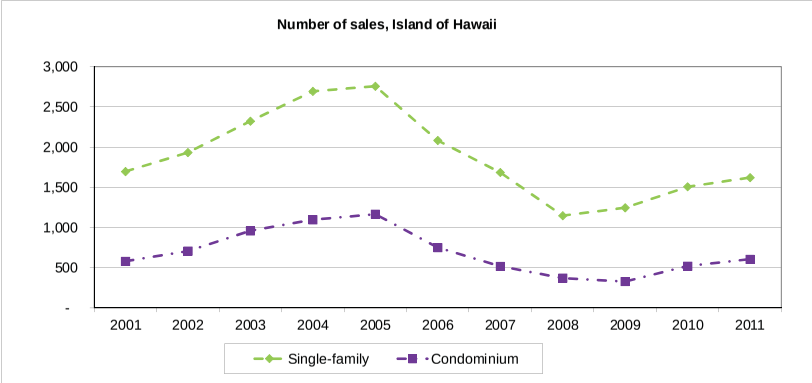
Sources: "Hawaii County Data Book Section 16: Construction & Housing," www.co.hawaii.hi.us/databook_current/section16.htm, date last modified 04/23/2010; Hawaii County, Department of Public Works http://www.hawaii-county.com/permits/2010permits.html.

County of Hawaii: Department of Research & Development - County of Hawaii Statistics; http://www.hawaii-county.com/info/stats/nov10.pdf

Exhibit 3-2
Hawaii County Residential Resales Trends
2001 to 2011

	2001	2005	2006	2007	2008	2009	2010	2011
Median price -								
Single-family	$188,400	$383,800	$416,100	$396,400	$342,400	$276,600	$258,400	$244,400
Condominium	$137,100	$370,600	$428,200	$379,100	$373,600	$284,900	$254,400	$209,800
Number of sales -								
Single-family	1,696	2,757	2,083	1,685	1,147	1,246	1,507	1,620
Condominium	580	1,166	750	517	371	328	520	605

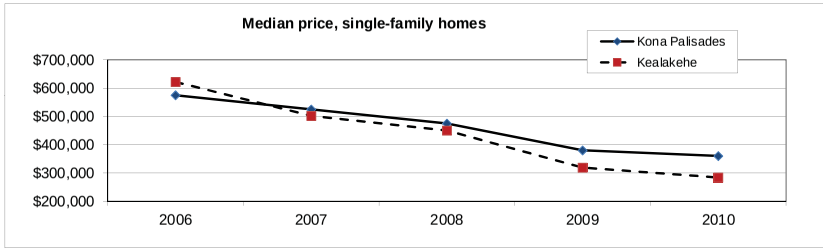


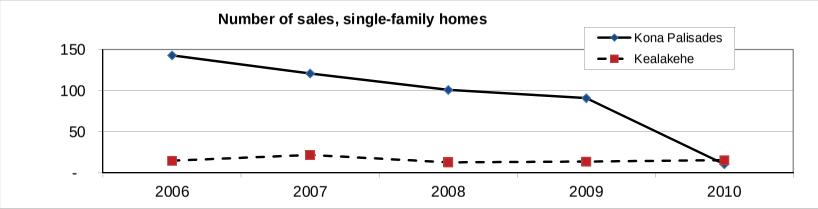


Sources: Annual data from University of Hawai`i Economic Research Organization, Data Portal, as accessed April 2012; recent month data from Pacific Business News, March 6, 2012.

Exhibit 3-3
Residential Sales in Kona Palisades and Kealakehe
TMKs 3-7-3 & 4, North Kona-North
2006 to 2010[1]

	2006	2007	2008	2009	2010[1]	Average annual percent change
Kona Palisades:						
Median price -						
Single-family	$575,000	$525,000	$475,000	$380,000	$360,000	-11.0%
Condominium[2]	$572,500	$293,403	$293,403	$399,950	$325,000	-13.2%
Number of sales -						
Single-family	143	121	101	91	154	1.8%
Condominium	16	35	14	18	11	-9.4%
Kealakehe:						
Median price -						
Single-family	$622,000	$502,000	$450,000	$318,700	$284,000	-17.8%
Condominium	$975,000	$600,000	--	$580,000	--	INA
Number of sales -						
Single-family	15	22	13	14	16	1.0%
Condominium	13	3	0	4	0	INA





[1] Based on 2010 sales data through October: median price based on 10 months data; number of sales annualized. Figures not seasonally adjusted.

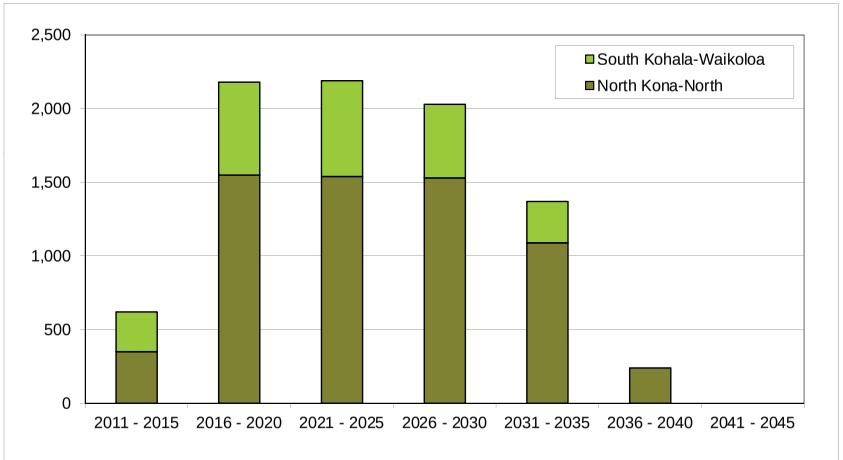
[2] Median prices for 2007 and 2008 are identical because they represent same floor plan devleoper sales by Seascape Development LLC.

Note: Kona Palisades and Kealakehe neighborhoods evaluated based on recorded residential sales within Tax Map Keys 3-7-3 and 4, respectively, but excluding properties makai of Queen Kaahumanu Highway, west of Palani Road and *mauka* of Mamalahoa Highway.

Source: Hawaii Information Service, data as of November 4, 2010.

Exhibit 3-4
Potential New Resident Housing Units - Competitive Residential Market Area
Based on Planned Developments with State Entitlement or Exemption as of December 2010

	2011 - 2015	2016 - 2020	2021 - 2025	2026 - 2030	2031 - 2035	2036 - 2040	2041 - 2045	Total, rounded
North Kona-North[1]	350	1,550	1,540	1,530	1,090	240	0	6,300
South Kohala-Waikoloa[2]	270	630	650	500	280	0	0	2,300
Total (rounded)	**620**	**2,180**	**2,190**	**2,030**	**1,370**	**240**	**0**	**8,600**
% of projection period	**7%**	**25%**	**25%**	**24%**	**16%**	**3%**	**0%**	**100%**
cumulative %	**7%**	**33%**	**58%**	**82%**	**98%**	**100%**	**100%**	



[1] Census Tract 215.01, the northern part of the North Kona District, generally to Henry Road. Excludes Kailua-Kona and areas southward. See Appendix 1 for map.

[2] Census Tract 217.01, the southern part of the South Kohala District, generally from Waikoloa Beach Resort to Mauna Kea Resort, and mauka to Waikoloa Village. Excludes Waimea Town. See Appendix 2 for map.

Note: Survey targeted projects of 100 units or more. Excludes emergency shelters, dormitory beds and other group living quarters.

Sources: Interviews with developers, landowners and project principals as shown in Appendix 3. Component numbers may vary slightly from those in Appendix 3 due to rounding.

Exhibit 4-1
Performance Indicators for Selected Comparison Residential Projects
Comparison to Kaloko Makai market unit plans

Kaloko Makai Transcect Zone	Permitted uses[1]: Building types	Permitted uses[1]: Density and story height	Preliminary SCD plans/ densities - market units	Comparison projects: Name, location (developer)	Density (U/A)	Recent price indicators[2]: 2008 - 1Q 2009	Recent price indicators[2]: 2010	Developer sales[3]		Comments
Urban, T4 and T5	Townhouses, apartments, or SF condominiums; may be mixed with retail or office uses	Up to 12 (for T4) or 30 (for T5) units/acre; 1- to 5-stories	**Multi- and single-family, 8 to 16 unts per acre**	**Makana Kai,** Wehilani, Waikoloa Village (Castle & Cooke)	12	$225,000 to $295,000; $255,700 average	$85,000 to $306,000; $191,000 average[4]	50/ year	2007, at $337,000-$400,000+	4- and 6-plex THs, marketed 2/2006 to 12/2009. 80% primary residential.
				Alii Cove, Kailua-Kona (Sunstone Realty Partners X LLC)	11	$200,000 to $595,000; $426,868 average	$238,500 to $415,000; $305,567 average	70-110/ year	2005-2006, at $365,000-$400,000 average	Mauka side of Alii Drive; first marketed late 2004, 200 total units. Transient rentals permitted.
				Alii Park Place, Kailua-Kona (Alii Park Place LLC)	11	$360,000 to $492,153; $414,593 average	$265,000 to $385,000; $330,819 average	20 & 40/ year	2004-2005, at $370,000 & $460,000 averages	Mauka side of Alii Drive; first marketed in 2004, 59 total units. Transient rentals permitted.
				Pines at Kailua-Kona I and II, North Kona-South (Taiyo Hawaii Co., Ltd.)	7	$270,000 to $490,000; $369,000 average	$221,000 to $362,500; $276,670 average	NA	resales	191 units built 1989 & 1990. SFD condos/ZLL; 3,000 to 5,000 sf lots; ocean views from many.
Suburban, T3	SFD or duplex	Up to 6 units/acre; 1-2 stories	**Single-family, 3 to 6 units/acre**	**Pualani Estates**, North Kona-South (DR Horton-Schuler Division)	4	$380,000 to $627,000; $489,000 average	$314,900 to $527,732; $403,273 average	50-70/year[5]	2004 to 2008 at $327,000 to $557,000 average	Average 6,000 sf lots, range 5,000 to 8,000, with homes 1,140-1,680 sf. First sales in 2004.
				Kikaha, Wehilani, Waikoloa Village (Castle & Cooke)	3	$379,000 to $450,000; $424,000 average	$380,000 to $568,000; $453,000 average	20/year	9/2006-6/2009, at $425,000 average	SFD - 36 homes and 18 vacant lots; average 10,000 sf.

[1] Place Makers, LLC, "Kona Villlage Design Guidelines" (calibrated for County of Hawaii), Final Draft, October 10, 2010. Density expressed in units per gross acre (including throughfares but excluding civic zones such as trails, plazas, playgrounds, etc.)

[2] Current asking prices for projects in marketing; recorded sales prices from 1/1/08 to 4/19/09 and 1/1/10 to 12/31/10 for projects with recorded sales; projected sales prices for planned developments. Excludes pricing of affordable units within projects, where applicable.

[3] Range of average annual sales during years of substantial developer inventory; years specified.

[4] All 5 transactions appear to represent bank foreclosures and subsequently discounted REO sales, and so are considered less representative; no developer sales.

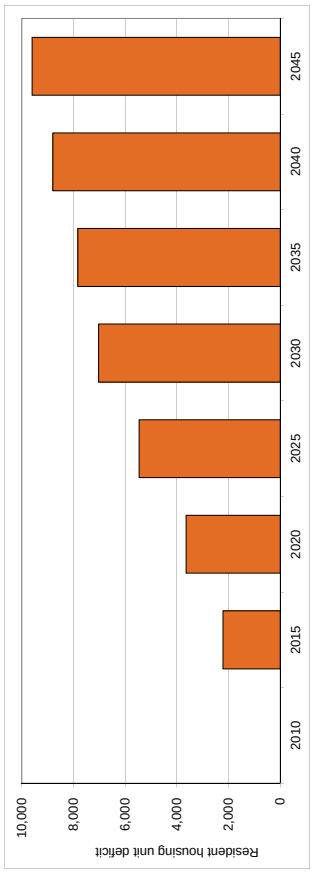
[5] Rate applies except in 2006, when only 19 developer sales recorded.

INA - Information not available; MF - mulitfamily homes; SFD - single-family detached homes; TH - townhouse; U/A - units per gross acre.

Sources: Interviews with developers and other project representatives; project websites; Hawaii Information Service; Pacific Business News; Honolulu Star Advertiser.

Exhibit 3-5
Projected Supply and Demand for Housing - Competitive Residential Market Area
2010 to 2045

	Basis/ reference	2010	2015	2020	2025	2030	2035	2040	2045	Total/ average, 2010-2045
Demand (households):										
Number	Exhibit 2-6	7,800	10,600	14,100	18,000	21,500	23,600	24,800	25,600	
Change since prior date -										
Total (rounded)		--	2,800	3,500	3,900	3,500	2,100	1,200	800	17,800
Average annual		--	560	700	780	700	420	240	160	510
Supply (resident housing units):										
Estimated occupied housing units in 2010[1]	Claritas/ Mikiko	7,800								
Entitled new developments - Potential development since prior date (total rounded)	Exhibit 3-4	--	620	2,180	2,190	2,030	1,370	240	0	8,600
Less vacancy allowance (applied to new units, rounded)	5%	--	-30	-110	-110	-100	-69	-12	0	-431
Net available RHUs (rounded)		7,800	8,390	10,460	12,540	14,470	15,770	16,000	16,000	8,200
Change since prior date -										
Total		--	590	2,070	2,080	1,930	1,300	230	0	8,200
Average annual		--	120	410	420	390	260	50	-	230
Resident housing unit surplus/(deficit):										
At prior date shown[2]		INA	0	(2,210)	(3,640)	(5,460)	(7,030)	(7,830)	(8,800)	
Net surplus (deficit) in RHU production since prior date[2]		INA	(2,210)	(1,430)	(1,820)	(1,570)	(800)	(970)	(800)	
By end of column date		0	(2,210)	(3,640)	(5,460)	(7,030)	(7,830)	(8,800)	(9,600)	



INA = Information not available RHU = resident housing unit (for full-time residents)

[1] Estimated based on total less vacant housing units as estimated by Claritas for 2010, as of October 2010. Figure includes occupied vacation or seasonal homes and thus is considered an overestimate of available RHUs. See beginning of Chapter 3 text for discussion.

[2] Unmet market demand (vs. desires) assumed to be 0 in 2010 due to prevailing soft economic conditions and relatively high primary residential vacancies compared to historical trends.

Exhibit 4-2
Residential Market Assessment for Kaloko Makai

Based on maximum development scenario with 1,000 units of affordable housing

2010 Dollars

Unit type/area	Number of units	Example densities (U/A)	Average annual absorption rate[1]	Average unit sales price	Potential marketing period (years)
Affordable homes (T4 & T5)	1,000 [2]	8 to 16	32	$284,500 [2]	31
Market homes:					
T4 and T5 - Multi- or single-family	3,014	8 to 16	98	$370,000	31
T3 - Single-family	986	3 to 6	35	$475,000	28
Subtotal/average, market homes	4,000	3 to 13	130	$396,000	31
Total/average, all products (rounded)[3]	**5,000**	**3 to 16**	**160**	**$374,000**	**31**

1 Total assumes several but not all products are marketing simultaneously; therefore it may be less than sum of average absorption of individual product types.

2 Affordable unit count expected to range from 700 to 1,000 units based on 5,000 total units, and varying with County rules regarding assignment of credits by income range of buyers. See Hawaii County Code, Chapter 11, Section 11-5 (amended 2011.) If additional housing credits are required to address nonresidential units at Kaloko Makai, developer will comply with such requirements.

For illustrative purposes, Hawaii County guidelines in effect as of September 1, 2010 would specify for-sale housing offered to households of two to four persons earning incomes ranging from less than 80% and up to 120% of the County median income be priced from $202,500 to $366,200; figure shown is based on a mix of market orientations that would satisfy the 1,0000 credits expected to be required of the developer.

Price guidelines also specify one- to two-bedroom rental units offered to households earning 80% to 100% of median income be priced from $1,037 to $1,500 per month, including utilities. County of Hawaii, Office of Housing and Community Development, "Affordable Housing Guidelines for the County of Hawai`i."

Actual inventory, unit types and tenure of affordable housing to be determined in future agreements with government agencies.

Exhibit 4-3
Kaloko Makai - Illustrative Potential Residential Sales Absorption

Based on maximum development scenario, no rentals
and 1,000 units of affordable housing

Unit type/area	Maximum units	Average annual absorption rate	2015 - 2025	2026 - 2035	2036 - 2045
Number of years in period			**11**	**10**	**10**
Affordable homes[1]	1,000	32	**360**	**320**	**320**
Market homes	4,000	130	**1,400**	**1,300**	**1,300**
Total Project (rounded)[2]	**5,000**	**160**	**1,760**	**1,620**	**1,620**

1 Affordable unit count expected to range from 700 to 1,000 units based on 5,000 total units, and varying with County rules regarding assignment of credits by income range of buyers.

2 Total assumes several but not all products are marketing simultaneously; therefore it may be less than sum of average absorption of individual product types.

Exhibit 5-1
Existing Retail Supply and Market Indicators - Primary Trade Area
In square feet, as of December 2010

	North Kona[1]	South Kohala[2]	Total PTA
Gross leasable area	1,937,000	676,000	2,613,000
Vacancy indicators[3]	10%	11%	10%
Largest properties	Kona Commons including Target (505,000)	Parker Ranch Center (146,800)	Kona Commons including Target (505,000)
	Makalapua Shopping Center (170,000)	Queen's Marketplace (135,000)	Makalapua Shopping Center (170,000)

Note: Excludes retail uses in light industrial or business centers. Includes some office/service tenants within shopping centers or other primarily retail complexes.

[1] Defined as Census Tracts 215.01, 215.02, 215.03, 216.01 and 216.02.

[2] Defined as Census Tracts 217.01 and 217.02.

[3] PTA vacancies based on survey by Colliers Hawaii Consulting in November 2010, with sample representing approximately 88% of the PTA's GLA.

Sources: Colliers Hawaii Consulting, A Division of Colliers Monroe Friedlander, Inc., custom and proprietary reports, 2010. Pacific Business News, "Book of Lists 2010," 2010.

Exhibit 5-2
Existing Office Supply and Market Indicators - Primary Trade Area
In square feet, as of December 2010

	North Kona[1]	South Kohala[2]	Total PTA
Rentable building area (rounded)	529,000	63,000	592,000
Vacancy indicators	18%	21%	18%
Largest properties/areas (Rentable building area)	The Pottery Terrace (47,500)	Waikoloa Highlands Center (19,900)	The Pottery Terrace (47,500)
	Kaiwi Square (37,600)[4]	Kamuela Business Center (18,400)	Kaiwi Square (37,600)[4]

Note: Excludes government-owned buildings and some exclusively owner-occupied buildings. Properties may also house some retail spaces, not included in retail inventory on previous exhibit.

[1] Defined as Census Tracts 215.01, 215.02, 215.03, 216.01 and 216.02.

[2] Defined as Census Tracts 217.01 and 217.02.

[3] PTA vacancies based on survey by Colliers Hawaii Consulting in November 2010, with sample representing approximately 84% of the PTA's GLA.

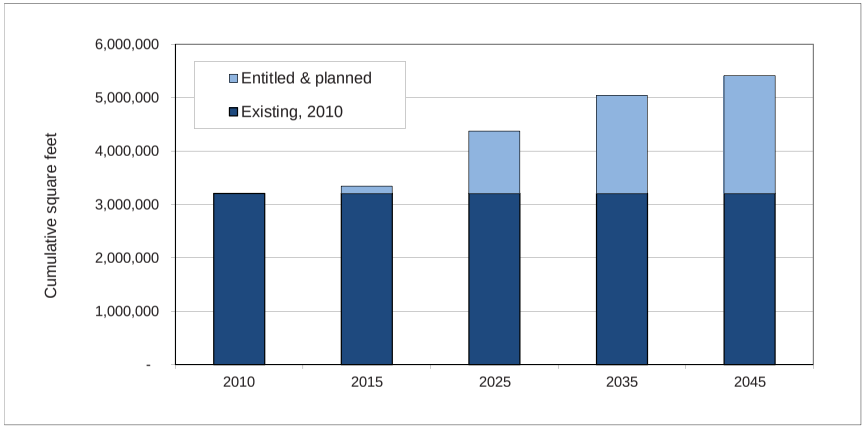
[4] May include ground floor retail.

Sources: Colliers Hawaii Consulting, A Division of Colliers Monroe Friedlander, Inc., custom and proprietary reports, 2010. Pacific Business News, "Book of Lists 2010," 2010.

Exhibit 5-3
Potential Future Commercial Space - Primary Trade Area
Existing and Planned/Entitled Developments

Square feet of gross leasable area, plans known as of December 2010

	Reference	Existing, Dec. 2010	Potential new market entries 2015	2025	2035	2045	Total
Existing inventory:							
Retail	*Exhibit 5-1*	2,613,000					2,613,000
Office	*Exhibit 5-2*	592,000					592,000
Entitled potential spaces (since prior date):	*Appendix 4, distributed*						
North Kona[1]			140,000	880,000	470,000	320,000	1,810,000
South Kohala[2]			-	150,000	200,000	50,000	400,000
Total			140,000	1,030,000	670,000	370,000	2,210,000
Potential future inventory (cumulative):							
North Kona[1]		2,466,000	2,606,000	3,486,000	3,956,000	4,276,000	
South Kohala[2]		739,000	739,000	889,000	1,089,000	1,139,000	
Total		**3,205,000**	**3,345,000**	**4,375,000**	**5,045,000**	**5,415,000**	



Note: Includes proposed retail and office uses, but excludes industrial lands that could potentially accommodate similar uses.

[1] Defined as Census Tracts 215.01, 215.02, 215.03, 216.01 and 216.02.

[2] Defined as Census Tracts 217.01 and 217.02.

Exhibit 5-4
Resident Profiles - Primary Trade Area and Benchmarks
2000 Census and 2010 estimates

	Primary Trade Area: North Kona[1]	South Kohala[2]	Total PTA
Resident population:			
2000 U.S. Census	28,543	13,131	41,674
2010 estimated	37,300	18,000	55,300
Compound annual % increase, 2000-2010	2.7%	3.2%	2.9%
Median age (2010)	39	36	38
Civilian labor force (2010):			
Number	21,900	10,500	32,400
Percent of population	59%	58%	59%

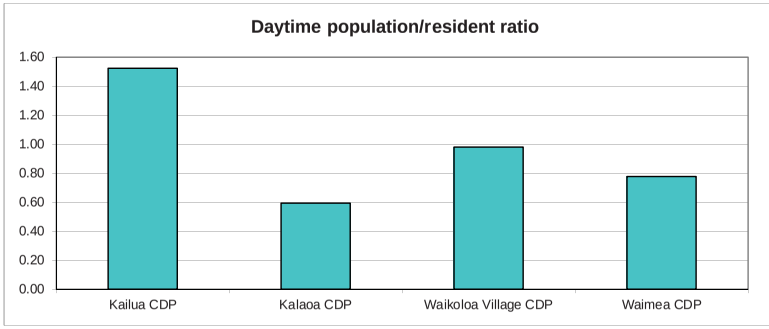
[1] Defined as Census Tracts 215.01, 215.02, 215.03, 216.01 and 216.02.

[2] Defined as Census Tracts 217.01 and 217.02.

Source: Claritas Inc., October 2010.

Exhibit 5-5
Daytime Resident Population and Employment Residence Ratios for Census Designated Places within the Primary Trade Area
2000

	Residents, 2000	Total working in the CDP	Daytime population[1]	CDP daytime population /residents
CDPs in North Kona District:				
Kailua CDP	9,870	9,992	15,036	1.52
Kalaoa CDP	6,794	965	4,036	0.59
Subtotal of CDPs	16,664	10,957	19,072	1.14
CDPs in South Kohala District:				
Waikoloa Village CDP	4,806	2,430	4,713	0.98
Waimea CDP	7,028	1,774	5,466	0.78
Subtotal of CDPs	11,834	4,204	10,179	0.86
Four CDPs combined[2]	56,996	30,322	58,502	1.03



INA = Information not available.

Note: All ratios shown are within the respective CDP. Ratios would be higher if reported on a regional basis.

[1] Residents of area plus workers working in area less workers living in area.

[2] Composite of four CDPs covers a smaller and slightly different area than the PTA.

Source: US Census Bureau, Census 2000, PHC-T-40, "Estimated Daytime Population and Employment-Residence Ratios: 2000" Journey to Work and Migration Statistics Branch, 2005.

Exhibit 5-6
Existing Commercial Areas in Relation to User Populations
As of 2010

	Primary Trade Area		
	North Kona[1]	South Kohala[2]	Total PTA
Retail market:			
Estimated consumers:			
Resident population	37,300	18,000	55,300
Daytime population -			
Daytime resident ratio in district[3]	*1.37*	*1.03*	*1.26*
Daytime resident pop. in district	51,200	18,600	69,800
Average daily visitors[4]	10,400	8,200	18,600
Total daytime pop.	61,600	26,800	88,400
Retail GLA[5]	1,937,000	676,000	2,613,000
GLA per daytime population	31	25	30
Office market:			
Estimated users:			
Resident population	37,300	18,000	55,300
Civilian labor force	21,900	10,500	32,400
% in civilian LF	59%	58%	59%
Office RBA[6]	529,000	63,000	592,000
Per civilian employee	24	6	18

[1] Defined as Census Tracts 215.01, 215.02, 215.03, 216.01 and 216.02.

[2] Defined as Census Tracts 217.01 and 217.02.

[3] 2000 CDP ratios, as shown in Exhibit 5-5, are increased 20% to reflect the larger population and employment areas encompassed by the relevant districts. PTA ratios shown here vary from those shown for the CDPs within the PTA in Exhibit 5-5, since the former reflect the total PTA, while the latter is a weighted average for the CDPs, smaller places within each district. No adjustments assumed for economic changes occurring between 2000 and 2010.

[4] Based on estimated 18,622 average daily visitor census in Kona for 2009; distribution within the PTA based on DBEDT's 2008 visitor unit count, with 5,369 in Kona and 4,207 in Kohala/Waimea.

[5] As shown in Exhibit 5-1.

[6] As shown in Exhibit 5-2.

Sources: Claritas Inc., October 2010; Colliers Monroe Friedlander Consulting, November 2010; State of Hawaii, Department of Business Economic Development and Tourism, Hawaii Tourism Authority; Ibid, 2009, "Visitor Plant Inventory".

Exhibit 5-7
Projected Supportable Commercial Areas - Primary Trade Area
In square feet, 2010 to 2045

	Basis/reference	2010	2015	2025	2035	2045	Ave. annual change, 2010-2045
Resident population in Primary Trade Area:							
Population in North Kona-North & South Kohala-Waikoloa[1]	Exhibit 2-4	22,300	30,000	49,800	64,200	69,500	3.3%
Trade Area in relation to CRMA (above)	2.7 in 2000 2.5 in 2010	2.5	2.4	2.2	2.1	2.1	-0.5%
Population in Trade Area		55,300	72,000	110,000	135,000	146,000	2.8%
Retail-based demand assessment:							
Trade Area daytime resident population -	*PTA estimated at*						
Ratio to resident pop	*1.26 in 2010*[2] *(Ex. 5-6)*	*1.26*	*1.30*	*1.32*	*1.32*	*1.32*	0.1%
Daytime residents		69,800	93,600	145,200	178,200	192,700	2.9%
Visitor population[3]	*18,600 in 2010*	18,600	20,000	23,200	26,900	31,200	1.5%
Retail consumer population in Trade Area		88,400	113,600	168,400	205,100	223,900	2.7%
Supportable GLA in Primary Trade Area	30 sf/daytime population in 2010[4]	28	28	27	27	26	-0.2%
Area in square feet		2,500,000	3,200,000	4,500,000	5,500,000	5,800,000	2.4%
Office-based demand assessment:							
Civilian labor force							
Percent of population	59% of resident population in 2010[5]	59%	57%	56%	55%	55%	-0.2%
Number of persons		32,600	41,000	61,600	74,300	80,300	2.6%
Supportable RBA in Primary Trade Area	18 sf/person in 2010[4]	16	17	17	17	17	0.2%
Area in square feet		520,000	700,000	1,000,000	1,300,000	1,400,000	2.9%
Total supportable commercial areas		**3,000,000**	**3,900,000**	**5,500,000**	**6,800,000**	**7,200,000**	**4.1%**

Note: Demand projections could be conservative in that market support from area second home is residents not explicitly considered.

[1] Census Tracts 215.01 and 217.01, respectively.

[2] Based on estimated ratios derived for the PTA, as shown in Exhibit 5-6.

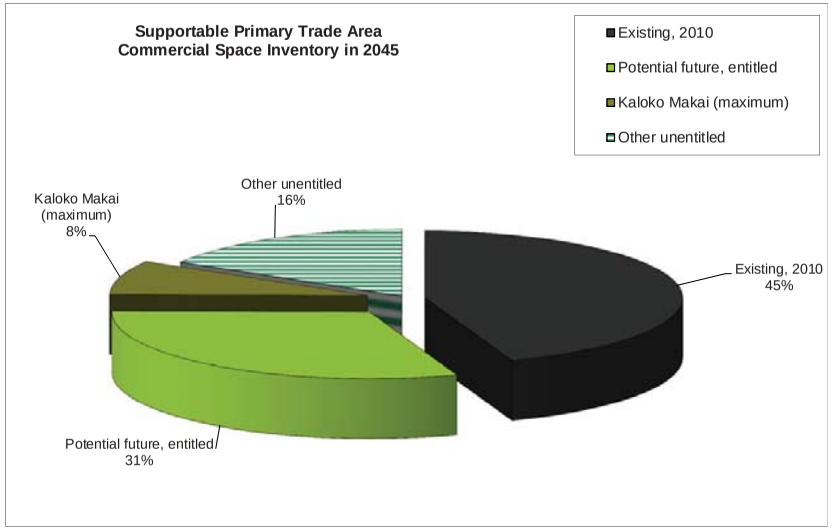
[3] Assumes annually compounded 1.5% average growth in visitor population, most originating in planned interval ownership developments. Projected growth rate based on Department of Business, Economic Development and Tourism, "Population and Economic Projections for the State of Hawaii to 2035: DBEDT 2035 series," January 2008. Table A-66 shows an average 1.1% increase in visitor days from 2010 to 2035 based on the "average growth scenario-baseline scenario." However, those projections do not consider the growing timeshare population of the region. Note also that estimated average daily visitor population in the PTA in 2006 was 21,700 persons, based on DBEDT data, and was unusually depressed in 2010.

[4] As shown in Exhibit 5-6. Supportable ratios for 2010 stated as below existing ratios due to high vacancies in 2010; declining retail ratio reflects potential new retailing modes, while slowly rising office ratio reflects an outlook for more professional opportunities within the PTA in the future.

[5] Compares to 46% for island as a whole in 2010, reflecting currently depressed labor market conditions, particularly outside of the PTA (see Exhibit 5-4.) A declining ratio within the PTA in the long-term is anticipated due to aging population.

Exhibit 5-8
Commercial Market Assessment for Kaloko Makai
Cumulative square feet

	Basis/reference	2025	2035	2045
Kaloko Makai commercial market:				
Potential development phasing	***600,000*** *maximum*	**430,000**	**560,000**	**600,000**
Share of total future Trade Area		8%	8%	8%
Share of net unplanned PTA market support		38%	32%	34%
Projected supportable in Primary Trade Area:	***Cumulative figures***			
Existing, 2010	*Exhibit 5-3*	3,205,000	3,205,000	3,205,000
Potential future, entitled	*Exhibit 5-3*	1,170,000	1,840,000	2,210,000
Net additional supportable		1,125,000	1,755,000	1,785,000
Total	*Exhibit 5-7*	**5,500,000**	**6,800,000**	**7,200,000**



Note: Demand projections could be conservative in that market support from area second home residents is not explicitly considered.

Exhibit 6-1
Existing Business Park/Industrial Supply and Market Indicators - Primary Trade Area
As of December 2010

	North Kona DPA	South Kohala DPA	Total	Comment
Land inventory:				
In net acres -				
Kona Industrial Subdivision	67		67	Mature subdivision adjacent to Kailua-Kona Town.
Kaloko Industrial Park, Phases I & II	110		110	Adjacent to Subject; includes Home Depot, Costco, CS Wo.
Kohanaiki Industrial Park & Honokohau areas	140		140	Adjacent to Subject. Includes McClean Warehouses, Kamanu Street & Huliko'a Drive.
Waimea		5	5	Seiselstad; includes Waimea Self-Storage.
Kawaihae		67	67	Includes DHHL's Kaei Hana II ("I" is in Hilo) & Kawaihae Village, also Kawaihae Industrial Center.
Total net acres	**320**	**70**	**390**	Rounded.
Total in gross acres[1] -	**400**	**90**	**490**	
Undeveloped lands as % of total	15%	1%	12%	"Undeveloped lands" may be encumbered with ground leases and in use.
Built space (square feet):	2,901,000	226,000	3,127,000	Based on CMF survey of approximately 70% of buildings in North Kona and 40% in South Kohala.
Average building vacancy	15%	2%	14%	Up from about 8% in 2008.
Average rent PSF	$0.95	INA	INA	Down 11% since 2008.

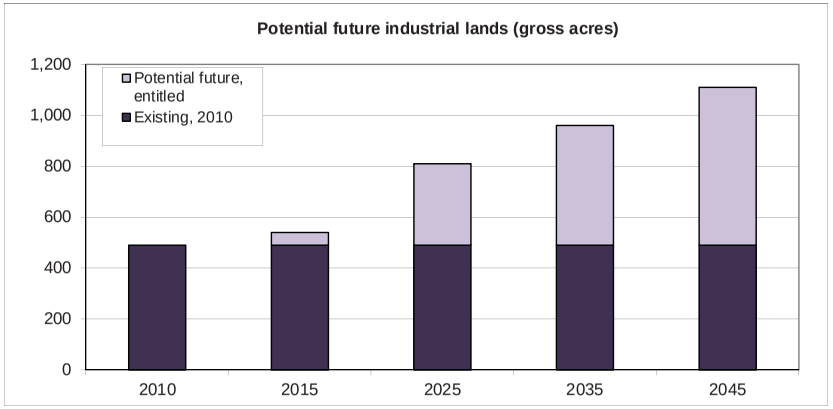
Notes: INA - Information not available. Net of government-owned and operated facilities such as military bases, harbors, airports and universities. (Excludes Honokohau and Kawaihae Harbors, Keahole-Kona International Airport, and the Natural Energy Laboratory of Hawaii.)

[1] Estimated based on 1.25 times net acres.

Sources: Mikiko Corporation; Colliers Hawaii Consulting, A Division of Colliers Monroe Friedlander, Inc. 2010, custom report.

Exhibit 6-2
Potential Future Business Park/Industrial Lands in North Kona and South Kohala Districts
Existing and Planned/Entitled Developments
Gross acres; plans known as of December 2010

Location	Existing, Dec. 2010 (Ex. 6-1)	Potential new market entries[1] 2015	2025	2035	2045	Total
Entitled potential development (since prior date):						
North Kona	400	50	257	150	150	607
South Kohala	90	0	10	0	0	10
Total, rounded	**490**	**50**	**270**	**150**	**150**	620
Potential future supply (existing and planned, cumulative):						
North Kona	400	450	707	857	1,007	
South Kohala	90	90	100	100	100	
Total, rounded	**490**	**540**	**810**	**960**	**1,110**	



Note: Gross acres represent salable or leasable areas plus allowance for major roads and other infrastructure. Planned inventory excludes government-owned and operated facilities such as harbors, airports and university campuses.

[1] See Appendix 5 for listings. Based on plans known as of December 2010. Some proposed projects assumed to occur beyond the projection period, if at all.

Sources: Colliers Hawaii Consulting, A Division of Colliers Monroe Friedlander, Inc. 2010, custom report; interviews with landowners; company web sites.

Exhibit 7-1
Hawaii Island Visitor Unit Inventory
2010

	Number of units	Percent mix
Type of accomodations:		
Hotel	6,958	60%
Individual Vaction Unit[1]	1,675	14%
Timeshare	1,609	14%
Condominium	872	8%
B&B	362	3%
Other	119	1%
Total	11,595	100%
Market orientation (rack room rate):		
Budget (up to $100)		13%
Standard ($101 to $250)		33%
Deluxe ($251 to $500)		40%
Luxury (over $500)		14%
Total		100%

[1] According to the HTA, an individual vacation unit (IVU) may be a condominium unit (not in a hotel rental operation), a house, villa, or cottage or a cabin unit. Unclassified units may also be listed as individual vacation units.
See HTA survey and definitions at:
http://www.hawaiitourismauthority.org/default/assets/File/reports/accommodations/2010-VISITOR-PLANT-INVENTORY-REPORT-FINAL-1.pdf

Source: Hawaii Tourism Authority, 2010 Visitor Plant Inventory.

Exhibit 6-3
Projected Supportable Business Park/Industrial Land Areas
Cumulative gross acres, North Kona & South Kohala

	Basis/notes	Benchmark - 2010	Projected 2015	2025	2035	2045	Average annual change, 2010-2045
Sources of demand:							
Civilian employed persons	Exhibit 5-7	32,600	41,000	61,600	74,300	80,300	2.6%
2010 PTA market characteristics:	Exhibit 6-1						
Land area (gross acres)	Year-end	490					
Occupied lands[1]	90% of land area	440					
Future land demand (gross acres, cumulative):							
Required lands for market balance, rounded	10% availability/ surplus	484	600	910	1,080	1,160	2.5%
Ratio[2]	Employees per gross acre	67	68	68	69	69	0.1%
Supportable industrial land areas (gross acres, cumulative):							
Less existing areas, 2010	Exhibit 6-1	490	490	490	490	490	0.0%
Potential delivery of entitled lands	Appendix 5		50	320	470	620	
Net unentitled demand (surplus), rounded		**(10)**	**60**	**100**	**120**	**50**	

Notes: Net of government-owned and operated facilities such as military bases, harbors, airports and universities. FAR - Floor area ratio.

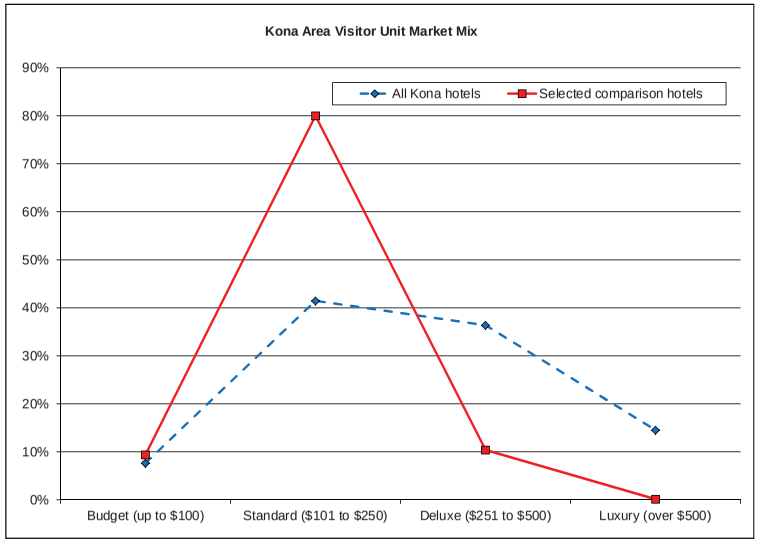
[1] Estimated based on the 12% of lands observed to be "undeveloped" (Exhibit 6-1), less a share known to be encumbered by ground leases and that may also be in use, such as for surface parking.

[2] Note many of these PTA industrial lands serve island-wide needs but are being benchmarked here to PTA employment levels. Therefore the ratios shown above may appear to be lower than their actual function. Higher than historic ratio reflects potential increase in more intensive land uses over time.

Sources: Mikiko Corporation, 2011; Colliers Hawaii Consulting, A Division of Colliers Monroe Friedlander, Inc. 2010, custom report.

Exhibit 7-2
Kona Area Visitor Units by Market Orientation
2010

	Year built	Budget (up to $100)	Standard ($101 to $250)	Deluxe ($251 to $500)	Luxury (over $500)	Total
All Kona hotels[1]:						
Number of units		193	1,044	916	366	2,519
Market mix		8%	41%	36%	15%	100%
Selected comparison hotels:						
King Kamehameha's Kona Beach Hotel	1975	0	460	0	0	460
Kona Seaside Hotel	1960	116	109	0	0	225
Royal Kona Resort	1967	0	306	128	2	436
Uncle Billy's Kona Bay Hotel	1975	0	110	0	0	110
Total, selected hotels		116	985	128	2	1,231
Market mix of selected hotels		9%	80%	10%	0%	100%
% of Kona hotel rooms		60%	94%	14%	1%	49%



[1] Includes 125-unit Kona Village Resort (Deluxe to Luxury class), which was closed after being damaged by the tsunami following the Sendai Earthquake on March 11, 2011.

Source: Hawaii Tourism Authority, 2010 Visitor Plant Inventory.

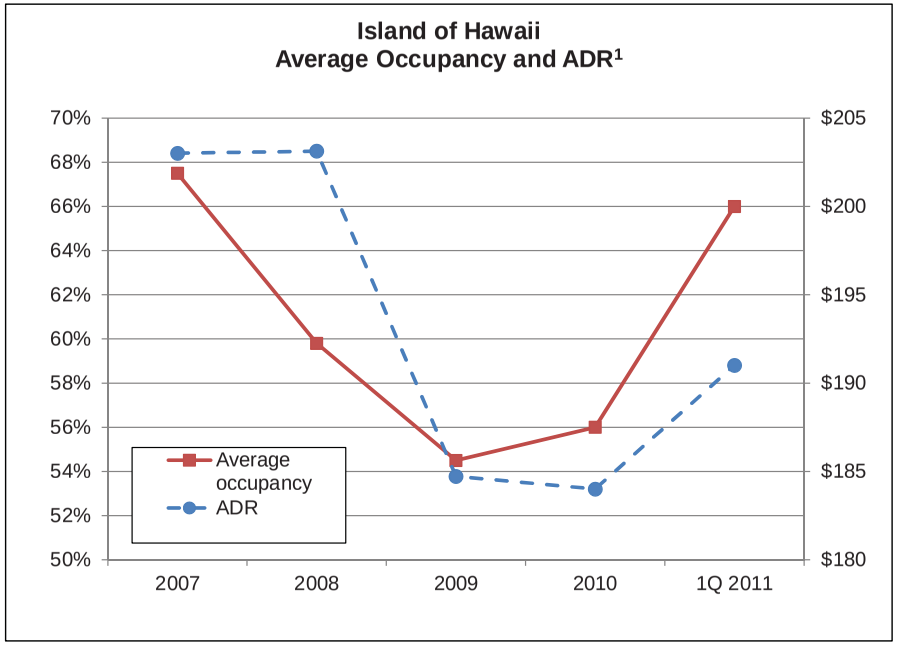
Exhibit 7-3
Kona Out-of-State Visitor Characteristics
2009

	Domestic	International	Total
Visitor days	5,995,257	801,679	6,796,936
Market mix	88%	12%	100%
Average party size	2.0	2.4	2.1
Travel method:			
Group tour	5%	15%	7%
Package	23%	40%	27%
Group tour & package	3%	13%	6%
True independent	69%	32%	61%
Total sample	100%	100%	100%
Length of stay (days):			
In Kona	7.3	4.2	6.7
In State	11.3	9.3	11.0
Accommodations:			
Hotel	45%	68%	49%
Condominium	17%	14%	17%
Timeshare	12%	5%	11%
Friends or relatives	10%	5%	9%
Other (rental house, B&B, cruise ship)	17%	8%	15%
Total sample	100%	100%	100%
Purpose of trip:			
Pleasure (net)	79%	86%	80%
MC&I	7%	4%	6%
Other business	3%	1%	3%
Visit friends or relatives	9%	6%	8%
Sport events	1%	2%	2%
Other (government, military, school)	1%	1%	1%
Total sample	100%	100%	100%

Note: data tracks out-of-State arrivals by air only.
Source: Hawaii Tourism Authority; "Annual Research Tables - 2009, Table 54: Kona Visitor Characteristics: 2009 vs. 2008".

Exhibit 7-4
Hotel Market Performance
2007 - 1Q 2011

	2007	2008	2009	2010	1Q 2011
State of Hawaii:					
Average occupancy	75%	70%	65%	71%	77%
ADR[1]	$200	$201	$177	$174	$191
Island of Hawaii:					
Average occupancy	68%	60%	55%	56%	66%
ADR[1]	$203	$203	$185	$184	$191



1 Average daily room rate.
Source: Hawaii Tourism Authority, 2009, 2010 and 2011.

Market Assessment for Kaloko Makai

Appendices

Appendix 1: Census Tract 215.01 – Portion of North Kona District Considered Within the Competitive Residential Market Area

Source: Claritas, Inc., 2007.

Appendix 2: Census Tract 217.01 – Portion of South Kohala District Considered Within the Competitive Residential Market Area

Source: Claritas, Inc., 2007.

Appendix 3: Planned Primary Residential Development Projects in CRMA - Census Tracts 215.01 and 217.01, Island of Hawaii

Subject and Primary Residential Projects with
State Entitlement or Exemption, as of December 2010

Project identification	Landowner or developer	Number of units: Total	Number of units: Built by 12/ 2010	Number of units: Potential for 2011+	*Est % primary resident & buildout*[1]	Projected additional RHU at buildout	Comment
North Kona-North (CT 215.01):							
Subject: Kaloko Makai	***SCD-TSA Kaloko Makai, LLC***	***5,000***	***0***	***5,000***	***85%***	***4,250***	
Palamanui (previously Hilu Hilu)	Palamanui LLC (Hunt Development Group/Charles Schwab/Guy Lam)	1,116	0	1,116	*80%*	890	Total is max per 2/2010 ordinance. Excludes dormitories. TND design within 725-acre site tied to proposed UH West Hawaii Center.
Kula Nei	The Shopoff Group, LP (TSG Kula Nei LP & Springbrook Investments, LP)	270	0	270	*60%*	160	216-220 lots plus affordable housing. 3/4-mi makai of Mamalahoa, adjacent and to north of Kaloko Heights.
Keahole Heights Phase II	INA - marketed by American Dream Realty	40	29	11	*60%*	10	On Oneone St., northern side of Kaiminani
Kaloko Heights	Stanford Carr Development/Kaloko Heights Associates LLC	1,362	0	1,362	*75%*	1,020	Adjacent to Subject, on Hina Lani. Urban designation for southern half of site vests after meeting completion goals on northern half per LUC, 1986.
Villages of La`i `Opua (Kealakehe ahupua'a)	State - DHHL	1,097	225	872	*95%*	830	SF at Villages 1,2,4,5,7. V5 now being developed/marketed, V3 is completed. Others are planned for nonresidential uses or are indefinite.
Keahuolu	State - DHHL	750	0	750	*95%*	710	150 acres adjacent to La`i `Opua; potential development not likely until 2020+ (after Lai Opua.)
Kamakana Villages	State-HHFDC landowner; Forest City developer.	2,330	0	2,330	95%	2,210	272 acres mauka of Ane Keohokalole Hwy. LUC approved plan 11/4/2010.
Seascape Phase I	Formerly Seascape Development LLC	108	92	16	*95%*	20	Stalled. For-sale condominiums, 25 or 26 sold. Lender took over but has gone insolvent.
Seascape Phase II	Formerly Seascape Development LLC	300	0	300	*95%*	290	Stalled. 10-acre extension to Seascape site, south of end of Kakahiaka St. Affordable housing.
Lohaki Makai	Sonny Ventures, LLC	191	97	94	*70%*	70	Stalled. Vacant lots. Developer related to Seascape. Phases I & II sold 4-5 years ago; III - V on hold.
Wainani Estates	INA; marketed by Clark Realty Corporation	49	29	20	*70%*	10	Lots, 15,000 to 25,000 sf and some finished homes. Ko'iko'i and Kaiminani Streets.
Kaloko Housing Project	County of Hawaii, OHCD	72	0	72	*100%*	70	Broke ground June 2010, 96 units total. On Hina Lani St., south and adjacent to Subject. Figure is net of 24 u lost at Hale O Kawaihae Transitional Housing Program.

Appendix 3: Planned Primary Residential Development Projects in CRMA - Census Tracts 215.01 and 217.01, Island of Hawaii

Subject and Primary Residential Projects with
State Entitlement or Exemption, as of December 2010

Project identification	Landowner or developer	Number of units: Total	Number of units: Built by 12/ 2010	Number of units: Potential for 2011+	*Est % primary resident & buildout*[1]	Projected additional RHU at buildout	Comment
South Kohala-Waikoloa (CT 217.01):							
Wehilani (formerly "Na Puu Nani")	Castle & Cooke Waikoloa LLC (C&C Homes Hawaii, Inc. subsidiary)	804	104	700	*70%*	490	Makana Kai (68 MFs) and Kikaha (36 SFs) closed out 2009. Rest on hold. West & south of Waikoloa Village entrance.
Kilohana Kai at Waikoloa Phase II	Marketed by Hawaiian Island Homes	230	116	114	*65%*	70	80 homes/150 vacant lots. Ph I (51) sold 2005; Ph II (148) on market with 83 shown available; Ph III (31) on hold.
Kamakoa Nui (Waikoloa Workforce Housing)	County of Hawaii	1,200	0	1,200	*95%*	1,140	Infrastructure complete; first phase of 91 units projected for 1Q2012 with County as developer, Coastal building model homes.
Sunset Ridge	Towne Development	197	136	61	*25%*	20	Phases 5 & 6 now on market; developer asked County to rescind Phase 7. Mostly second home buyers.
Keolalani at Waikoloa (formerly "Waikoloa Heights")	Keolalani Investment Partners (purchased from Lynch; entity known as Waikoloa Ma La'i)	2,000	0	2,000	*20%*	400	On hold. Zoned for up to 3,000 units but unlikely; RHU % considers slope, lack of affordable condition and stated intention to price above Sunset Ridge.
Kohala Place at Waikoloa ("Waikoloa Village")	Metric Passco Waikoloa, LLC (may have lost project)	300	0	300	*65%*	200	Project in default. 45 acres total: 300 apartments, commercial & business park. Across Waikoloa Road from Village Golf Course.
Totals, rounded (excluding Subject):							
	North Kona-North	7,700	500	7,200		6,300	
	South Kohala-Waikoloa	4,700	400	4,400		2,300	
		12,400	**900**	**11,600**		**8,600**	

Note - Based on survey of projects planned on lands with State Land Use "Urban" designation as of November 2010, or with landowner that may be exempt from LUC governance. Survey targeted projects of 100 or more planned units. Excludes projects developed in conjunction with beachfront resorts offering golf and/or hotel amenities; also excludes QLT Urban lands for which LUC petitions to be filed to redesignate uses from commercial to residential. Figures shown based on stated owner or developer plans where available, else maximum entitled units.

DEIS - Draft Environmental Impact Statement; DHHL - Department of Hawaiian Home Lands; DLNR - Department of Land & Natural Resources; HHFDC - Hawaii Housing Finance & Development Corporation; INA - Information not available; LUC - State Land Use Commission; MF - Multifamily; MFY - median family income; MU - Mixed use development including residential and retail uses; QLT - Queen Lili`uokalani Trust; RHU - primary resident housing unit; sf - square feet; SF - Single-family detached home; TH - Townhouse (multifamily); u - residential unit.

[1] Reflects estimated percent of project anticipated to sell to primary residents already established on-Island and the likelihood of project building to maximum entitled capacity.

Sources: Interviews with project principals, developers, planners and brokers, and County and State officials; Honolulu Star Advertiser; Pacific Business News; West Hawaii Today; State of Hawaii, Office of Environmental Quality Control; project websites and internet searches.

Appendix 4: Entitled and Planned Commercial Developments in the North Kona and South Kohala Districts, Island of Hawaii

Lands with State Entitlement or Exemption, as of December 2010

Project identification	Location	Landowner or developer	Site area (Ac)	Estimated GLA (Sq. ft.)	Comments
North Kona:					
Subject: Kaloko Makai	***Hina Lani Street and Queen Kaahumanu***	***SCD-TSA Kaloko Makai, LLC***	***INA***	***600,000***	***Timing is hypothetical; ties to commercial market conclusion; don't use numbers***
Kaloko Heights	Mauka of Subject	Stanford Carr Development/Kaloko Heights Associates LLC	6	60,000	Neighborhood commercial; zoned CN-20. Parcel currently on market for sale or land lease.
Kamakana Village	North of Palani Road, between QLT lands	Forest City/State of Hawaii, HHFDC	18	196,000	Received LUC-U approvals Fall 2010. Part of 272-acre affordable master-planned community awarded to Forest City for development.
Palamanui (previously Hilu Hilu)	North of Airport	Hunt Development Group/Charles Schwab/Guy Lam	INA	100,000	UH West Hawaii Center to open in 2012. Village and Community Commercial areas designated within 725-acre site. Excludes 70-acre potential business park shown on industrial analysis.
Kona Commons	N. of Kona Industrial Park	QLT lands; Kona Commons LLC (MacNaughton Group & Kobayashi Group)	INA	305,000	GLA shown is net additional (Phase I of 132,000 SF completed in 2008, 163,000 SF Target opened 2009.)
Kalaoa area (south of Palamanui)	1 across Airport, 1 South of Kaiminani	State Department of Hawaiian Home Lands	40	400,000	Assumed retail portion of two parcels being marketed Jan 2011 (152 acres gross, 122 acres net); balance allocated to industrial. Lease offerings in 2009 & 2010 yielded no results.
DHHL La`i`Opua Other	Within Villages of La`i`Opua	State Department of Hawaiian Home Lands	INA	245,000	Maximum potential developments on Villages 7 & 8 of 350K adjusted because portions of V7 may be undevelopable; no current plans for either.
CG10 site	Keahuolu - South of Palani, Makai of Henry Street	Queen Lili`uokalani Trust Estate	10	110,000	Project on hold. Office and retail potential development; no residential planned at this time.
Lots 14 & 15	Keahuolu - Kona Industrial Subdivision	Queen Lili`uokalani Trust Estate	9	60,000	To resubmit to LUC due to old approvals: Project on hold; plans under review.
Makalapua Shopping Center Phase 2	Keahuolu - adjacent existing	Queen Lili`uokalani Trust Estate	20	116,000	To resubmit to LUC due to old approvals. Currently on hold due to poor market conditions. Up to 20-acre expansion permitted by water agreements within current Urban Phase 1.
Lanihau Shopping Center Phase 2	Kailua-Kona outskirts	Westwood Development Group	22	220,000	Fronts Henry Street. Westwood recently sold Lanihau Center back to A&B, but still holds these vacant lands.
South Kohala:					
Kohala Place at Waikoloa (prev. "Waikoloa Village")	Waikoloa Rd. and Puu Melia St.	Metric Passco Waikoloa, LLC	13	200,000	Development postponed. Zoned CV-10; project also includes residential rentals, senior housing, business park lands, hotel.
Waimea Town Center	Waimea Town, various locations	Parker Ranch	90	200,000	Town Center Plan under review; represents maximum development expected.

Totals of available information, rounded (excluding Subject):

North Kona	1,810,000	**1,810,000**
South Kohala	400,000	**400,000**
Total, Primary Trade Area	**2,210,000**	**2,210,000**
		2,210,000

Note: Survey covers projects with LUC "Urban" designation as of December 2010. Survey targeted community and regional facilities, generally those of 20,000 square feet or more.

INA - Information not available; Ac - Acres; LUC - Land Use Commission; U/C - Under construction; MUD - mixed-use development, including residential and retail; SC - Shopping center

Sources: Interviews with project developers, landowners, planners and brokers; area site visits; Colliers Hawaii Consulting, A Division of Colliers Monroe Friedlander, Inc., December 2010; Pacific Business News (weekly); developer websites; Honolulu Star Advertiser; West Hawaii Today.

Appendix 5: Entitled and Planned Industrial Developments in the North Kona and South Kohala Districts

As of December 2010

	Location	Landowner or developer	Site area (gross acres)	Comments
North Kona:				
Subject: Kaloko Makai	***Hina Lani Street and Queen Kaahumanu***	***SCD-TSA Kaloko Makai, LLC***	***75***	*35 acres interim use and 40 acres long-term use.*
Kaloko Industrial Park Phases III and IV	Hina Lani Street	TSA Corporation	105	Phase III (Kaloko Business Center) 41 net acres, infrastructure completed in 2009; future Phase IV estimated at 57 net acres.
West Hawai'i Business Park	Queen Kaahumanu Hwy	Lanihau Partners	327	337 gross acres less 10 net acres used by West Hawaii Concrete as quarry, with one building. To be marketed as lots. Absorption may extend beyond projection period.
Palamanui	Queen Kaahumanu Hwy	Palamanui Global Holdings LLC	70	Planned as condominium lots in business park; Phase I is 29 acres.
Kalaoa	Across from Airport, south of Palamanui	DHHL	112	Portion of 152 acres offered at 2 sites on Queen Kaahumanu Hwy.; balance assumed to be retail/office.
South Kohala				
Waikoloa Village	Waikoloa Village, Pua Melia Rd.	Formerly Passco Waikoloa LLC & Metric Waikoloa, LLC	10	Total site of 45 acres previously planned for 200,000 SF retail, 300 apts, limited service hotel as well as business/industrial park.

Area summaries, excluding Subject

North Kona	614
South Kohala	10
Total, rounded	620

Notes: Excludes potential government-sponsored or related enterprises at Airport, Honokohau Harbor, and at NELHA. Also excludes lands between Kalaoa and Palamanui which DHHL recently acquired from State for "income purposes," but for which no plans have yet been determined.

Sources: Mikiko Corporation, 2011; Colliers Hawaii Consulting, A Division of Colliers Monroe Friedlander, Inc. 2010, custom report; Pacific Business News; interviews with landowners.

Appendix 6: Report Conditions

This assessment is based on information provided by government agencies, developers, brokers, landowners, and other third party sources. While every attempt has been made to verify information via multiple sources, it is not always possible to do so. Mikiko cannot guarantee the accuracy of all information upon which its assessments may be based.

Mikiko has no responsibility to update this report or any of the underlying data for events and circumstances occurring after December 31, 2010, the date of substantial completion of primary data collection.

This report is for the planning purposes of SCD-TSA Kaloko Makai, LLC and its consultants, as well as for public disclosure of the nature of Kaloko Makai pursuant to seeking State and County land entitlements. It is not to be used for solicitation of investment or other third party purposes without prior written consent of the author.

This report does not offer an appraisal of Kaloko Makai, nor should it be construed as any opinion of value for Kaloko Makai.

Appendix B

Service Area Health Care Facilities Forecast – Kaloko Makai
Cattaneo & Stroud, Inc.
June 2011

Cattaneo & Stroud, Inc.

Consultants to the Health Care Industry

1601 Old Bayshore Highway, Suite 107
Burlingame, California 94010

Service Area Health Care Facilities Forecast - Kaloko Makai

Prepared for:
SCD-TSA Kaloko Makai, LLC

Prepared by:
Cattaneo & Stroud, Inc.

June 2011

Summary of Kaloko Makai Health Care Facilities Forecast

SCD-TSA Kaloko Makai, LLC is reserving 40 acres of land for the potential development of a hospital. SCD-TSA is not committed to developing the new hospital or any of the suggested support facilities indicated in this study. The purpose of this study is to show potential staffing requirements and space (square footage) demands for a finite number of healthcare facilities based on current and future population figures as well as Medical visit records produced by the Hawaii Health Information Corporation.

A population-based forecast of the health care facility and manpower needs for the residents of the Kona Coast region resulted in the following plan for health care facilities development:

Service Area Health Care Facilities Forecast - Kaloko Makai	
Campus Planning Scenarios: Phase One (2015-2020)	
Medical Office Building (# MDs)	10
Urgent Care	4,500
Hospital	
Skilled Nursing/LTC	50
Campus Planning Scenarios: Phase Two (2020-2030)	
Medical Office Building (# MDs)	50
Urgent Care	5,100
Hospital	130
Skilled Nursing/LTC	100
Campus Planning Scenarios: Phase Three (2030-2040)	
Medical Office Building (# MDs)	100
Urgent Care	5,700
Hospital	150
Skilled Nursing/LTC	150

The forecast is presented in three phases that result in the estimated need for the following services:

- **Medical Office Building(s):** The estimated number of physicians that would locate in the proposed Kaloko Makai development. Phase One would occur early in the development and before a hospital is located in the area, hence the offices would start small, with limited ancillary services (xray, lab draw station, pharmacy) to support the community and medical practices. Over the next five to ten years, as the development grows and plans for the hospital are

completed, medical office needs would grow to an estimated 50 physicians. As the community and hospital grow, the need for physician offices will grow to up to 100 physicians.

- **Urgent Care:** The Urgent Care component of the project will meet the immediate medical needs of the growing community, in concert with the physician offices, as well as provide access to health care for lower acuity cases. The forecast is based on an assumption that approximately 17% of emergency visits are low acuity, based on a 2010 study of Hawaii resident cases. When the hospital opens, the urgent care function would be coordinated with the hospital emergency room to determine the optimal staffing and facility for both services.

- **Hospital:** Construction of the hospital is anticipated in Phase Two which is forecast to occur between 2020 – 2025. This plan assumes that the hospital is built in two phases, with the first hospital building sized to house up to 130 beds. However, capacity could be phased in depending on how quickly demand develops in the area. Overall demand for acute care beds is forecast to reach 150 by 2035 at recent use rates for Big Island residents of the Kona Coast. Additionally, a portion of beds could be operated as "swing beds", i.e. they could be operated as acute or skilled nursing based on demand.

- **Long Term Care:** There is a significant shortage of long term care beds in the state of Hawaii, including on the Big Island. The elderly population is the fastest-growing component locally and statewide. This project proposes to develop a fifty bed facility in Phase One with fifty bed increments added in Phases Two and Three, for a total of 150 beds.

Summary

The proposed health care facilities address a growing need for local services to support the needs of the regional population. Over the past few years, local and state groups have documented the shortage of skilled nursing and long term care beds, the shortage of physicians, and the aging status of the state's hospitals. The Kaloko Makai development includes a continuum of modern, needed services that should provide a strong foundation for community health and for attracting health professionals to the region.

Health Care Facilities Forecast - Kaloko Makai

Revised as of June 2011

Campus Planning Scenarios: Phase One

Building Types	Components	Building GSF	Parking	Acreage for new Buildings
Outpatient Care Center	Imaging, Lab, Pharmacy, Urgent Care	14,629	73	1.28
MOB #1	10 MD Office/Suites	18,750	94	1.44
Hospital	No hospital this phase	-	-	-
Skilled Nursing/LTC	No Skilled Nursing Beds	-	-	-
	Totals	33,379	167	2.72

Campus Planning Scenarios: Phase Two

Building Types	Components	Building GSF	Parking	Acreage for new Buildings
Outpatient Care Center	Expand OP service. Add Ambul Surgery	23,639	118	2.06
MOB #2	30 MD Office/Suites	56,250	281	4.33
Hospital	No hospital this phase	-	-	-
Skilled Nursing/LTC	50 Skilled Nursing Beds	32,500	75	1.71
	Totals	112,389	474	8.10

Campus Planning Scenarios: Phase Three

Building Types	Components	Building GSF	Parking	Acreage for new Buildings
Outpatient Care Center	New OP services replaces UC & ASC	23,639	118	2.06
MOB #3	50 MD Office/Suites	93,750	469	6.78
Hospital	100 bed hospital this phase	185,000	500	8.55
Skilled Nursing/LTC	100 Skilled Nursing Beds	60,000	150	3.31
Service Building 1		6,000	12.00	0.34
	Totals	362,389	1,237	21.04

Campus Planning Scenarios: Phase Four

Building Types	Components	Building GSF	Parking	Acreage for new Buildings
Outpatient Care Center	OP Services expands by 25%	29,548	148	2.58
MOB #4	100 MD Office/Suites	187,500	938	13.56
Hospital	150 bed hospital this phase	270,000	750	12.74
Skilled Nursing/LTC	150 Skilled Nursing Beds	82,500	225	4.79
Service Building 2		10,000	20	0.57
	Totals	569,548	2,060	34.23

Campus Staffing Forecast - Kaloko Makai

Revised as of June 2011

Building Types	Staffing Assumptions	Building GSF	MD's	Total Staff
Outpatient Care Center	1 MD plus 4 staff/ 2000 usable SF	14,629	9	47
MOB #1	1 MD plus 4 staff/ 1500 usable SF	18,750	10	50
Hospital	No hospital this phase	-	-	-
Skilled Nursing/LTC	No Skilled Nursing Beds	-	-	-
	Totals	33,379	19	97

Building Types	Staffing Assumptions	Building GSF	MD's	Total Staff
Outpatient Care Center	1 MD plus 4 staff/ 2000 usable SF	23,639	9	47
MOB #2	1 MD plus 4 staff/ 1500 usable SF	56,250	30	150
Hospital	No hospital this phase	-	-	-
Skilled Nursing: 50 Beds	1.6 staff/ bed	32,500		275
	Totals	112,389	39	472

Building Types	Staffing Assumptions	Building GSF	MD's	Total Staff
Outpatient Care Center	1 MD plus 4 staff/ 2000 usable SF	23,639	9	47
MOB #3	1 MD plus 4 staff/ 1500 usable SF	93,750	50	250
Hospital: 100 Beds	5.5 staff/ bed	185,000		550
Skilled Nursing: 100 Beds	1.6 staff/ bed	60,000		160
Service Building 1	Included in hospital staff	6,000		
	Totals	362,389	59	1,007

Building Types	Staffing Assumptions	Building GSF	MD's	Total Staff
Outpatient Care Center	1 MD plus 4 staff/ 2000 usable SF	29,548	12	59
MOB #4	1 MD plus 4 staff/ 1500 usable SF	187,500	100	500
Hospital:150 Beds	5.5 staff/ bed	270,000		825
Skilled Nursing: 150 Beds	1.6 staff/ bed	82,500		240
Service Building 2	Included in hospital staff	10,000		
	Totals	569,548	112	1,624

Kaloko Makai, Medical Campus: Site Planning Scenarios

SCD-TSA Kaloko Makai, LLC

Revised as of June 2011

Building Group by Phase	Building GSF	Parking Spaces	Building Site in Acres	Peak Trips per Hour
Outpatient Care 1	14,629	73	1.28	76
Outpatient Care 2	23,639	118	2.06	122
Outpatient Care 3	23,639	118	2.06	122
Outpatient Care 4	29,548	148	2.58	153
MOB 1,	18,750	94	1.44	70
MOB's 2	56,250	281	4.33	209
MOB's 3	93,750	469	6.78	349
MOB's 4	187,500	938	13.56	698
Skilled Nursing, 50 beds	32,500	75	2.46	14
Skilled Nursing, 100 beds	60,000	150	4.68	25
Skilled Nursing, 150 beds	82,500	225	6.68	35
Hospital: 100 beds	185,000	500	8.55	218
Hospital: 150 beds	270,000	750	12.74	319
Service Building 1	6,000	12	0.34	7
Service Building 2	10,000	20	0.57	12

Traffic Volumes for each building-type based on guidelines from the Institute for Transportation Engineering

Traffic Volumes (Peak Trips per hour) do not occur across all buildings at the same hour.

"Building Acreage" does not include Storm Detention areas or Open Space

Kaloko Makai, Medical Campus, Medical Office Buildings

SCD-TSA Kaloko Makai, LLC Revised as of June 2011

Building by Phase (1)	Total MD's	GSF /MD Suite	Total GSF	Total of MOB's Footprint (2)	Total Footprint Acres
MOB 1	10	1,500	18,750	10,313	0.24
MOB's 2	30	1,500	56,250	30,938	0.71
MOB's 3	50	1,500	93,750	32,813	0.75
MOB's 4	100	1,500	187,500	65,625	1.51
Parking Spaces by Phase (3)			**Parking GSF**	**With all Drives, Landscape & Misc (4)**	**Total Site Work Acres**
MOB 1	94		37,500	52,500	1.44
MOB 2	281		112,500	157,500	4.33
MOB 3	469		187,500	262,500	6.78
MOB 4	938		375,000	525,000	13.56

Notes:

1. Medical Office Building with 80% Usable per floor
2. Building Footprint assumes 2 story building with 55% at grade level
3. Parking at 5 Spaces/ 1000 GSF
4. Roadways, Landscape & Misc Sitework at 40% of Parking lots

Kaloko Makai, Medical Campus: Skilled Nursing Facility

SCD-TSA Kaloko Makai, LLC Revised as of June 2011

Building Group by Phase (1)		GSF/Bed	Total GSF	Building Footprint (2)	Building Footprint Acres
SNF 1: Beds	50	650	32,500	32,500	0.75
SNF 2: Beds	100	600	60,000	60,000	1.38
SNF 3: Beds	150	550	82,500	82,500	1.89
Parking Spaces by Phase (3)		**GSF/Space**	**Parking GSF**	**With all Drives, Landscape & Misc (4)**	**Total Site Work Acres**
SNF 1:	75	400	30,000	42,000	1.71
SNF 2:	150	400	60,000	84,000	3.31
SNF 3:	225	400	90,000	126,000	4.79

Notes:

1. Freestanding SNF w/ 80% Semi-private rooms and minimal outsourcing of medical services
2. Building Footprint assumes 1 story building with 100% at grade level
3. Parking at 1.5 Spaces/ Bed
4. Roadways, Landscape & Misc Sitework at 40% of Parking lots

Kaloko Makai, Medical Campus: Community Hospital

SCD-TSA Kaloko Makai, LLC — Revised as of June 2011

Building Group by Phase (1)		GSF/Bed (5)	Total GSF	Building Footprint (2)	Building Footprint Acres
Hospital 3: Beds 100		1850	185,000	92,500	2.12
Hospital 4: Beds 150		1800	270,000	135,000	3.10
Parking Spaces by Phase (3)		**GSF/Space**	**Parking GSF**	**With all Drives, Landscape & Misc (4)**	**Total Site Work Acres**
Hospital 3: Beds	500	400	200,000	280,000	8.55
Hospital 4: Beds	750	400	300,000	420,000	12.74

Notes:

1. Community Hospital w/ private rooms and minimal outsourcing of medical services
2. Building Footprint assumes 3 story building with 50% at grade level
3. Parking at 5 Spaces/ Bed
4. Roadways, Landscape & Misc Sitework at 40% of Parking lots

Kaloko Makai, Medical Campus, Outpatient Care Center

SCD-TSA Kaloko Makai, LLC — Revised as of June 2011

Building Group by Phase		GSF for these services	Total GSF	Building Footprint	Total Footprint Acres
Outpatient Care Center 1	Imaging, Lab & Urgent Care (1)	11,704	14,629	14,629	0.34
Outpatient Care Center 2	Expand OP, Add ASC (2)	18,911	23,639	23,639	0.54
Outpatient Care Center 3	Backfill OP as UC & ASC move to hosp (3)	18,911	23,639	23,639	0.54
Outpatient Care Center 4	Expand OP services by 25% (4)	23,639	29,548	29,548	0.68
Parking Spaces by Phase (6)		**GSF/Space**	**Parking GSF**	**With all Drives, Landscape & Misc (5)**	**Total Site Work Acres**
OCC 1	73	400	29,259	40,962	1.28
OCC 2	118	400	47,278	66,189	2.06
OCC 3	118	400	47,278	66,189	2.06
OCC 4	148	400	59,097	82,736	2.58
Total all ACC phases	457		182,911	256,075	5.88

Notes:

1. Includes Imaging rooms, Draw Stations, 8 bed Urgent Care Center & Support Space
2. Adds ASC with 2 ORs, Prep/Recovery & Support Spaces
3. ASC and UC to hospital. Backfill spaces with PT and Women's Center
4. All OP centers grow by 25%
5. Roadways, landscaping and misc sitework 40% of parking lots
6. Outpatient Parking Ratio, 5 spaces/1000 GSF

Kaloko Makai Health Campus	*Facility Master Planning*
Space Program	Revised as of June 2011

Urgent Care Center

Room Name or Space Reqd.	Remarks	Units	SF/Unit	Total SF
Waiting Room	Seats 20 plus child's play area	1	400	400
Volunteers Station	Desk and Refreshment Cart	1	40	40
Public Toilet		2	55	110
Reception & Registration	2 Registration Booths & Work counter	1	60	60
Staff Stations				
Central Nurses Station	Workstations for 6 Staff	1	160	160
MD Dictation	2 Workstations	1	30	30
Medication Room	Automated Dispensing	1	60	60
PACS Viewing Station		1	40	40
Medical Supplies	Cart Resupply Room	1	80	80
Clean Utility	Sink Counter and Storage	1	100	100
Linen Storage	Linen Carts	1	20	20
Soiled Utility	Hopper Sink	1	60	60
Treatment Bays				-
Fast Track/ Minor Treatment	Partial Walled Stations w/ Cubicle Curtain	4	100	400
Exam Rooms	Isolated / Secured Exam Room	4	120	480
Handwash Stations	Staff Stations	1	10	10
Patient Toilets		2	55	110
Support Services				
MD Office		1	100	100
Unit Managers Office		1	100	100
Electrical Closet		1	60	60
Communication Closet		1	40	40
Janitor Closet		1	40	40
Staff Lockers/ Showers		1	140	140
Staff Conference Lounge	Table & Kitchenette	1	120	120
Staff Toilet		1	60	60
		Total Net SF		2,820
		Circulatio	1.5	1,410
		Total SF		4,230

Pharmacy

Prescription Preparation	3 Fill Stations, Dispensing and Sink	1	60	60
Cashier Station	Swing staff w/ pharmacy	1	20	20
Pharmaceutical Shelving	350 LF of Shelving	1	100	100
Bulk Stores and workroom		1	60	60
Pharmacy Waiting	5 seats	2	15	30
Retail Shelving	Medical/ Retail. No food or DME	1	200	200
		Net SF		470
		Circulation 1.4		188
		Subtotal SF		**658**

Outpatient Reception/ Waiting Area

Room Name or Space Reqd.	Remarks	Units	SF/Unit	Total SF
Entry/ Waiting				
Entry Vestibule	Separate entry from Women's Center	1	100	100
Reception Desk	2 Workstations, Copier, Fax	1	100	100
				-
Registration				-
Registration Cubicles	Access to Women's & Amb Care Waiting	2	60	120
Clerical Area	Copy, Chart Assembly, Files & Storage	1	100	100
Financial Counseling/ Insur Verif.	PAT discharge counseling	1	100	100
				-
Waiting Area				-
Patient/ Family Waiting	General waiting, seats (120	1	240	240
Children's Area	Quiet play, games, puzzles	1	50	50
Toilets		2	60	120
Health Resource Center	Books, Videos, Operable Wall	1	100	100
		Net SF		1,030
		Circulation 1.5		515
		Subtotal SF		**1,545**

Lab and Testing Services

Room Name or Space Reqd.	Remarks	Units	SF/Unit	Total SF
Point of Care Testing	Countertop equipment. Basic tests	1	100	100
Specimen Processing	Specimen storage, sorting & pick -up	1	40	40
Workstation	Paperwork station	1	65	65
Lab Storage	Lab Supplies & Refrig. Storage	1	40	40
Testing/ Consult Rooms	Draws, EKG, History, Staff Work	1	100	100
Draw Stations	Draw Chair & phlebo. cart	2	70	140
Clerical Work	Chart assembly & Storage	1	80	80
Toilet	Specimen collections	1	55	55
(Group Teach in RMP Conf Room)				-
		Net SF		620
		Circulation 1.4		248
		Subtotal SF		**868**

Imaging Services

Room Name or Space Reqd.	Remarks	Units	SF/Unit	Total SF
Reception/ Scheduling				
Reception/ Scheduling	Workstations, Copier, Fax	1	80	80
Sub-Waiting for Imaging	Seats 4 w/ Main Waiting nearby	1	100	100
Men's Change Booths	Booths w/ adjacent patient lockers	2	30	60
Women's Change Booths	Booths w/ adjacent patient lockers	2	30	60
Women's Toilet		1	55	55
				-
Image Reading & Processing				-
PAC Work Stations/ Film Reading	PAC & Large Film Reading cubicles	1	80	80
Radiologists Work Stations	Work cubicles	1	50	50
Clerical Area	Clerical, Copy, Sorting	1	100	100
Dept Manager	Private Office	1	80	80
Utility Storage	Paper Storage & Coffee/ microwave	1	100	100
				-
Rad/ Flouro				-
Rad/Flouro Room	Digital R/F	2	320	640
Control Areas	Shared Room Controls	1	75	75
R/F Toilet	Toilet w/ 2 doors	1	60	60
Radiographic Rooms	Rad Unit w/ Chest Stand	1	225	225
				-
Central Workroom/ Processing				-
Central Workroom/ Processing	Rad Techs, Film Load, Digital Q/A	1	120	120
Darkroom	Film Process	1	65	65
Tech Lounge	Conf, Lockers, Kitchenette	1	100	100
Staff Toilet		1	55	55
				-
Mammo & UltraSound Suite	Adjacent to Women's changing area			-
Ultrasound Exam Rooms		1	150	150
Mammography	Change at Dressing Area	1	140	140
Work/Utility		1	60	60
				-
Support Functions				-
General Storage Rooms		1	100	100
Hallway Alcoves	Wheelchair, Equip Storage	2	30	60
Staff Locker/ Toilet	lockers, Toilet & Shower	1	120	120
General Staff Lounge and Conf.	Used by all Amb. Care Staff	1	100	100
Janitor Closet		1	40	40
Electrical Room		1	60	60
		Net SF		2,935
		Circulation 1.5		1,468
		Subtotal SF		**4,403**

Ambulatory Surgery

Room Name or Space Reqd.	Remarks	Units	SF/Unit	Total SF
General Operating Rooms	General Surgery	2	350	700
Scrub Station Alcoves	2 sinks per station	1	50	50
Flash Sterilization	Shared between 2 OR's	1	60	60
MD Dictation Alcove	Stand-up Dictation	1	15	15
Stretcher Alcoves		2	30	60
Clean Utility/ Storage	Clean Surgical Supplies	1	120	120
Equipment Storage	Rolling Equipment	1	120	120
Anesth. Workroom	Bottle storage, Carts, Equip & charting	1	80	80
Blood Bank	UC Refrig & Workstation	1	60	60
Frozen Section Lab	Cryostat, Scope, Bench, UC Freezer	1	80	
Control Station	Nurse, Charting, Clerical	1	100	100
Men's Lockeroom/ Changing	40 lockers, sink vanity, gown storage	1	140	140
Men's Toilet	1 Toilet, Urinal & Shower	1	120	120
Women's Lockeroom/ Changing	40 lockers, sink vanity, gown storage	1	160	160
Women's Toilet	2 Toilet & Shower	1	100	100
Staff Lounge/ Conference	Seating, Table, Refreshments	1	120	120
Physician Dictation	Dictation cubicle	1	20	20
Janitor Closet	Near OR's	1	60	60
(All Prep/ Recovery Adjacent)				-
				-
Central Processing/ Storage	(Processing for procedures, not Endo)			-
Soiled Utility/ Decontamination	Soiled Instruments & Clean-up	1	60	60
Sterile Processing	2 Wash/ Decont, 1 Steam Sterile, Carts	1	160	160
Tray make-up	Instr storage, Tray make-up	1	60	60
Equipment Storage	General Medical equip	1	100	100
Clean Supplies	Clean supplies and bulk storage	1	140	140
Gas Storage	Bottle Storage	1	60	60
		Net SF		2,665
		Circulation 1.5		1,333
		Subtotal SF		**3,998**

Recovery Center

Room Name or Space Reqd.	Remarks	Units	SF/Unit	Total SF
Prep/ Recov & Dressing				
Change/ Prep/ Recovery Rooms	Prep/ Recov, Locker, sink & bed	4	135	540
Patient Toilets	H/C Access	1	55	55
Nurse Station/ Charting	Adjacent to Recovery N/S	1	100	100
MD Dictation		1	30	30
Meds and Utility	Shared w/ Recovery#1			-
Linen Storage		1	40	40
Storage		1	80	80
Patient discharge area	Direct discharge to auto pick-up	1	60	60
				-
Patient Recovery Area				-
Level 1 Recovery Stations	Partial walled cubicles	4	80	320
Patient Toilets	H/C Accessible	1	55	55
Nurse Station/ Charting	Adjacent to Recovery N/S	1	120	120
Patient Meds and Nourishment	Med dispensing & Refrig	1	40	40
Staff Office	Unit Mgr & Conf	1	100	100
Anesthesia Office	Office and Consult	1	100	100
Hallway alcoves	Stretcher/ Wheelchair	2	30	60
Clean Utility	Clean Linen & Storage	1	100	100
Soiled Holding		1	100	100
Storage	Carts and Equipment	1	120	120
Janitor Closet		1	60	60
Electrical Closet		1	60	60
		Net SF		2,140
		Circulation 1.5		1,070
		Subtotal SF		**3,210**

Women's Center

Room Name or Space Reqd.	Remarks	Units	SF/Unit	Total SF
Entry Area				
Entry Vestibule	Separate entry from Amb.Care	1	80	80
Reception Desk	2 Workstations, Copier, Fax	1	120	120
Waiting Area	Seats 18 & Coffee Cart	1	360	360
Toilet	H/C Access & Diaper Station	1	60	60
Women's' Resource Center	Books, Videos, Linked w/ Amb Care	1	300	300
				-
				-
Women's Dressing Area				
Consult Room	Counseling & Education	1	100	100
Changing Booths	Adjacent to Imaging and Exam Rooms	8	30	240
Patient Locker/ Storage	With Booths: 8 Full Lockers, 2 Seats	1	120	120
Toilet	H/C Toilet w/ vanity	2	60	120
				-
Exam/ Teaching				-
Exam Rooms	Private Hall to Changing Rooms	3	100	300
Exam/ Procedure w/ toilet	Private toilet w/ 2 doors	1	180	180
Control Station	Scale, Charting and Clerical	1	80	80
MD Work Area	Paperwork & Film Viewer	2	60	120
Storage	Clinical and general supplies	1	100	100
Staff Lounge/ Lockers	Common Locker/Lounge (See Imaging)			-
		Net SF		2,280
		Circulation 1.5		1,140
		Subtotal SF		**3,420**

Appendix C

Assessment of the Potential Impact of the Proposed Kaloko Makai Project on Water Resources

Tom Nance Water Resource Engineering

Revised July 2013

An Assessment of the Potential Impact of the Proposed Kaloko Makai Project on Water Resources

Prepared for:

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Revised July 2013
December 2012

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INTRODUCTION

This report provides an assessment of the potential impact of the proposed Kaloko Makai project on water resources. It has been prepared to support the project's Supplemental EIS being prepared by others.

DESCRIPTION OF THE PROJECT

Project Site and Proposed Development

Location of the 1113-acre project site is shown on Figure 1. The site is on both sides of Hina Lani Drive and extends from Queen Kaahumanu Highway on its makai end to about 760-foot elevation at its highest point. The project is to be developed in three phases and would be comprised of a mix of residential, commercial, industrial, and public uses, the latter including a 150-acre dry land forest (Figure 2).

Projected Water Supply Requirements

Separate potable and non-potable systems are proposed to supply the project's water requirements. Projected supply requirements have been prepared by Wilson Okamoto Corporation (2012) and are summarized on Table 1. At full build out, projected average potable use would be 2.18 MGD. The average non-potable use would be 0.58 MGD.

Alternative Sources of Supply for the Potable System

The potable system's well pumping capacity must provide the maximum day use (defined as 1.5 times the average use) in a 24-hour pumping day. If the wells are dedicated to and incorporated into the County Department of Water Supply (DWS) system, one-third of the well capacity would be allocated to DWS and two-thirds would be allocated to the developer. Four alternative sources for potable supply are being considered: onsite wells at about 710-foot elevation at the upper end of the project; 710-foot onsite wells with desalinization; wells several miles to the south tapping the high level groundwater body; and desalinization using onsite saline groundwater as the feedwater supply. These are described in the paragraphs following.

Onsite Wells at 750-Foot Elevation Within the Project Site. The possibility of developing potable quality wells onsite at 710-foot elevation is suggested by the discoveries of two deep monitor wells (State Nos. 3858-01 and 3959-01), both of which encountered fresh groundwater under artesian pressure at depth below saline groundwater and far below and hydrologically disconnected from the basal lens. The phenomenon is discussed in detail later in this report. A deep exploratory borehole at 710-foot elevation at the upper end of the project site will be undertaken to determine if fresh groundwater can be found at depth and to determine the feasibility of its development. If successful, three production wells would be developed, each of 1150 GPM capacity and driven by 300 horsepower motors. These wells would be integrated into the DWS system, with two-thirds of their capacity allocated to supply the Kaloko Makai project.

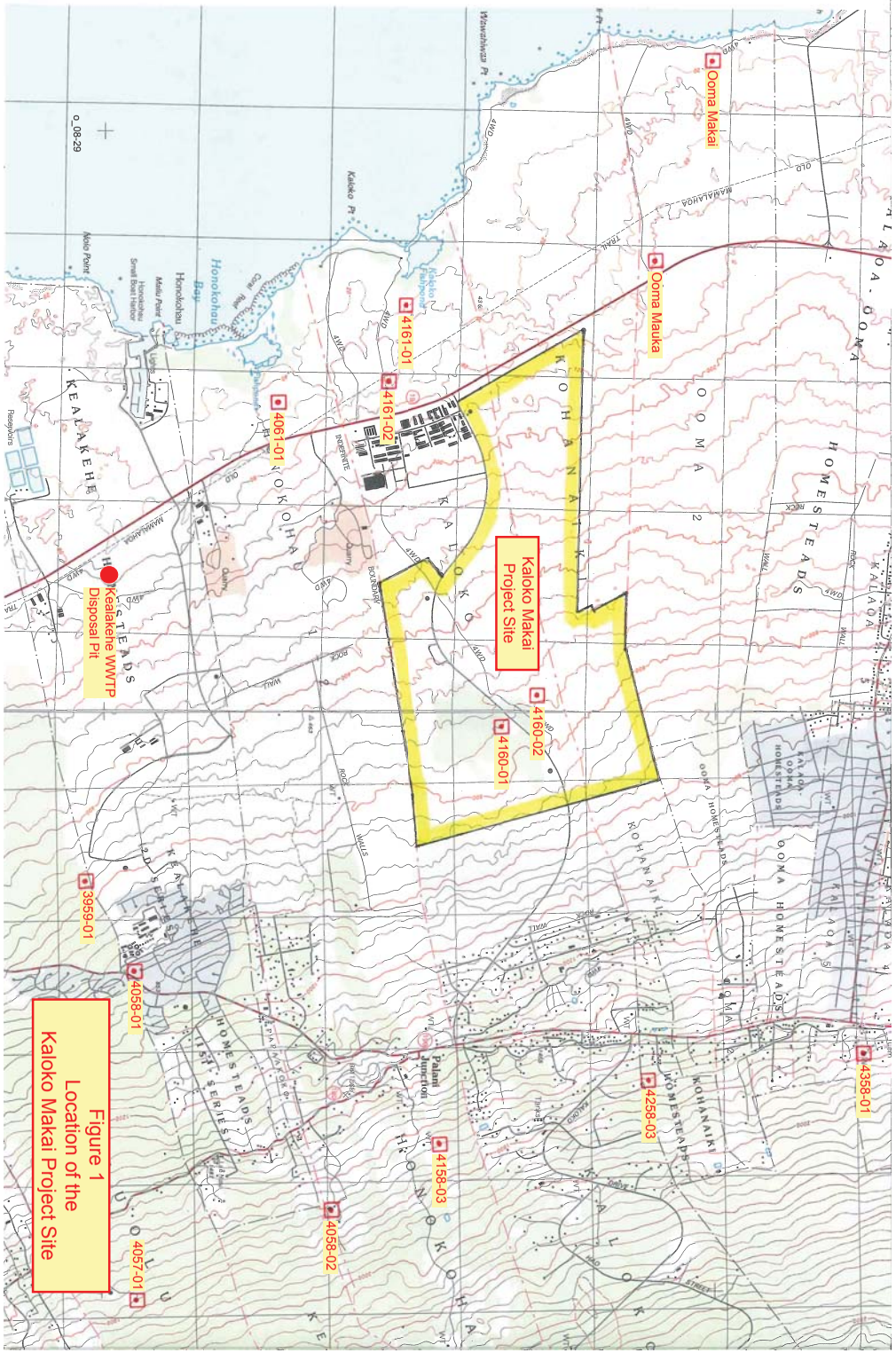


Figure 1
Location of the
Kaloko Makai Project Site

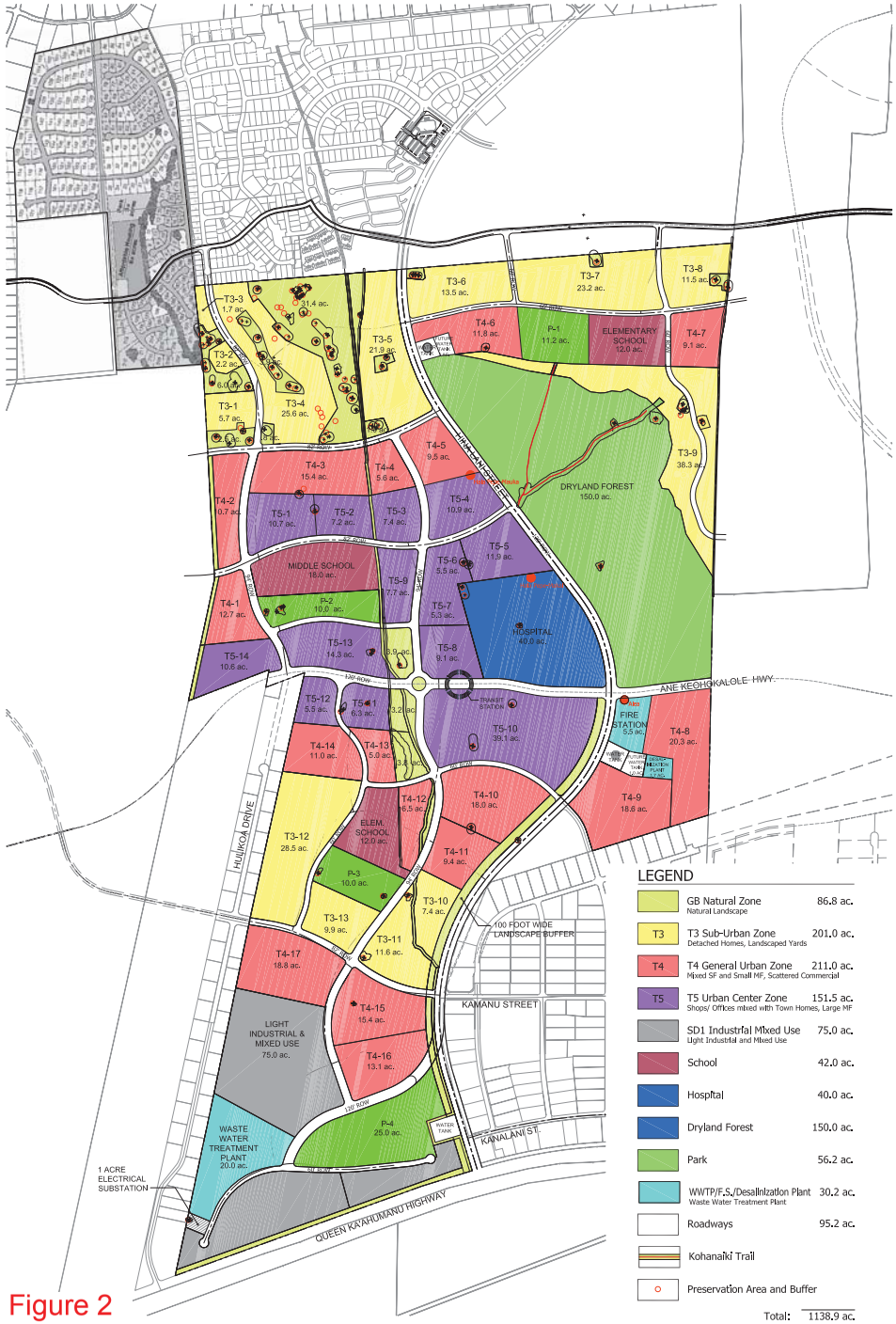


Figure 2

LAND USE PLAN

KALOKO MAKAI - VILLAGE PLAN

o_08-29 | 27 Nov-12

SCD - TSA KALOKO MAKAI, LLC

JUNE 2012

KAILUA-KONA, HAWAII

Table 1

Modification of the Water Supply Projections With
Multi-Family Parcels Irrigated by the Non-Potable System

Development Phase	Projected Supply Requirements		Wastewater Generator for Potential Reuse (MGD)	
	Potable (MGD)	Non-Potable (MGD)	Design Amounts by Wilson Okamoto	Expected Actual Generation by TNWRE
1	0.8558	0.3044	0.8183	0.5273
2	0.7382	0.1938	0.7635	0.5288
3	0.5897	0.0856	0.6003	0.4173
Total	2.1837	0.5838	2.1821	1.4734

Note: 400 GPD/Unit water use for multi-family parcels distributed 276 GPD for potable and 124 GPD for non-potable based on Honolulu BWS Guidelines.

710-Foot Onsite Wells With Reverse Osmosis (RO) Treatment. In the event that artesian groundwater is found below saline groundwater but its salinity at projected draft rates would not meet drinking water standards, the alternative of RO treatment of this water would be considered. This treatment process would produce a wastewater stream, referred to as a concentrate, that would be disposed of injection wells located at the project's wastewater treatment plant (WWTP) at the makai end of the project site. Due to the operating costs of the RO treatment, DWS may not accept the wells and RO treatment plant for dedication. In that case, the capacity of the wells, as feedwater sources for RO treatment, would be sized to provide the project's maximum day use in a 24-hour pumping day. A product recovery from the RO process is expected to be in the range of 60 to 70 percent. As a private system, provision of standby well pumping capacity would be required. These criteria translate to four 1170 GPM well pumps, one as standby. At full build out, the disposal of concentrate would be on the order of 1.15 MGD as a year-round average.

Wells to the South of the Project Site. In the event that neither of the two onsite well alternatives described above are feasible, development of potable wells several miles to the south, would be pursued. The exact locations of these wells will depend on land acquisition costs and the costs of additions to DWS' infrastructure required to transmit this well supply north to the project site. In general, however, there are two distinctly different possibilities, wells above Mamalahoa Highway tapping the high level groundwater directly or wells in the near vicinity of the State's deep monitor well tapping the high level groundwater at depth below saline groundwater. In either case, these wells would be incorporated into DWS' system. Depending on their location, three 1120 GPM or four 840 GPM wells would be required. Improvements to DWS' transmission/distribution system would also be required for this alternative.

Desalinization of Onsite Saline Groundwater. In the event that none of the three alternatives described above are feasible, desalinization of onsite saline groundwater would be undertaken. The raw water supply wells and desalinization plant would be located next to or below DWS' existing 363-foot tank along Hina Lani Drive. The raw water supply wells would draw saline groundwater from beneath the basal lens. Tentatively, the depth from which this supply would be withdrawn would be between 250 and 350 feet below sea level, requiring total well depths on the order of 710 feet. The expectable product recovery from this saline feedwater supply is on the order of 40 to 45 percent, meaning that about 2.5 gallons of saline groundwater would be required for every gallon of fresh product water produced. As a private system with redundant capacity, this would translate to four 750 GPM treatment trains with each treatment train supplied by a 1900 GPM raw water supply well.

To reduce the RO power requirements, pressure transfer devices would be installed to recover energy from the RO's concentrate stream. The concentrate itself would be hypersaline [salinity on the order of 50 parts per thousand (PPT) compared to seawater at 35 PPT]. Its disposal, amounting to 4.9 MGD at full build out, would be in three deep wells located at the project's WWTP.

Wastewater Generation, Treatment, and Reuse or Disposal

A 20-acre site for the project's WWTP would be located at the makai end of the project site (refer to Figure 2). The WWTP would produce R-1 quality effluent which would be the source of supply for the project's non-potable system. The last two columns of Table 1 list wastewater generation amounts, both

as design amounts compiled by Wilson Okamoto Corporation and as expectable average amounts compiled for this report. The expected wastewater amount substantially exceeds potential irrigation reuse in the project's non-potable system. The excess would be disposed of in injection wells at the WWTP if other uses for this water can not be found.

Rainfall-Runoff Generation and Disposal

According to the 2011 Rainfall Atlas of Hawaii (Giambelluca and Others, 2011), average annual rainfall across the project site varies from 15 to 25 inches a year. The land surface of the project site consists of unweathered and very permeable lavas with sparse deposits of ash soils and no defined drainageways. Essentially no rainfall runoff leaves the site in its present condition, even during intense storm events. It is either lost to evaporation or percolates to the underlying groundwater.

Development of the project will create impervious surfaces which will locally create surface runoff. All of this runoff would be directed into seepage pits and drywells such that no runoff will leave the site after it is developed.

DESCRIPTION OF THE HYDROGEOLOGIC ENVIRONMENT IN THE VICINITY OF THE KALOKO MAKAI PROJECT SITE

General Overview

The Kaloko Makai project site and the land upslope from it are comprised of unweathered lava flows with little or no soil cover and extraordinarily high permeability. Except where the natural ground has been converted to impervious surfaces by development, continuous flow of surface runoff during storm rainfalls does not occur. The rainfall percolates downward rather than flowing over the ground surface for any significant distance downslope. Because of this, the description of the hydrogeologic environment within and around the Kaloko Makai project site focuses exclusively on groundwater. Surface water resources are non-existent.

Groundwater in North Kona area occurs into two different modes. Along the coastline and for several miles inland, groundwater occurs as a brackish basal lens floating on saline groundwater beneath it and in hydraulic contact with seawater at the coastline. High level groundwater, the other mode of groundwater occurrence in North Kona, was first discovered in 1990 with a well drilled in Keauhou at 1620-foot elevation above Mamalahoa Highway. Since then, more than 20 high level wells have been developed from Kalaoa on the north and Kealakekua to the south. With only a few exceptions, all of these wells have been located above Mamalahoa Highway. Nine of the wells are currently in use, eight of which are owned and operated by the Hawaii County Department of Water Supply (DWS). DWS is about to put one more high level well (State No. 4158-03) into production in the near future.

Basal Groundwater Occurrence

Basal Water Levels. In the Keahole to Kailua area of north Kona which includes the Kaloko Makai site, basal groundwater levels near the shoreline are about one foot above sea level and slowly increase moving inland to between two and three feet above sea level at the mauka end of the project site. These water levels move up and down in response to the semi-diurnal tide with the tidal response

increasingly lagged and damped with distance inland. At the three monitor wells in the Kaloko Honokohau National Park (KAHO), which are 1500 to 3500 feet in from the shoreline, the tidal variation is about 50 percent of the ocean's tidal amplitude and is lagged by less than one hour. Further inland and within the Kaloko Makai project site at Well 4160-02, the tidal amplitude is about 15 percent and the lag is a little more than three hours (TNWRE 2002, page 10).

Figure 3 is a salinity and temperature profile through the water column of onsite Well 4160-02. It illustrates two relatively anomalous characteristics of the underlying basal groundwater, given the areal extent of the potentially contributing upland watershed. First, the 65.8º F. temperature in this top portion of the basal lens is four to six degrees colder than in upgradient wells which tap the high level groundwater. Second, the salinity is substantially higher than would otherwise be expected. These two characteristics are found in all basal wells from Keahole Point to at least as far south as the old Kona Airport. The subsurface geology which appears to be responsible for this occurrence is discussed in detail in subsequent sections.

Flowrate Through the Basal Aquifer. The most recent, sophisticated, and therefore most reliable computations of groundwater recharge for Hawaii Island are presented in Engott, 2011. The area within and around the Kaloko Makai project site is a part of the 167-square mile area delineated by the State Commission on Water Resource Management (CWRM) as the Keauhou Aquifer System. Its computed recharge in Engott, 2011 is 152 MGD. Reducing this by 14 MGD, the current groundwater pumpage from the aquifer system, leaves an average groundwater flowrate of about nine MGD per coastal mile across the aquifer's shoreline width. If all the rainfall-recharge into the high level aquifer were to discharge into the downgradient basal lens, this flowrate would create a robust basal groundwater body which could be developed for irrigation use and possibly even for potable supply.

This is decidedly not the case for the basal groundwater in the area from the Old Kona Airport to Keahole Point. Indications are that the actual basal flowrate is less than one-third of what might be expected if all of the discharge from the high level groundwater was into the inland margin of the basal lens. As noted above, the substantially lesser actual flowrate through the basal lens is reflected in water levels that are lower than otherwise expected, salinities which are too high for irrigation use, and anomalously cold temperatures.

Deep Monitor Well Results. Results of two deep monitor wells provide insight into the possible geologic feature creating the high level groundwater occurrence tapped by wells above Mamalahoa Highway and the resulting anomalous flowrate, salinity, and temperature in the basal lens. These two wells are the State's Keopu Monitor Well (No. 3858-01) and the Kamakana Monitor Well (No. 3959-01). Both were drilled through the basal lens, continued through the underlying saline groundwater, and then encountered fresh and confined groundwater at depth. Results of Well 3858-01 are described in Water Resources Associates, 2007. Since encountering fresh water at depth was unexpected at this location, the exact depth that it occurred in the borehole during drilling is not known and has not been determined with video logs and other measurements. During drilling of the Kamakana Monitor Well, salinity and temperature of the water in the borehole were closely monitored, enabling the different groundwater regimes penetrated by the borehole to be accurately documented. These are described below and illustrated on Figure 4.

Figure 3. Salinity and Temperature Profile through the Water Column of Well 4160-02 (September 14, 2012)

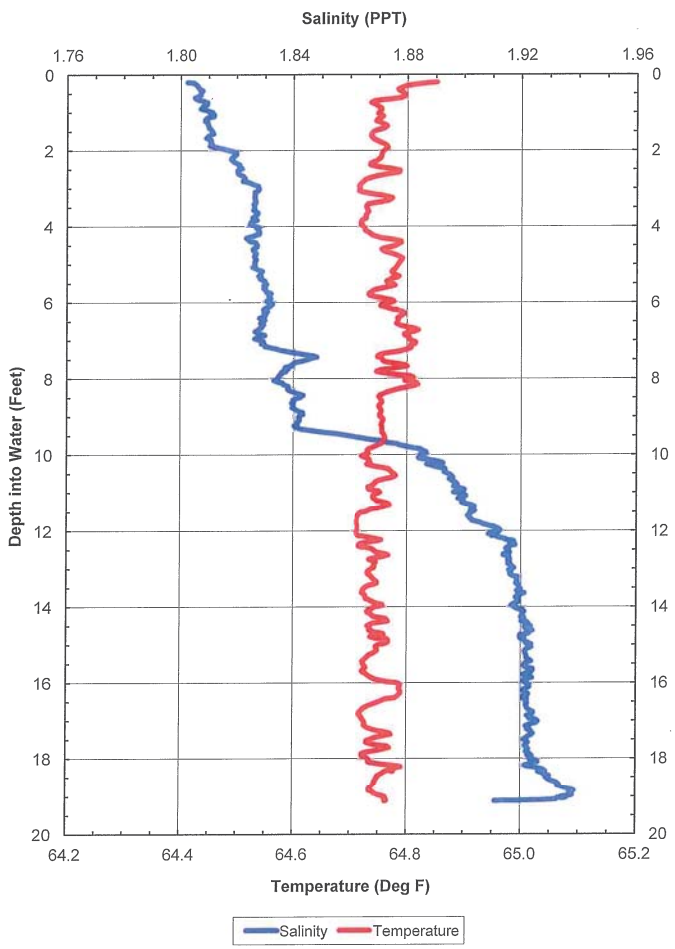
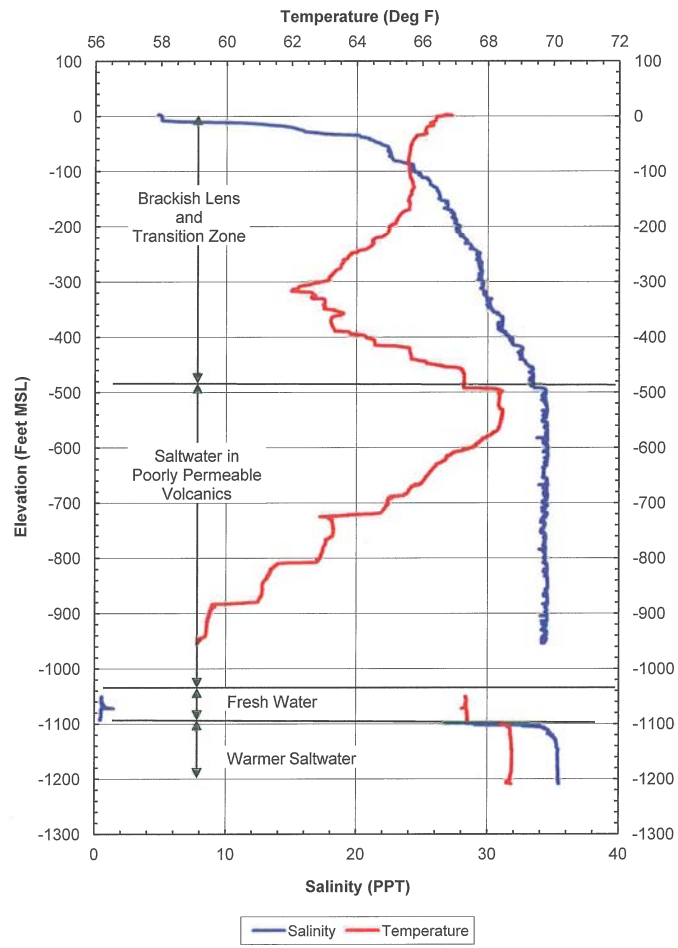


Figure 4. Composite Profile through the Water Column of the Kamakana Borehole (Profiles of 4/12/10, 5/12/10, and 8/18/10)



- Initially, a thin, relatively saline (5 PPT) and cool (66° F.) basal lens was encountered. The water level was typically about 2.5 feet (MSL) according to the available surveyed elevation. However, the mid-point of the transition zone of this basal lens is between 35 and 40 feet into water, suggesting that the actual water level relative to sea level may actually be less than two feet.

- Below the brackish basal lens is a thick transition zone which extends to a depth of 490 feet below sea level. In this transition zone, the water temperature steadily declines to 62° F. at 320 feet below sea level and then the temperature trend reverses, increasing to 67° F. at 490 feet below sea level.

- Below this thick transition zone, extending from 490 to more than 1020 feet below sea level, the salinity is essentially that of seawater and the temperature steadily declines with depth to about 59° F.

- At 1060 feet below sea level, fresh water was encountered. It was about eight degrees warmer than the saline groundwater immediately above it and had a piezometric head subsequently determined to be about 32 feet above sea level. The fresh water rushed up the borehole, mixing with the saltwater above for the first 150 feet, moving up the borehole for the next 720 feet with little or no mixing, and then mixing into the transition zone above that (Figure 5).

- The freshwater zone turned out to be less than 40 feet thick. At 1100 feet below sea level, warmer (70° F.) and slightly hypersaline (35.4 PPT) groundwater was encountered. Drilling was continued for another 120 feet with no salinity or temperature change.

Using inflatable packers to isolate the fresh water zone from the saline groundwater above and below it, short term air lift pumping was done to see if this narrow stratum containing fresh water could provide a developable supply. At low rates of pumping (120 GPM), however, the salinity of the pumped water became brackish and did not stabilize. Somewhat surprisingly, the freshwater zone had a substantial response to ocean tidal variations (Figures 6 and 7), significantly greater than the tidal response in the basal lens directly above. Comparative tidal lags and amplitudes for the respective periods of recording were as tabulated below.

Groundwater Zone	Tidal Lag (Hours)	Tidal Amplitude (% of Ocean Tide)
Fresh Water Zone	1.0	48
Brackish Basal Lens	3.0	25

Results of the two deep monitor wells provide insight on the relationship between high level and basal groundwater and the anomalies in the basal water body, at least in the near vicinity of these two monitor wells. These conclusions are:

Figure 5. Profile through the Water Column of the Kamakana Borehole After Fresh Water was Encountered (May 12, 2010)

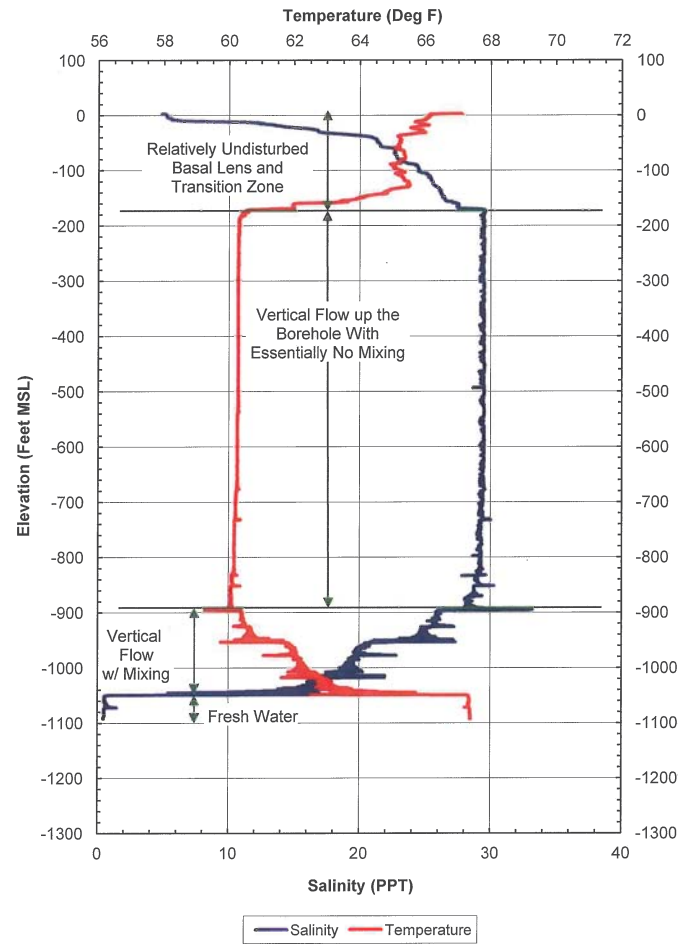


Figure 7. Tidal Variation in the Fresh Water Zone of the Kamakana Monitor Well in January 4 to 5, 2011

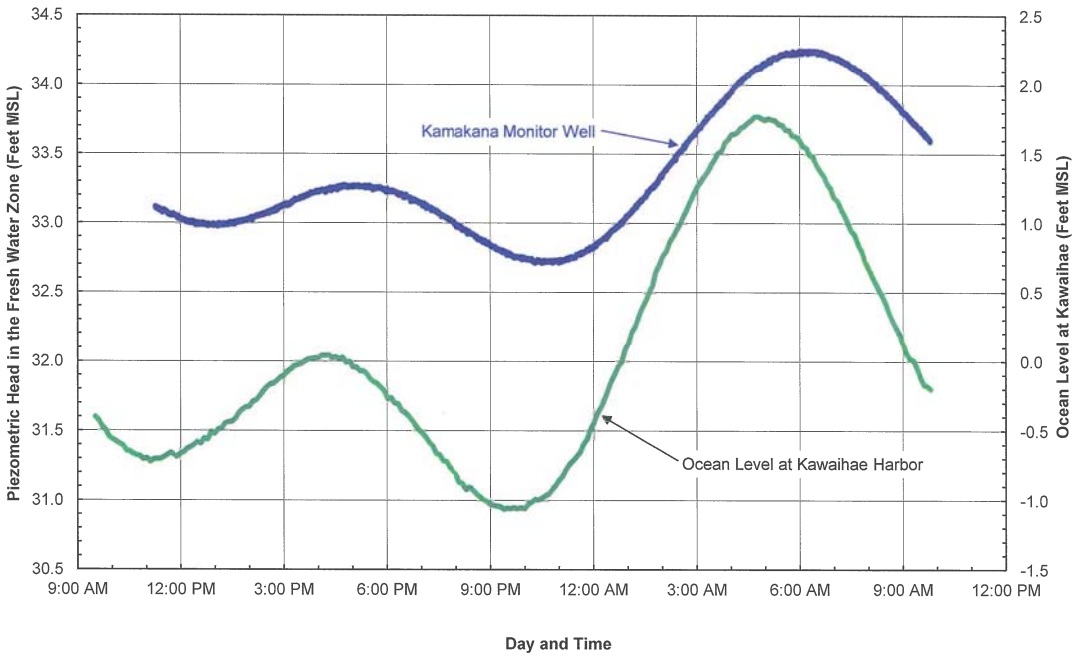
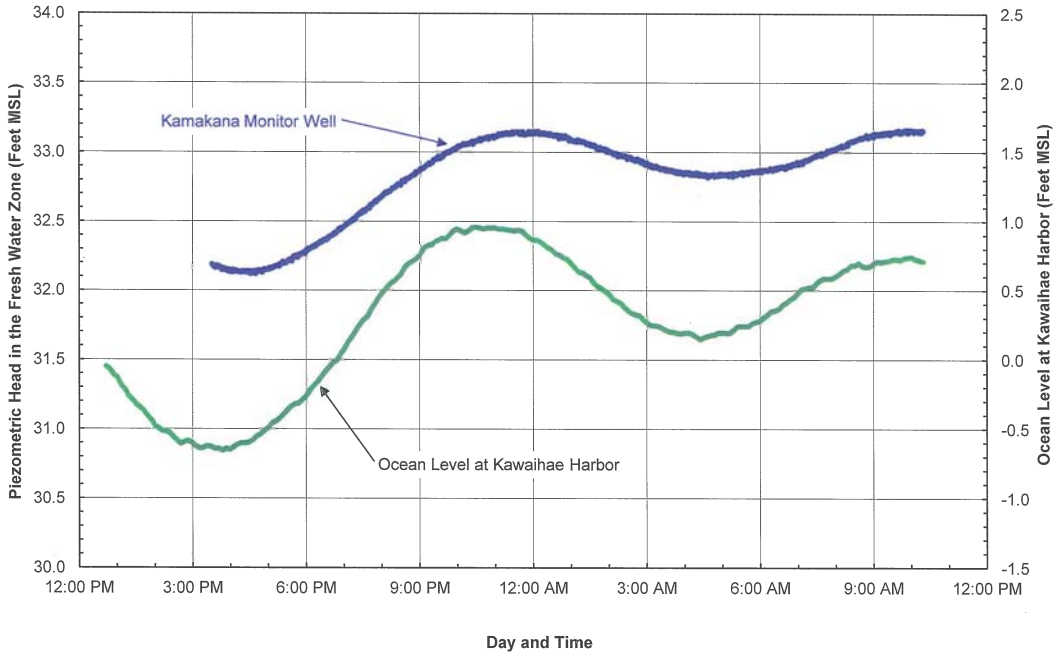


Figure 6. Tidal Variation in the Fresh Water Zone of the Kamakana Monitor Well in December 27 to 28, 2010



- The feature confining the fresh water at depth is a thick sequence of poorly permeable lava flows, in the aggregate hundreds of feet thick (the zone of vertical flow in the Kamakana borehole with essentially no mixing identified on Figure 5).

- That poorly permeable lava flows are the mechanism creating the high level groundwater in Kona is also supported by the results of two high level wells located above Mamalahoa Highway (Hualalai, State No. 4258-03 and Keopu, State No. 3957-05). During the construction and testing of both wells, water levels rose and yields were increased by drilling deeper.

- The confined fresh groundwater at depth, with an apparent hydraulic connection to seawater at depth offshore, suggests that at least some of the inland high level groundwater may discharge at depth offshore rather than flow into the basal lens at its inland margin.

- With limited amounts of warmer, high level groundwater flowing into the inland margin of the basal lens, the source of the colder temperatures in the basal lens is seawater at depth moving inland in a saltwater circulation pattern beneath the basal lens. Figure 8 compares the temperature profile through the water column of the Kamakana borehole with the ocean water directly offshore. Temperatures in the Kamakana borehole to a depth of 320 feet below sea level reflect the movement of saline groundwater below the basal lens which originated as seawater from more than 600-foot depth offshore. Deeper than 500 feet below sea level in the Kamakana borehole, the zone of poorly permeable lava with little groundwater movement on Figure 4, the temperature appear to be simply the result of cooling by the ocean water at similar depths offshore.

Groundwater Quality

Water quality analyses of samples from wells, anchialine ponds, and other locations within and near to the Kaloko Makai mauka-makai corridor are compiled in Table 2. Samples from high level groundwater wells, with very low salinity levels and nutrient concentrations reflecting only natural, rather than man-made input, are at the top of the table. Below that are samples from basal wells with significantly higher salinities and widely varying nutrient concentrations. Toward the bottom of the table are samples from the upper end of Honokohau Harbor and the discharge of the R-2 quality wastewater effluent from the Kealakehe Wastewater Treatment Plant (WWTP). The effluent discharge occurs into an excavated pit which is located on the mauka side of Queen Kaahumanu Highway and about 3700 feet nominally upgradient of Honokohau Harbor (its location is shown on Figure 1). Nutrient removal from the WWTP effluent as it moves to and discharges into upper end of Honokohau Harbor is quantified in section following.

Nutrient Removal by Natural Processes in the Groundwater Environment

The ongoing discharge of 1.3 to 1.7 MGD Kealakehe WWTP effluent into a pit which is nominally upgradient of Honokohau Harbor and the groundwater discharged into the back end of Honokohau Harbor provide an opportunity to quantify natural nutrient removal in the groundwater environment. The inland excavation of the harbor acts as a point sink for groundwater discharge, including the addition of the WWTP effluent into the groundwater. Travel from the pit disposal to the upper end of the harbor

Figure 8. Temperature Profile Comparison, Kamakana Borehole and the Ocean Offshore (Profiles of April 3, 2010 and December 9, 2011, Respectively)

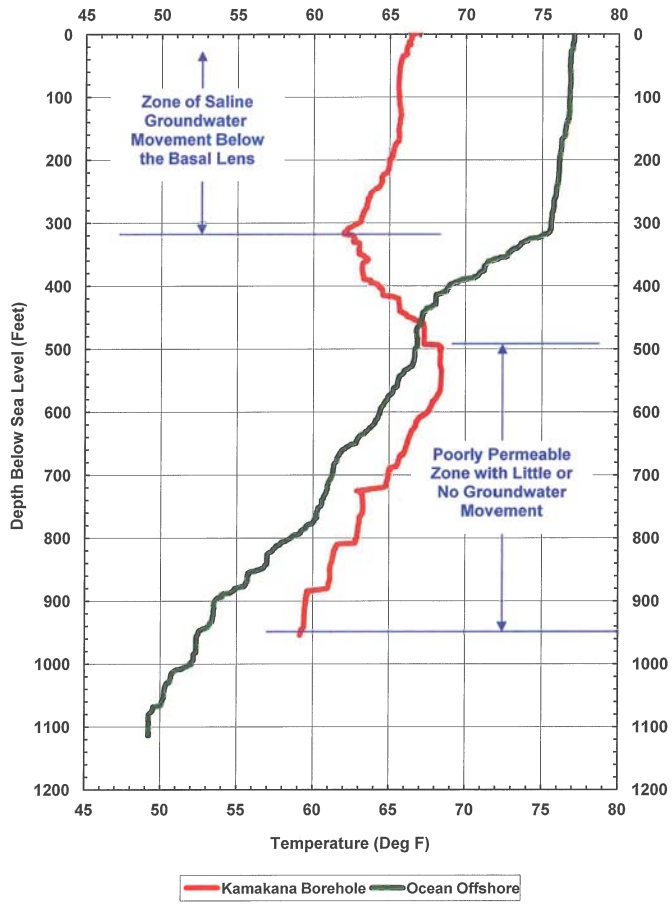


Table 2

Groundwater Quality Within and Near to the Kaloko Makai Corridor

Sampling Site		Date Sampled	Salinity (PPT)	Silica (µM)	Forms of Nitrogen (µM)				Forms of Phosphorus (µM)		
					NO_3	NH_4	TON	Total N	PO_4	TOP	Total P
High Level Potable Quality Wells											
3857-04	DWS Waiaha	11-02-11	0.129	752	74.1	1.5	20.6	96.2	4.24	0.24	4.48
		11-09-11	0.105	749	78.9	1.5	12.6	93.0	4.32	0.88	5.20
		11-25-11	0.119	750	75.9	0.9	13.1	89.9	4.30	0.60	4.90
4057-01	DWS QLT	5-26-00	0.109	801	86.0	0.0	14.7	100.7	3.76	0.08	3.84
		7-20-01	0.079	776	85.1	0.0	35.1	120.2	3.83	3.16	6.99
		11-02-11	0.116	776	87.1	1.1	22.1	110.3	4.00	0.24	4.24
		11-09-11	0.113	771	93.2	1.2	7.7	102.1	4.08	0.80	4.88
		11-25-11	0.130	746	85.4	1.1	11.7	98.2	4.00	0.50	4.50
4158-03	DWS Honokohau	5-26-00	0.144	844	80.1	0.0	14.5	94.6	3.64	0.20	3.84
		11-02-11	0.159	819	79.7	1.0	20.8	101.5	3.84	0.32	4.16
		11-09-11	0.152	804	85.0	2.6	16.6	104.2	4.24	0.80	5.04
		11-25-11	0.158	796	76.8	0.7	2.5	80.0	4.20	0.60	4.80
Basal Wells											
3959-01	Kamakana	11-02-11	5.390	578	160.4	0.7	9.7	170.8	3.84	0.88	4.72
		11-25-11	4.916	598	141.8	1.0	3.6	146.4	3.80	0.40	4.20
3960-01	QLT	10-23-94	25.543	318	28.1	0.3	4.9	33.3	1.49	0.02	1.15
		6-02-00	25.698	356	30.5	1.6	22.5	54.6	1.40	0.70	2.10
4061-01	KAHO 1	5-26-00	9.464	334	55.0	0.3	24.8	80.2	1.84	0.20	2.04
		6-10-00	9.463	304	56.2	3.5	32.1	91.8	1.44	2.96	4.40
		12-19-01	8.657	40	38.4	5.7	20.4	64.5	0.20	0.45	0.65
		11-14-07	10.015	301	67.1	2.7	33.2	103.0	1.65	0.60	2.25
		1-24-12	9.497	482	78.4	2.2	33.6	114.2	4.52	1.56	6.08
		10-29-12	9.317	518	86.3	8.6	68.0	162.9	2.00	0.90	2.90
4161-01	KAHO 3	5-26-00	6.259	672	75.0	0.2	14.8	90.0	4.36	0.04	4.40
		6-10-00	6.325	701	76.9	1.6	43.2	121.7	4.64	2.64	7.28
		12-19-01	6.305	652	79.4	4.2	0.1	83.7	4.35	0.07	4.42
		11-14-07	6.854	666	76.7	1.4	27.2	105.3	3.70	0.50	4.20
		1-24-12	6.387	589	81.4	1.2	11.9	94.5	4.32	0.16	4.48
		10-29-12	6.243	637	81.8	1.3	24.3	107.4	4.50	0.10	4.60
4161-02	KAHO 2	5-26-00	5.399	653	87.2	0.5	22.8	110.4	4.08	0.56	4.64
		6-10-00	5.361	691	104.3	5.1	42.2	151.6	9.04	2.88	11.92
		12-19-01	5.401	616	86.5	1.9	2.0	90.4	4.30	0.05	4.35
		11-14-07	5.382	651	100.4	1.9	31.6	133.9	3.20	1.15	4.35
		1-24-12	5.043	589	95.8	1.4	14.5	111.7	4.52	0.24	4.76
		10-29-12	5.009	653	107.7	2.7	32.9	143.3	5.20	0.00	5.20
4160-02	Kaloko Irrig.	5-15-94	1.734	670	68.6	0.3	2.9	71.8	5.89	0.03	5.92
		3-22-96	1.773	671	78.1	0.3	8.2	86.6	4.42	0.70	5.12
		9-14-12	1.837	633	70.0	1.1	14.4	85.5	4.70	0.60	5.30
		9-14-12	1.917	642	68.2	0.8	14.4	83.4	4.60	0.60	5.20
Ooma Mauka Monitor Well		3-15-96	7.962	661	81.8	0.2	15.8	97.8	3.08	0.16	3.24
		6-02-00	7.783	672	89.7	1.5	26.6	117.8	5.30	0.75	6.05
		6-10-00	7.850	741	91.4	1.0	35.8	128.2	3.60	0.72	4.32
		11-03-06	7.293	640	81.2	3.5	24.8	109.5	2.32	1.28	3.60
		10-29-12	7.067	644	89.5	1.8	9.6	100.9	4.00	0.20	4.20
Ooma Makai Monitor Well		11-03-06	9.945	577	67.0	2.5	22.8	99.2	2.64	1.04	3.68
		10-29-12	10.208	600	94.7	2.2	30.6	127.5	3.70	0.40	4.10
Groundwater Discharge into Honokohau Harbor											
Honokohau Harbor		6-03-00	20.987	373	39.7	0.0	4.2	43.9	2.30	0.07	2.37
		7-20-01	20.431	380	40.4	0.3	10.7	51.4	2.31	2.25	4.56
		9-03-01	20.362	341	38.1	0.3	2.7	41.1	2.05	0.27	2.32
		11-09-11	20.750	305	48.1	0.3	0.2	48.6	2.51	0.17	2.68
		11-09-11	23.216	278	38.0	0.5	1.5	40.0	2.05	0.19	2.24
		11-21-11	19.556	314	51.8	0.1	5.3	57.2	2.93	0.13	3.06
		11-21-11	21.074	318	42.8	0.1	3.6	46.5	2.71	0.09	2.80
Kealakehe WWTP Effluent											
		11-09-11	1.816	450	1037.4	26.2	1.90	1065.5	166.88	7.84	174.72
		12-09-11	1.869	762	1480.6	25.0	35.4	1541.0	193.00	4.80	197.80

Note: All samples collected by Tom Nance Water Resource Engineering (Tom Nance) and/or Marine Research Consultants (Steve Dollar) and analyzed by Marine Analytical Specialists.

consists of a 60-foot drop through the vadose zone and 3700 feet of travel with groundwater to the upper end of the harbor. Samples collected from two visually obvious groundwater discharge locations at the upper end of the harbor are a mix of: (1) the WWTP treated effluent that has undergone natural nutrient removal to the harbor; (2) the ambient groundwater; and (3) seawater. The amount of nutrient removal from the effluent can be approximated in the following steps:

- Assume a ratio of ambient groundwater to treated effluent in the discharge into the harbor;
- Using a salinity balance, solve for the amount of seawater in the mix; and then
- With the ratios of the three sources in the samples collected at the upper end of the harbor, solve for the remaining nitrogen and phosphorus that was originally in the WWTP effluent dumped into the pit.

If the groundwater to WWTP effluent ratio is selected to cover the plausible extremes of this mix, the ensuing nutrient balance calculations would bracket the probable nutrient removal rates from the WWTP effluent. In the resulting removal tabulations below, calculations were done as if only effluent is discharged into the upper end of the harbor and for a 4:1, groundwater to effluent mix. For this plausible range of effluent mixed with groundwater discharging into the upper end of Honokohau Harbor, rates of removal of nitrogen are 89 to 92 percent. For phosphorus, the removal rates are 93 to 98 percent. Several other aspects of the calculation results are worth noting:

- The calculations used the November 9, 2011 sample of the Kealakehe WWTP effluent being discharged into the pit. Had the second, December 9, 2011 sample been used instead, its higher nutrient levels would have resulted in even greater calculated removal rates.
- If it is argued that the WWTP effluent discharges to the shoreline south of Honokohau Harbor rather than into the upper end of the harbor, the nutrients in Kealakehe shoreline samples in Nance (2002) and the Keahuolu shoreline samples (TNWRE data not yet published) could be used for a similar set of calculations. Using these data results in similar, very high natural nutrient removal rates (Table 3).

ESTIMATES OF THE PROJECT'S POTENTIAL IMPACT ON BASAL GROUNDWATER

Assumptions Incorporated Into the Calculations

Relationship of Basal to High Level Groundwater. For the calculations herein, it is assumed that no high level groundwater leaks into the basal lens beneath the project site, meaning that the flow in the basal lens is entirely due to local recharge on the area between Mamalahoa Highway and the shoreline. That flowrate is estimated to be 1.7 MGD per coastal mile. Across the 1.2-mile width of the project site, the basal flowrate is estimated to be 2.0 MGD. It should be pointed out that if some or most of the high level groundwater is flowing into the basal lens, the project's relative impact on this greater basal flowrate would be less than calculated herein.

Table 3

Computed Removal Rates of Nitrogen and Phosphorus From Kealakekua WWTP Effluent Arriving at the Upper End of Honokohau Harbor

Sample Station in Honokohau Harbor	Sample Date	Computed Nutrient Removal Rates (%)			
		All WWTP Effluent		4:1, Groundwater:Effluent	
		Nitrogen	Phosphorus	Nitrogen	Phosphorus
Station 1	11-09-11	90.2	96.8	91.8	93.4
	11-21-11	89.2	96.6	87.7	97.8
Station 2	11-09-11	90.6	96.9	93.4	93.4
	11-21-11	90.5	96.6	93.0	93.1

Notes:
1. Salinity, nitrogen, and phosphorus values for Kealakehe WWTP effluent from the November 9, 2011 sample (bottom of Table 1).
2. Ambient groundwater salinity of nutrient concentrations based on Well 4061-01 in Table 1.
3. Seawater mixed in the sample assumed to be 35.0 PPT salinity; total nitrogen of 7.0 µM, and total phosphorus of 0.50 µM.
4. Discharge into the upper end of Honokohau Harbor based samples of Stations 1 and 2 in Table 2.

Ambient Quality of the Underlying Basal Groundwater. The salinity and nutrient levels in samples taken from onsite Well 4160-02 (Table 2) are assumed to represent the ambient quality of the underlying basal groundwater. These averages are: salinity of 1.75 PPT; total nitrogen of 80 µM or 1.12 mg/l; and total phosphorus of 5.5 µM or 0.17 mg/l.

Potable Supply Alternatives. Two of the four potable supply alternatives would drill wells at the inland end of the project site. If successful, wells for these two alternatives would tap fresh artesian groundwater which exists at depth below the basal lens and saline groundwater. One or the other of these options would only be pursued if it can be demonstrated, initially by testing in the exploratory borehole and subsequently by testing in the finished production wells, that pumping this water will have no impact on the basal lens above. Rather, it would simply be tapping groundwater than flows beneath the basal lens and does not leak into it.

The third potable alternative being considered would tap the high level groundwater at locations several miles or more to the south of the project site. For the purposes of this assessment, it is assumed that these offsite locations would either be to the north and south of DWS' existing Waiaha well (State No. 3857-04) or just north of the State's Keopu deep monitor well (State No. 3858-01). These locations are four and three miles to the south of the Kaloko Makai project site, respectively.

The fourth alternative, desalinization of saline groundwater, would utilize onsite wells designed to draw water from a substantial distance below the basal lens where the salinity may be on the order of 30 PPT. Extensive testing would be undertaken in the development of these wells to affirmatively demonstrate that such pumping can be done without adversely impacting the overlying basal lens.

A key requirement of all four of the supply alternatives being considered is that none would utilize water from the brackish basal lens flowing beneath the project site. Of the three alternatives that would draw from the high level groundwater body, none would impact basal groundwater in the project's mauka-to-makai corridor or elsewhere in North Kona. However, all three of these alternatives would result in a 1:1 reduction of fresh groundwater ultimately discharged into the marine environment offshore.

Landscape Irrigation Return Flow. Landscape irrigation will be supplied by both the potable and non-potable systems, the former occurring primarily in single family residential areas which will not be supplied by the non-potable system. The use of potable water for this purpose at full build out is estimated to be 0.46 MGD, calculated as an average of 4000 GPD/acre on 115 acres throughout the project site. Irrigation using R-1 effluent as the source of supply is estimated to be 0.58 MGD (Table 1). That means the excess of R-1 for disposal in injection wells at the project's WWTP site would be about 0.90 MGD as a year-round average at full build out. For the calculations herein regarding the percolation of excess applied irrigation water to the underlying basal lens, three assumptions are made. First, 12 percent of the water applied for irrigation will be in excess of crop requirements and percolate to the basal groundwater below. Second, total nitrogen and total phosphorus in the R-1 effluent are assumed to be 1500 and 200 µM, respectively, based on levels of these nutrients in the effluent from the County's Kealakehe WWTP (Table 2). Third, fertilizer levels where landscape irrigation is supplied by R-1 effluent will be far less than where the supply is the potable system. Assumed fertilizer applications are:

- In areas irrigated with potable water, nitrogen and phosphorus in fertilizers will be applied at 3.0 and 0.5 pounds/year/1000 ft^2, respectively.
- In areas irrigated where R-1 effluent, nitrogen and phosphorus in fertilizers would be applied at 10 percent of the rate applied in areas with potable water irrigation.
- Ten (10) percent of the applied nitrogen and two (2) percent of the applied phosphorus will be carried in the excess applied irrigation water below the plant root zone.

Onsite Rainfall-Recharge. As an approximation, it is assumed that 60 percent of the project site's 20 inches of average annual rainfall percolates to and becomes groundwater recharge. Over the 1113-acre site, this amounts to an average of 1.0 MGD. Drainage features of the development will capture surface runoff and direct it to seepage basins and drywells, resulting, as a first order approximation, in no change in the amount of onsite rainfall ultimately becoming groundwater recharge. However, it is also assumed that nutrient levels in the post-development rainfall percolating to groundwater will be increased by 20 µM and 2 µM for nitrogen and phosphorus, respectively.

Natural Removal of Nutrients Originating From the Project Site. Earlier in this report, computed nitrogen and phosphorus removal from Kealakehe WWTP effluent disposed of in a pit 3700 feet nominally upgradient of Honokohau Harbor were given. Selecting values slightly lower values than these computed rates, removal rates of 88 and 92 percent of nitrogen and phosphorus are assumed for the calculations herein.

Calculated Changes to Basal Groundwater Flowing Beneath the Kaloko Makai Project Site

Table 4 incorporates all of the foregoing assumptions to approximate possible changes to the brackish basal lens flowing beneath the project site as a result of its proposed development. The resulting approximations are: a 6.2 percent increase in the flowrate; a 5.1 percent reduction in salinity; and nitrogen and phosphorus increases of 5.2 and 2.1 percent, respectively.

OTHER CHANGES TO THE GROUNDWATER DISCHARGE INTO THE MARINE ENVIRONMENT

All of the foregoing calculations were for estimated changes to the brackish basal groundwater flowing directly beneath the project site. Three other aspects of the project's development, although not having an impact on this basal lens, will affect the ultimate discharge of groundwater into the marine environment. Each of these is described and quantified below.

Consumptive Use of Potable Quality Groundwater

Three of the project's four potable supply alternatives under consideration would draw water from what is referred to as the high level groundwater, either as it exists at depth below the basal lens at the inland end of the project site or at a location to the south where it can be accessed directly. The project's ultimate potable water use would be 2.18 MGD as a year-round average. Wells developed for such use would actually draw 3.27 MGD, one-third of which would be used by DWS to serve other customers in its service area. If RO treatment is necessary (Alternative 2), the draft would be slightly greater at about 3.33 MGD.

Table 4

Approximated Changes to the Brackish Basal Groundwater Flowing Beneath the Kaloko Makai Project Site

I t e m	Flowrate (MGD)	Salinity (PPT)	Nitrogen (lbs / day)	Phosphorus (lbs / day)
Present Groundwater Flow	2.0	1.75	18.66	2.83
Excess Applied Irrigation				
• As Potable Water + Fertilizer	0.055	0.15	0.502	0.011
• As R-1 Treated Wastewater + Fertilizer	0.070	0.30	0.210	0.007
Change in Local Rainfall-Recharge	No Change	No Change	0.280	0.041
Post-Development Totals : Amount	2.125	1.661	19.652	2.889
: % Change	+ 6.2	- 5.1	+ 5.2	+ 2.1

Notes: 1. The area irrigated with potable water is 115 acres. The amount of water used for this purpose is 0.46 MGD.

2. The area irrigated with R-1 effluent is 165 acres. The amount of R-1 used for this purpose is 0.58 MGD.

Based on the Keauhou Aquifer recharge calculations in Engott (2011), this total draft for the project and DWS would represent a two to three percent reduction of the total groundwater discharge into the marine environment offshore of the aquifer. Essentially all of this change would be occurring at substantial depth and distance offshore with no significant impact.

Disposal of Excess R-1 Treated Effluent in Onsite Injection Wells

As a long-term average, it appears that the amount of R-1 treated wastewater effluent will exceed its onsite irrigation reuse by about 0.90 MGD. If other uses can not be found for this water, this excess would be disposed of in injection wells located at the project's WWTP. That excess could amount to about half the present disposal by the County's Kealakehe WWTP into a pit inland of Honokohau Harbor. The disposal wells would be designed to deliver the excess effluent at depth below the basal lens so as not to impact the lens itself. To accomplish this, disposal would be at and below where the receiving groundwater salinity is 30 PPT or greater and below poorly permeable lava flows identified in the process of drilling. This may require the injection wells to deliver the water at depths of 300 feet or more below sea level. However, the extraordinary disposal depth is warranted to avoid having a significant impact on basal groundwater moving through the Kaloko-Honokohau National Historical Park or to the Park's nearshore waters. The effluent disposed of would be significantly less dense than the receiving basal groundwater. The tendency for the disposed of effluent to rise up due to its lesser density would be offset by several factors: (1) disposal beneath one or more poorly permeable lava flows; (2) the substantial vertical to horizontal anisotropy in the lava flows; and (3) progressive mixing of the effluent into the receiving groundwater, causing its density to increase. Wastewater disposal in this manner is being done at the Mauna Lani Resort without adverse impact.

Potential Disposal of RO Concentrate

Two of the four drinking water supply alternatives being considered would involve desalinization. An inevitable part of this process is the production of a wastewater stream, referred to as the concentrate. For the desalinization alternative using slightly brackish water extracted at depth below the basal lens, the expected concentrate amount product recovery would be about 1.15 MGD, assuming that the product recovery rate would be in the range of 60 to 70 percent. If it is assumed that the salinity of the feedwater supply is between 2.0 and 3.0 PPT, the salinity of the concentrate would be in the range of 5.3 to 8.2 PPT. This would be too salty for irrigation reuse and would require disposal in wells located on the project's WWTP site. The disposal wells would be designed to deliver the concentrate to below the midpoint of the transition zone between brackish basal water above and saline groundwater below in order to avoid impacting the overlying basal lens.

For the desalinization alternative using onsite saline groundwater as the feedwater source, the hypersaline (50 PPT) concentrate would amount to an average of 3.33 MGD at the project's full development. Disposal will be at the project's WWTP site and utilize the wells also used for excess R-1 disposal. Mixing the hypersaline concentrate with the excess R-1 will assist in ensuring that the less dense R-1 does not rise up into the overlying basal lens.

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Appendix D

Assessment of Marine and Pond Environments in the Vicinity of the Kaloko Makai Project
Marine Research Consultants
December 2012

AN ASSESSMENT OF MARINE AND POND ENVIRONMENTS IN THE VICINITY OF THE KALOKO MAKAI PROJECT NORTH KONA, HAWAII

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1.0 PURPOSE

Planning is underway to prepare an Environmental Impact Statement (EIS) for 1,139-acres of land known as the Kaloko Makai Project site. The parcel of land is located mauka of the Queen Kaahumanu Highway, is on both sides of Hinalani Drive, and extends to a mauka boundary at an elevation of approximately 760 feet (Figure 1). The project is to be developed in three phases and would consist of a mixture of residential, commercial, industrial and public uses, including a 150-acre dry land forest. None of the proposed land uses includes any alteration of the coastal areas or nearshore waters.

A somewhat unique characteristic of the project is the location relative to the Kaloko-Honokohau National Historical Park (hereafter referred to as KAHO) which lies directly to the west and downslope of the project site on the makai side of Queen Kaahumanu Highway. The National Parks and Recreation Act of 1978 provided for the establishment of the Kaloko-Honokohau National Historical Park to preserve the integrity of the many archaeological features and fishponds found in the area. Kaloko Pond and Aimakapa Pond are large brackish bodies of water separated from the ocean by a basaltic rock wall at Kaloko, and a sand beach berm at Aimakapa. The rock wall at Kaloko Pond has recently been reconstructed, and the new wall incorporates channels which afford a direct connection between the pond and ocean.

Water in the ponds is brackish, consisting of a mixture of low salinity groundwater, and seawater. As a result, water chemistry in the ponds can potentially be influenced by changes in groundwater composition and runoff of surface water. Leaching of materials such as fertilizer nutrients, pest control agents or other materials originating from anthropogenic activities to groundwater could potentially alter pond water chemistry. In addition, as pond water exchanges with ocean water in the nearshore area, there is also potential for alteration of marine water chemistry owing to changes in groundwater composition. Such alterations in water chemistry can, in turn, provide the potential to affect the structure of marine biotic communities in the nearshore area.

In the interest of addressing these concerns and assuring maintenance of environmental quality, it has been deemed appropriate to conduct an assessment of the pond and marine environments that are downslope from the proposed Kaloko Makai project site. The rationale of this assessment is to determine the contribution of groundwater to the pond and marine environments, and the effects of such input on marine community structure and function at the present time before the commencement of any new construction activities. Of particular interest is assessing the nutrient dynamics and associated metabolic activity of the Aimakapa Pond. As this pond is essentially sealed from direct contact with the ocean, the metabolic function of the pond is directly linked to groundwater flux and composition. As a result, Aimakapa Pond is the area with the most potential for changes associated with alteration of groundwater from activities upslope of KAHO.

An important component of the present assessment is the capability to evaluate the effects to water chemistry in Aimakapa and Kaloko Ponds over time. Marine Research Consultants has had the opportunity to conduct investigations of these systems in 2000 and 2007 for other upland development projects using virtually identical methodologies as employed in the 2012

investigations. The opportunity to establish a time-course data series provides a basis to determine how water chemistry has changed over the last eleven years as a result of existing land development makai of the National Park. Combining this information with estimates of changes in groundwater flow rates and chemical composition that will enter the ponds that are predicted to result from the proposed project, it will be possible to evaluate the potential future effects to the composition of the marine and pond environments. Predicted changes in groundwater flow rates and groundwater chemistry have been supplied by Tom Nance Water Resource Engineering (TNWRE) in a report under separate cover entitled "An Assessment of the Potential Impact of the Proposed Kaloko Makai Project on Water Resources" dated December 2012. Results of the combined evaluation will indicate if, and to what degree, there is the potential for negative effects to the aquatic environments from the proposed project.

2.0. METHODS

2.1. WATER CHEMISTRY

2.11. Sampling Sites

The Kaloko-Honokohau National Historical Park is located seaward of the existing Kaloko-Honokohau Industrial development on the mauka side of Queen Kaahumanu Highway, as well as the planned increment of the Kaloko Makai project (Figure 1). Over half of this 1,160-acre National Park is comprised of ocean waters. Contained within its boundaries are also two large fishponds (Kaloko and Aimakapa), tidal areas and wetlands (Figures 2 and 3).

Water samples were collected twice in 2012 (February and November) using a small inflatable boat (February) and kayak (November) paddled along transects that bisected each fishpond in an inshore-offshore direction. Ten sampling stations were established approximately equidistantly along each transect extending from the most landward shoreline of the ponds to the seaward shorelines. For the February event, sampling was continued into the ocean from the shoreline for a distance deemed to reach open coastal ocean (Figures 2 and 3). No ocean sampling was conducted in November 2012. Sampling of the ponds and ocean during previous surveys in 2000 and 2007 were conducted in an identical manner. In addition, in February 2012 samples were collected from three anchialine pools within the Park, designated as numbers 96, 119 and 123.

2.12. Sampling Protocol

All field work was conducted on February 24, 2012 and November 19, 2012. Environmental conditions consisted of light westerly winds and flat seas during both sampling events. Surface water samples were collected by carefully sampling the upper 20 cm of the water column in areas that were not subjected to resuspended sediment plumes. During the February sampling, bottom water was collected using a Niskin-type oceanographic sampling bottle that was lowered to the desired sampling depth with spring-loaded end-caps cocked in an open position allowing free exchange of water through the bottle. At the desired sampling depth, a weighted messenger is released which trips the end-caps closed isolating a 1.8 liter sample of water. During the November sampling, bottom samples were collected by lowering a bottle

attached to a wooden pole to the desired sampling depth and removing the lid with an attached line. Sampling of undisturbed bottom waters presented a challenge in the ponds owing to the shallow water column, extremely turbid conditions and soft, flocculent sediment bottom that was easily resuspended with the slightest water motion. In addition, the bottom topography was extremely variable with numerous deep holes and shallow platforms. Owing to the shallow depth of much of the pond (less than one meter), the highly irregular surface, the extremely flocculent bottom sediments, and the lack of visibility of the bottom from above the water, remote sampling may have resulted in some unavoidable contamination of samples from resuspended material.

Samples were collected in pre-rinsed 1-liter polyethylene bottles. Subsamples for nutrient analyses were immediately filtered into in 125-milliliter (ml) acid-washed, triple rinsed, polyethylene bottles and stored on ice until delivery on the same day as collection to the analytical laboratory in Honolulu. Water for other analyses was subsampled from 1-liter polyethylene bottles and kept chilled until analysis.

2.13. Monitoring Constituents

Water quality parameters evaluated included the 10 specific criteria designated for open coastal waters in Chapter 11-54, Section 06 (Open Coastal waters) of the Water Quality Standards, Department of Health, State of Hawaii. These criteria include: total nitrogen (TN) which is defined as inorganic nitrogen plus organic nitrogen, nitrate + nitrite nitrogen (NO_3^- + NO_2^-, hereafter referred to as NO_3^-), ammonium (NH_4^+), total phosphorus (TP) which is defined as inorganic phosphorus plus organic phosphorus, chlorophyll a (Chl a), turbidity, dissolved oxygen, pH and salinity. In addition, orthophosphate phosphorus (PO_4^{-3}) and silica (Si) were reported because these constituents are sensitive indicators of biological activity and the degree of groundwater mixing, respectively. Vertical profiles of temperature, salinity and dissolved oxygen were acquired at each station using an RBR Model 650 CTD calibrated to factory specifications.

2.14. Analytical Methodology

Analyses for NH_4^+, PO_4^{3-}, and NO_3^- + NO_2^- (hereafter termed NO_3^-) were performed using a Technicon autoanalyzer according to standard methods for seawater analysis (Strickland and Parsons 1968, Grasshoff 1983). TN and TP were analyzed in a similar fashion following persulfate oxidative digestion. For unfiltered samples, total organic nitrogen (TON) and total organic phosphorus (TOP) were calculated as the difference between total nitrogen (TN) and inorganic nitrogen (NO_3^- + NH_4^+), and total phosphorus (TP) and inorganic phosphorus (PO_4^{3-}), respectively. For the filtered samples, dissolved organic nitrogen (DON) and dissolved organic phosphorus (DOP) were calculated in the same manner as the difference between TN and dissolved inorganic nitrogen (DIN), and TP and dissolved inorganic phosphorus (DIP), respectively. The level of detection for the dissolved nutrients is 0.2 μM for TN and Si, 0.02 μM for TP, NO_3^- and NH_4^+, and 0.01 μM for PO_4^{3-}.

Turbidity was measured on a Monitek Model 21 90-degree nephelometer, and reported in nephelometric turbidity units (ntu, level of detection 0.01 ntu). Chl a was measured by filtering

300 ml of water through glass fiber filters; pigments on filters were extracted in 90% acetone in the dark at -5° C for 12-24 hours, and the fluorescence before and after acidification of the extract was measured with a Turner Designs fluorometer (level of detection 0.01 µg/L). Salinity was determined using an AGE Model 2100 laboratory salinometer with a precision of 0.0003‰. pH was determined using a lab meter with combination electrode and a precision of 0.01 pH units. All lab analyses were conducted by Marine Analytical Specialists (Laboratory Certification NO. HI-0009).

2.2. SEDIMENT CHEMISTRY

Surface sediments from a water depth of approximately 10 cm near the shorelines of Aimakapa, Kaloko and anchialine pool 96 were collected in 1-liter glass jars. Jars were sealed, placed on ice and shipped to Calsciences Environmental Laboratories in Garden Grove California for analyses of a organochlorines, organophosphates, chlorinated herbicides, semi-volatile organics and metals.

2.3 BIOTIC COMMUNITY STRUCTURE

The nearshore marine biotic communities off the Kaloko Makai site consist of a well-developed and relatively undisturbed Hawaiian coral reef habitat. The intent of the present study was to describe the overall physical and biotic setting, and to create a benthic habitat map that characterizes this area of the marine environment, particularly with respect to coral cover. The resulting characterization is intended to provide an overview of the habitat characteristics of the region in order to provide information that might be of value relating to the potential effects from upland development. The purpose of the study was not to generate an exhaustive species list of all biota occupying the area.

Evaluation of the marine biological community was conducted by qualitative reconnaissance surveys along the length of the area comprising the marine portion of the Kaloko-Honokohau National Historical Park from the shoreline out to the 10 meters (30 feet) depth contour. Information gathered during the surveys included abundance estimates of the dominant flora and fauna, as well as observations on the factors that affect these biotic assemblages.

An additional component of the biotic evaluation of the area was the production of benthic habitat maps of the area. In brief, this method involved obtaining commercially available remote sensing satellite imagery of the area of interest. Extensive ground-truth data were collected throughout the marine environment fronting the Kaloko Makai property. The ground-truth data were then used to develop a classification system that calibrated the spectral information contained in the remote sensing images. The resulting classification scheme was translated on a pixel-by-pixel basis into area coverage of categories of living benthos (e.g., coral, algae), as well as non-living bottom (e.g., sand, rock). Bathymetry was also added to the maps using available LiDAR (Light Detection and Ranging) data.

The survey area encompassed approximately 1.9 miles [3 km] of linear coastline and extended from the shoreline to a water depth of approximately 33 feet (10 m). While it is acknowledged

that there are deeper reef areas, these reefs are not likely to be affected by activities on land and, hence, were not part of the present survey. The resulting map product provides a unique tool for quantification of components of the entire marine setting that is a valuable asset for understanding the effects of human inputs and subsequent impacts. It is important to note that the purpose of the study was not to generate an exhaustive species list of all biota occupying the area.

All methods utilized in this study to generate nearshore marine habitat maps followed standard procedures for processing coral reef remote sensing imagery (e.g., Andréfouët et al. 2003, Green et al. 2000, Mumby et al. 1998). The benthic habitat map was created based on a fully georeferenced, cloud-free WorldView-2 multispectral satellite image of the Kaloko-Honokohau area that was purchased from the Image Library at DigitalGlobe.com. The image had 2.0 m (6.6 ft) ground sample distance. The WorldView-2 image was processed to highlight submerged features, which revealed areas of different bottom composition.

Fieldwork was carried out on March 19-20, 2012 by divers working from either a 21-ft. boat or from the shoreline. Field operations consisted of assessing 20 "calibration-validation" (cal/val) sites placed strategically throughout the survey areas. Locations of cal/val sites were selected in the field based on investigator knowledge and visual interpretation of existing satellite "true-color" imagery, with the intent of maximizing coverage of all reef areas within the region of interest. Exact locations of cal/val sites were recorded during the course of field work using a waterproofed GPS with a presumed accuracy of <1 m.

At each geo-located site, cal/val data were obtained by digitally recording the composition of the benthic surface using an underwater camera fitted with a 14 mm-wide angle lens. To ensure uniformity of the area of data collection, the camera was mounted on a platform centered over a PVC quadrat frame by four legs, similar to a tripod. The base of the frame forms a quadrat with dimensions of 1 m x 0.66 m, which is the same proportion as a photographic frame. Each cal/val site consists of five photo-quadrats arranged in a "cross" pattern ~5 m in diagonal, resulting in total reef surface area of 3.33 m^2, which encompasses an area of approximately four pixels of remote sensing imagery. For the present project, a substantial portion of the inner reef flat had water depths shallower than the height of the camera platform. In these areas oblique photographs of the bottom were taken and bottom cover data were extracted from these photographs.

Following fieldwork, the digital images were analyzed by projecting a grid dividing the frame into 100 equal-sized segments. Coral cover by species, as well as bottom cover of benthic algae, motile macro-benthos and non-living categories including sand, mud, bare limestone and rubble, were estimated by tabulating cover types within the segments. Zoom features of computer software and the high resolution of the digital photographs (~10 megapixels) generally allowed delineation of corals to the species level. Total cover of all five photographic frames constituted the cover estimates for each cal/val site. An advantage of using such a photo-quadrat method is that it allows for the collection of far more data per unit time than traditional *in-situ* transect techniques, with little or no loss of data quality or interpretation. Thus, the photo-quadrat technique provides far more extensive coverage of the subject area without any significant loss of information. In addition, the photographic survey method

provides a permanent data record that can be utilized for future time-course surveys that are of value in determining changes to reef structure. All photo-quadrats evaluated by point counts are contained in Appendix B.

In the lab, map generation was accomplished by locating cal/val points on the geo-referenced satellite multispectral image that served as the basis for statistical image classification. "Training classes" (defined as the combination of geo-morphological zone and bottom cover) were created by assigning a class label to a survey point using the ground truth data for context. To spectrally define a "region of interest" for a training class, 20-30 adjoining pixels were isolated and included in the class. All training classes with the same spectral label were used to create a map showing the distribution of that particular bottom cover over the reef. The resultant analysis produced maps showing discrete classifications of coral, algal and mud/sediment cover. In addition to benthic habitat classifications, maps incorporate depth contours based on available LiDAR data (Figure 22). The data used to create the maps are compatible with ArcGIS.

Abundance of reef fish was estimated at selected cal/val sites using 10-minute stationary point counts. At these locations, an observer remained at the location of the boat anchor and recorded all fish visible within a 360° viewplane.

3.0 RESULTS

3.1 WATER CHEMISTRY

3.1.1 Physical Characteristics of Aimakapa and Kaloko Ponds.

Tables 1-5 and 1A-5A show results of marine and pond water chemical analyses for samples collected in Aimakapa and Kaloko Ponds and the adjacent ocean during four survey increments from 2000 to 2012.Tables 1-5 show nutrient concentrations in micromolar units (μM), while tables 1A-5A show nutrient concentrations in unit of micrograms per liter (μg/L). Tables 1-1A and 2-2A shows results of sampling in Aimakapa Pond and Kaloko Pond and adjacent ocean in February 2012, respectively, while Table 3-3A shows results of pond sampling conducted in November 2012. Tables 4-4A and 5-5A show results from samples collected during surveys in 2007 and 2000, respectively. Concentrations of twelve chemical constituents in surface and bottom water samples from Kaloko and Aimakapa Ponds and the offshore ocean from the four survey years are plotted as functions of distance from the shorelines in Figures 4-17.

Examination of Tables 1-5 and Figures 4-17 show several major patterns of horizontal stratification of water chemistry constituents in the ponds and ocean. The most obvious characteristic of the data set is the major differences between patterns of water quality constituents in Aimakapa/Kaloko Ponds and the ocean. The second most apparent difference in water chemistry is the variation in the patterns of distribution of water chemistry constituents between Aimakapa Pond and Kaloko Pond. These variations between the two large fishponds are primarily the result of differences in physical structure of the barriers between the ponds

and the ocean. Aimakapa pond is separated from the ocean by a fairly wide (~20 m) continuous sand berm which is not very permeable to exchange between the pond and the ocean. Such impermeability is apparent in the sharp, nearly vertical gradients at the shoreline of many of the water chemistry constituents (e.g., Salinity, Si, TN, TP, TON, TOP) in Aimakapa Pond (Figures 4, 5, 11, 12, 13, 14).

Compared to the sand berm bounding Aimakapa Pond, the rock wall that separates Kaloko Pond from the ocean is highly permeable, and exchange of water between the ocean and pond is enhanced by channels ("makahas") constructed into the wall. Hence, the gradation in the water chemistry constituents between pond and ocean are less distinct in Kaloko compared to Aimakapa Pond, and the gradients within Kaloko Pond are more continuous between pond and ocean compared to Aimakapa. It should be noted that these direct connections between the pond and ocean eliminate Kaloko Pond from the designation of "anchialine" which requires that no such connections exist.

While both ponds contain thick sediment bottoms, there is a substantial difference in the quality of the sediment. Bottom composition of Aimakapa Pond consists of soft flocculent silty mud that is easily penetrable for at least one meter. Bottom composition of Kaloko Pond is a hard sand/mud mixture that is largely covered with marine algae, primarily the introduced species *Acanthophora specifera*. Sand/mud bottoms in both ponds were distinctly anaerobic beneath the surface layer as evidenced by the strong odor of H_2S when the bottom was even slightly disturbed.

3.1.2 Horizontal and Vertical Stratification of the Water Column

3.1.2.1 Salinity

During all sampling events, salinity within ponds showed very different horizontal gradations from the ocean to the shoreward sides of the ponds. In Aimakapa Pond, average salinity during the four surveys ranged from 12.45‰ in November 2012, 12.44‰ in February 2012, 12.67‰ in 2007 and 3.17‰ in 2000. The overall salinity in Aimakapa averaged over all four surveys was 12.64‰, with a standard deviation of 0.43‰. These data indicate that the salinity in Aimakapa is remarkable constant over the entire area of the entire pond, as well as over the 12-year interval of sampling. There is however, a slight trend of freshening over time, with the 2012 samples exhibiting the lowest salinities. The constancy of salinity through both time and space in Aimakapa Pond is clearly evident in Figure 4.

The overall pattern of salinity in Kaloko Pond was substantially different than in Aimakapa. Average salinity in the fishpond during the four increments of sampling was 22.93‰ in Nov. 2012, 24.52‰ in Feb. 2012, 19.59‰ in 2007 and 33.02‰ in 2000. The overall average salinity in Kaloko Pond for all surveys was 24.8‰ with a standard deviation of 6.1‰. As Kaloko Pond is "connected" to the ocean, the variability in salinity is a result of sampling at various stages of tide, and is also likely a response to the various stages of construction of the rock wall separating the pond from the ocean. As can be seen in Figure 4, all of the samplings of Kaloko Pond exhibited a pattern of increasing salinity with decreasing distance from the shoreline, indicating gradient of mixing between seawater and groundwater. The overall

patterns of salinity, with the lowest values in 2007 and the highest in 2000 do not suggest any consistent pattern with respect to time as a function of groundwater input into the pond.

Inspection of Tables 1-5 reveal slight vertical gradients in salinity in all sample sets with a surface layer of fresher water overlying a water column of saltier water. In Aimakapa Pond, salinity of surface samples was generally about 0.1-0.2‰ lower than bottom samples. In Kaloko Pond, the differences between surface and bottom samples was up to 2-4‰. The difference in vertical stratification between the ponds reflects the different levels of input and mixing between ocean water and groundwater, which are both lower in Aimakapa relative to Kaloko.

Comparing values of salinity within Aimakapa Pond to salinities of anchialine pools located in KAHO indicate that salinity in the fishpond is within the range of salinity as water in three representative pools water (8-14‰), while the salinity in Kaloko Pond is substantially higher than anchialine pools (Table 1). These comparisons again point to the open circulation between Kaloko Pond and the ocean.

Nearshore ocean waters in West Hawaii are typified by a pattern of decreasing salinity with distance from shore. This gradient is indicative of low salinity groundwater entering the ocean near the shoreline and mixing with high salinity ocean water. While this was the general pattern observed on the KAHO transect sites in 2007 and 2012, a somewhat unusual result in the 2000 data is that the lowest salinities in the ocean samples were not found nearest to the shoreline off of either fishpond. Rather, the lowest salinities were measured in surface ocean samples approximately 25-50 m offshore. Such a result suggests that the majority of groundwater flow to the ocean may be around the pond boundaries, rather than through the shoreline barriers that separate the ponds from the ocean.

Horizontal and vertical stratification of salinity in the ocean samples was evident at all stations during all surveys. Beyond 25-50 m from shore, with increasing distance from shore, salinity increased at all stations in both surface and bottom water, while at all sampling stations, surface salinity was lower than the corresponding bottom sample. These gradients indicate that mixing of groundwater entering the ocean does not completely homogenize the water column, with a surface layer of lower salinity water overlying a water column of ocean water.

3.1.2.2 Nutrients

As a result of the differences in permeability between the two ponds in terms of both input of groundwater and mixing with the ocean, the patterns of dissolved nutrients vary considerably between ponds. The patterns prescribed by the concentrations of dissolved Silica (Si) on transects are essentially a mirror image of salinity during all surveys (Figures 4 and 5). These mirror image patterns reflects the two orders of magnitude difference in concentrations of Si between groundwater and ocean water. In addition, the mirror image of Si and salinity indicates that Si is a "conservative" tracer, in that it is not utilized to any measurable extent by biotic or chemical reactions within the ponds and ocean. As a result, there is the same large variation in patterns of concentration of Si between the ponds, and same degree of stratification of Si as was evident in salinity.

In addition to Si, the other nutrient found in high concentrations in groundwater relative to ocean water is nitrate nitrogen (NO_3^-). However, while the distribution patterns of Si in Aimakapa Pond revealed consistent and similar magnitudes of Si concentrations across Aimakapa Pond (Figure 5), the situation for NO_3^- is substantially different. While the concentrations of NO_3^- in the 2000 and 2007 surveys were consistently low (below 0.5 μM) across the entire sampling transect, substantially different patterns occurred in both 2012 surveys. During these two surveys, concentrations of NO_3^- at the inshore end of the pond exhibited peak values with rapidly decreasing concentrations to the center region of the pond (Figures 6 and 7). The magnitude of the gradients was different between the February and November 2012 surveys, with peak values of about 13 μM in February and 50 μM in November. However, the location in the pond where the concentrations dropped to previously measured levels of NO_3^- of less than 1 μM occurred at nearly the same place during both surveys (~150 m from the shoreline) (Figure 6 and 7). The pattern of the other major inorganic nutrient, phosphate phosphorus (PO_4^{3-}) exhibits a similar pattern, with highest values at the shoreward edge of Aimakapa Pond wand sharply decreasing values up to the center of the pond (Figure 9).
These steep horizontal gradients of NO_3^- and PO_4^{3-}, as well as depressed salinity, suggest the possibility of a qualitatively different level of groundwater input at the mauka shoreline of Aimakapa Pond in 2012 relative to past surveys. While it is unlikely that the magnitude of groundwater flux has increased, it is possible that influx varies as a result of water level in the ponds. It has been shown that Aimakapa Pond responds to tidal fluctuations (damped relative to the ocean cycle in both magnitude and time) which push pond water inland during flood tides and draw groundwater into the ponds during ebbing tidal cycles (Tom Nance, personal communication). As pond salinity was higher in 2000 and 2007 relative to 2012 (Figure 7), the distinct differences in nutrient gradients between these years may be a reflection of when samples were collected relative to tidal state. Sample collection in 2012 may have taken place during a stage of ebbing tide resulting in higher groundwater efflux into the pond at the inland shoreline, while sampling in 2000 and 2007 may have occurred during a flooding tide which swamped out the groundwater flow into the pond, or produced a flow from the pond inland.

However, while there is a distinctly higher input flux of NO_3^- and PO_4^{3-} along the mauka shoreline of Aimakapa during 2012, the incoming inorganic plant nutrients are almost completely taken up within the shoreward half of the pond (Figures 6 and 7).

Kaloko Pond also shows distinct gradients of NO_3^- and PO_4^{3-}, with an overall similar pattern to Aimakapa Pond. While the peak values of NO_3^- occurred in 2012 in Aimakapa, the peaks in Kaloko occurred in 2007 corresponding to minimum values of salinity (Figures 6 and 8). In contrast to the steeply declining concentrations of NO_3^- down to very low values before the center of Aimakapa Pond, gradients were less steep and extended further toward the ocean end of Kaloko Pond (Figures 6 and 9).

Gradients of other forms of nitrogen and phosphorus show distinctly different patterns of distributions than NO_3^- and PO_4^{3-}, particularly in Aimakapa Pond. During all four of the sampling events, total nitrogen (TN) is relatively constant across the entirety of Aimakapa Pond, showing little of the steep gradients evident for NO_3^- (Figure 10). While the lowest

concentration of NO_3^- occurred in Aimakapa in 2000, the highest levels of TN were present in pond water during that year (Figure 10). Of the peak values of TN in 2000, virtually all of it exists as total organic nitrogen (TON) (Figure 11), rather than either NO_3^- or ammonium (NH_4^+) (Figure 12). In the 2012 surveys, concentrations of TON mirror NO_3^- with lowest values at the inshore end of the pond, and elevated values in the seaward portion of the pond. In particular in the November 2012 survey, the sharp elevation in concentrations of TON occur at the sampling station approximately 150 m from the shoreline, which is the same location that concentrations of NO_3^- dropped to low values. The same patterns are evident for total phosphorus (TP) and total organic phosphorus (TOP) (Figures 13 and 14).

Total organic nitrogen and phosphorus are the end products of decomposition of organic material, while the inorganic nutrients NO_3^- and PO_4^{3-}, as well as NH_4^+ are the nutrients taken up by plants during photosynthetic activity. The considerably different patterns of distributions of these nutrient components in Aimakapa Pond over the last 12 years suggest a shift in metabolic function over time. During the earliest survey in 2000, virtually all of the nitrogen and phosphorus in Aimakapa Pond was in the form an organic form (TON, TOP), with essentially no NO_3^- and PO_4^{3-} present. Such a distribution indicates that the pond was in a decaying state, proceeding toward anoxic conditions. The patterns of pH also confirm such metabolic function with highest values increasing across the pond in 2000 (Figure 15). The increasing metabolic breakdown of organic material and production of carbon dioxide, increases values of pH.

During both 2012 surveys, the metabolic functioning of Aimakapa appears to have shifted toward a more "open" system. High input of low salinity water containing high concentrations of inorganic nutrients found in groundwater are evident along the inland shoreline of the pond. These concentrations decrease with distance seaward until the approximate center of the pond, where concentrations approach the levels found in 2000. TON and pH mirror the pattern of nutrients indicating gradients of progressive uptake and metabolic processes from the mauka edge toward the center of the pond. Hence, the recent data indicates steep gradients within Aimakapa Pond indicate that the entire system does not remain a completely heterotrophic system removing nutrients from the water column, while adding back end products of metabolic decomposition. Rather, the apparent increase in groundwater now results in indications that at least part of the pond is a more open system with respect to metabolic cycling reversing somewhat the progression toward an anoxic system. It may be however, that the differences between nutrient gradients in different sampling years is a response to sampling during different phases of the tidal cycle, with nutrient fluxes into the pond more pronounced during ebbing tides.

Plots of Chlorophyll a (Figure 16) and turbidity (Figure 17) are similar, indicating that most of the turbidity of pond water is a result of phytoplankton. The highest Chlorophyll a levels were evident in bottom waters of Aimakapa pond during the 2000 survey. The close tracking of Chl a and turbidity in this survey indicates that the high values are not the result of resuspension of bottom sediment. Chlorophyll a (Figure 16) and turbidity (Figure 17) are also elevated in surface and bottom waters of Kaloko Pond relative to ocean water, but without the anomalous values in bottom water during 2000.

3.1.3 Conservative Mixing Analysis

A useful treatment of water chemistry data for interpreting the extent of material input from land is application of a hydrographic mixing model. In the simplest form, such a model consists of plotting the concentration of a dissolved chemical species as a function of salinity. Comparison of the curves produced by such plots with conservative mixing lines provides an indication of the origin and fate of the material in question (Officer 1979, Dollar and Atkinson 1992, Smith and Atkinson 1993). This method of data interpretation has recently been adopted by the State of Hawaii Department of Health as a new protocol for evaluating compliance with water quality standards in West Hawaii.

Figures 18-20 show plots of concentrations of four nutrient constituents as functions of salinity for Aimakapa and Kaloko ponds, anchialine pools and ocean water samples collected in the KAHO during the four sampling surveys in 2000, 2007 and 2012. In addition, nutrient concentrations and salinity from data collected in three monitoring wells within the KAHO boundaries are also shown. Each plot in Figures 18-20 also show two conservative mixing lines that was constructed by connecting the end member concentrations of open ocean water and averaged high-level groundwater concentrations from the DWS Honokohau Well (4158-03), and averaged basal groundwater Kaloko Irrigation Well (4160-02) (Well data provided by TNWRE 2012).

If the parameter in question displays purely conservative behavior (no input or removal from any process other than physical mixing), data points should fall on, or very near, the conservative mixing line. If, however, external material is added to the system through processes such as leaching of fertilizer nutrients to groundwater, data points will fall above the mixing line. If material is being removed from the system by processes such as uptake by biotic metabolic processes, data points will fall below the mixing line. It is also important to note that since nutrient concentrations are scaled to salinity, the effects of tidal state are not a factor in interpreting data on source or sinks.

Dissolved Si represents a check on the model as this material is present in high concentration in groundwater, but is not a major component of fertilizer. In addition, Si is not utilized rapidly within the nearshore environment by biological processes. It can be seen in Figure 18 that all of the data points from both Aimakapa and Kaloko Ponds, the three anchialine pools, and the ocean fall very close to the conservative mixing line for Si. Such agreement indicates that the end members used to construct the lines are representative of the system. The only data set that deviates from the linear pattern falling near the conservative mixing lines is for Monitoring Well 1, with anomalously low values in samples collected in 2000 and 2001 (TNWRE 2012). The lack of curvature in the linear arrays of data points also indicate that there is no detectable uptake of Si within the pond and marine system, and no other sources of Si other than groundwater.

The plot of NO_3^- versus salinity reveals distinctly different results than plot of Si (Figure 18). Plots of concentrations of NO_3^- versus salinity in Aimakapa Pond show a distinct nearly vertical line extending from the point of intersection with the mixing line (data from November 2012)

to the X-axis with a NO_3^- concentration of essentially zero. This linear array illustrates the process described in the section above where groundwater containing high levels of NO_3^- relative to seawater enters Aimakapa Pond at the mauka shoreline. With mixing of the groundwater into the pond, NO_3^- is rapidly stripped by biotic uptake. The orientation of data points from both of the surveys in 2012 along the same linear array suggests the same degree of removal of nutrients relative to salinity is occurring within the pond.

The arrays of NO_3^- data points for Kaloko Pond are substantially different than for Aimakapa (Figure 16). At the low salinity end of the plots, at salinities less than 15‰, all data points fall on the conservative mixing lines, indicating that concentrations in the pond at these sampling points consists exclusively of mixing of groundwater and ocean water. At salinities higher than 15‰, data points all lie beneath the mixing lines, with concentrations of NO_3^- decreasing steadily to very low values to a salinity of approximately 30‰. These patterns delineate uptake of NO_3^- by biotic processes within the main body of Kaloko Pond. As with the smooth linear array of data points of decreasing value with increasing salinity in Aimakapa, the relatively smooth curve prescribed by the data points in Kaloko indicate that there are no other sources or sinks of NO_3^- within the pond. Salinities above about 30‰ represent samples from the nearshore ocean, which show a slight increase in concentration relative to pond waters. Such an increase suggests that groundwater may be entering the ocean from other entry points than through the ponds.
Concentrations of NO_3^- in the anchialine pools scaled to salinity lie on, or slightly above the conservative mixing lines. The position of these points indicates that the same processes of NO_3^- uptake occurring in the two large fishponds is not occurring in the anchialine pools. Rather, groundwater nutrients remain in essentially the same concentration while in the anchialine pool as in the submarine aquifer. Such a difference in nutrient cycling in the smaller anchialine pools relative to the fishponds is a result of far more rapid flushing and turnover rate of water in the pools. Concentrations of NO_3^- in monitoring wells are generally above the conservative mixing lines, suggesting an external source of NO_3^- other than naturally occurring groundwater.

Phosphate phosphorus (PO_4^{3-}) is also a major component of fertilizer and sewage effluent, but is usually not found to leach to groundwater to the extent of NO_3^-, owing to a high absorptive affinity of phosphorus in soils. The curves defined by the plotted data of PO_4^{3-} as a function of salinity are similar to NO_3^-, although the concentrations differ by an order of magnitude (Figure 19). In addition, data points from the shoreward end of Aimakapa Pond occur above the mixing lines, indicating a source of PO_4^{3-} that is not completely naturally occurring groundwater. However, the near-vertical linear array of data points indicates rapid uptake of PO_4^{3-} beyond the shoreward edge of the pond. The distribution of data points in Kaloko Pond also reflects mixing of groundwater and ocean water along with uptake by biotic activity within the pond, although the magnitude of uptake is less than in Aimakapa Pond (Figure 19). Concentrations of PO_4^{3-} scaled to salinity in the anchialine pools all fall near the conservative mixing lines indicating that there are no external sources of PO_4^{3-} to the anchialine pools from sources other than naturally occurring groundwater. Similar to anchialine pools, the scaled concentrations of PO_4^{3-} for monitoring wells 2 and 3 fall on the conservative mixing lines, while most data points for well 1 lies below the mixing lines.

The other form of dissolved inorganic nitrogen, NH_4^+, shows a reversed pattern of distribution relative to conservative mixing lines when concentrations are plotted as functions of salinity. It can be seen in Figure 19 that the conservative mixing lines are nearly flat with nearly similar concentrations in groundwater and ocean water. The occurrence of nearly all of the data points from all water sources lying above the mixing lines indicates that the observed concentrations of NH_4^+ are not a result of mixing of groundwater and ocean water. Rather, these concentrations are the result of either input from another source, or as is more likely the case, from *in-situ* metabolic processes within the ponds.

Because total organic nitrogen and phosphorus (TON and TOP) occur in very low concentrations in both open ocean water and high level groundwater, the mixing lines for these constituents are essentially flat (Figure 20). The occurrence of data points of TOP and TON far above the mixing lines likely reflects the metabolic cycling conversion of inorganic nutrients to organic nutrients by plant metabolism and decomposition in Aimakapa Pond. Owing to low circulation and flushing of the majority of Aimakapa, and no uptake by biotic function, these organic nutrients remain in the water column. Contrary to Aimakapa Pond, the data points of TOP and TON versus salinity fall near the mixing lines, indicating that the level of organic decomposition and/or flushing of the pond is not occurring at the same level in Kaloko Pond. Within the anchialine pools and monitoring wells, TON and TOP occur at very low levels, supporting the observation that rapid water exchange through the pools and wells prevents accumulation of the products of organic metabolism.
Two major points can be made to summarize the results of the mixing analyses. First, and most importantly, there are no indications of significant input to any of the ponds of inorganic nutrients from sources other than naturally occurring groundwater. None of the data points scaling inorganic nutrients to salinity within the ponds or nearshore ocean indicate substantial nutrient subsidies to groundwater that could be a result of human activities in upland areas. The constituents that show substantial elevations in the ponds (NH_4^+, TON and TOP) are not the direct result of nutrient loading, but rather byproducts of metabolic cycling coupled with long residence time (slow water exchange) within the ponds.

The second major point that is illustrated by the nutrient data and mixing plots is that during the recent samplings in 2012 Aimakapa Pond exhibited a far more detectable pattern of active groundwater flux than in previous surveys. At the inland shoreline of the pond, input of low salinity, high nutrient groundwater was clearly evident during both of the 2012 surveys. Such input was not present in earlier surveys utilizing identical sampling methods. While the nutrient inputs were rapidly taken up within the shoreward half of the pond, the input of groundwater suggests a more active circulation than in the past. While the process responsible for these differences in input over a decadal period are not readily decipherable, it is clear that there is no indication of increased senescence of Aimakapa Pond. Rather, the measured increase in circulation indicates that the pond may be stabilizing the trend of tending toward a system completely dominated by decomposition and infilling of sediment.

While not included in the present data presentation, past investigations of the KAHO area have included comparisons of the nutrient dynamics occurring in the fishponds to the effects of discharges of water from the Natural Energy Laboratory of Hawaii at Keahole Point. These comparisons indicate that subsidies to groundwater of NO_3^- and PO_4^{-3} are far greater at

NELHA than in the Kaloko-Honokohau area as a result of high concentrations in deep seawater that is discharged into disposal trenches along the shoreline.

3.1.3 Pond Metabolism

The major concern regarding impacts to the pond resources at the KAHO from development of the Kaloko-Honokohau Business Park is the effect that increased nutrient loading will have on pond metabolic function. The perception is that increases in nutrient concentrations to groundwater flowing mauka from the development site to the National Park will alter the ponds in an undesirable manner. While the data discussed above indicates that at the present time there is no increases in nutrient loading in the ponds, it is of value to present the results of experiments conducted in Aimakapa Pond during a one-week period in December 2001-January 2002 when pond metabolism was estimated using measured changes in dissolved oxygen.

Figure 21 shows the resulting plots of dissolved oxygen and temperature over the 7-day deployment. Oxygen concentrations and temperature track exceptionally well. The highest daylight temperatures corresponding to the peak oxygen concentrations in mid-afternoon. The temperature and oxygen lows occur just prior to dawn. Peak oxygen concentrations of 11 mg/L at 27.5° correspond to saturation of about 140% while lows of oxygen concentration of 2.5 mg/L at 23° correspond to a saturation of about 33%. Of interest is that the daily amplitude of the peaks and lows for each day is similar with the exception of December 30, 2001, when peak temperature and oxygen were lower than the remainder of the data set. Weather conditions on this day consisted of heavy rainfall, with little direct sun. All other days were sunny.

This pattern indicates that pond metabolism is dominated by daylight photosynthesis and dark respiration. Comparing groundwater nutrient loading to the pond with gross production/respiration within the pond indicates that only approximately 4% of the pond metabolism can be supported by "new" nutrients delivered to the pond by groundwater flux. The remaining 96% of nutrient uptake must therefore be supported by recycling of nutrients within the pond. It is likely that the actual percentage of nutrient recycling is even higher (~99%) than the estimate as it is clear from all available data that groundwater flow into the pond is substantially restricted.

3.2. POND SEDIMENT ASSESSMENT

In order to evaluate the presence of toxic compounds and elements in sediments of the KAHO ponds, samples were collected at the seaward ends of Aimakapa Pond (KAHO-1), Kaloko Pond (KAHO-2) and in anchialine pool 96 (KAHO-3). Complete results of analyses are shown in Appendix A. In summary, none of the 28 organochlorides (EPA Method 8081A), 20 organophosphates (EPA Method 8141B), or 10 chlorinated herbicides (EPA Method 8151A) were detected in any pond sediment.

Of the 40 semivolatile organics (EPA Method 8270C), the only compound above the level of detection was phenol, which was present in the sample from Kaloko Pond at a concentration of 0.14 mg/kg. In previous surveys, phenol was also the only compound detected. Phenols are ubiquitous in the environment as they are a naturally occurring component of all foods, particularly plants, and are considered an antioxidant. They are also used in cosmetics, mouthwashes, disinfectants and in the synthesis of manufactured surfaces. The EPA has determined that exposure to phenol in drinking water at a concentration of 6 mg/L for up to 10 days is not expected to cause any adverse effects in children, and that a lifetime exposure to 2 mg/L in drinking water is not expected to cause any adverse effects. The single detection of phenol at a concentration of 0.14 mg/kg in sediments that will never be injested is an order of magnitude lower that the EPA limits.

Results of metal analysis in sediments conducted by Inductively Coupled Plasma Mass Spectrometry (ICPMS) revealed numerous detections in sediments from all three sampling stations (Appendix A). Aluminum, Arsenic, Barium, Chromium, Cobalt, Copper, Iron, Lead, Manganese, Molybdenum, Nickel, Selenium, Vanadium and Zinc occurred in all samples, while Cadmium was present in the sample from Aimakapa Pond (KAHO-1). Mercury was not detected in any of the samples. While metals were present in all of the samples, they are naturally present in volcanic soils. Further comparison of the concentrations found in the KAHO samples to reference levels in soils and water will be necessary to determine if the levels present represent significant input from other than natural sources.

3.3. BIOLOGICAL COMMUNITY ASSESSMENT

Marine community structure as represented in this report can be defined as the abundance, diversity, and distribution of a benthos (bottom dwelling organisms), including stony and soft corals, marine plants (algae), a motile benthos such as echinoderms, pelagic species such as reef fish, and federally protected species. When considering environmental changes caused by changes in land use or changes in non-point input of water of altered composition, benthic communities are probably the most useful biological assemblages for direct evaluation of environmental impacts to the offshore marine environment. Because benthos are generally long-lived, immobile, and can be significantly affected by exogenous input of sediments and other potential pollutants, these organisms must either tolerate the surrounding conditions within the limits of adaptability or die.

3.3.1 Zonation of the Marine Habitat

As described above, Kaloko Pond is separated from the ocean by a rampart of basaltic boulders, while Aimakapa Pond is separated from the ocean by a solid berm of beach sand. The main structural feature of the offshore area seaward of both ponds is a shallow basaltic ledge of pahoehoe lava. The ledge is particularly wide fronting Aimakapa Pond. Adjacent to the Kaloko Pond frontage the shoreline is composed of a rocky shoreline composed primarily of outcrops of lava that extend seaward.

Because of the structure of the boulder rampart and beach berm that separate the ponds from the ocean, there is virtually no intertidal area. Beyond the boulder shoreline, the structure of

the offshore environment off of Kaloko generally conforms to the pattern that has been documented as characterizing much of the west coast of the Island of Hawaii (Dollar 1975, 1982, Dollar and Tribble 1993).

The zonation scheme consists of three predominant regions. Beginning at the shoreline and moving seaward, the shallowest zone beyond the shoreline is comprised of a seaward extension of the basaltic shoreline bench, consisting largely of essentially bare basalt surfaces. Owing to the shallow depth and exposure to waves, the bench area is characterized by high turbidity and scour from resuspended sand. The most abundant coral occupying the nearshore bench is *Pocillopora meandrina*, a sturdy hemispherical coral is the dominant colonizer of the nearshore area. This species is able to flourish in areas that are physically too harsh for most other species, particularly due to wave stress. The shallow flat pavement area directly in front of the Kaloko Pond seawall appears to be an ideal habitat for *Pocillopora meandrina*. Other corals in the area consist of hemispherical heads of *Porites lobata*, and flat encrustations of *Montipora* spp.

Moving seaward, the flat nearshore bench area terminates in a ledge that has a roughly vertical face that extends to a depth of approximately 25 feet. Beyond the ledge, bottom topography consists of a reef platform that is typical of West Hawaii. The transition area between the shallow flat pavement zone and the reef platform zone is characterized by high relief in the form of undercut ledges and basaltic boulder pinnacles. As wave stress in this region is less than in the shallower areas, and suitable hard substrata abound, the area provides an ideal locale for colonization by attached benthos, particularly reef corals, and generally the widest assortment of species and growth forms are encountered in this region. The predominant coral in the area in *Porites lobata*, which occurs in a variety of growth forms.

The seaward edge of the reef platform (at a depth of about 50 feet) is marked by an increase in slope to an angle of approximately 20-30 degrees. In the deep slope zone, substratum changes from the solid continuation of the island mass to an aggregate of generally unconsolidated sand and rubble. The predominant coral cover in the slope zone is typically interconnected mats of "finger coral" (*Porites compressa*), which grow laterally over unconsolidated substrata.

The physical structure of the offshore region at Aimakapa is somewhat different than off Kaloko. The nearshore area consists of an extended flat basalt shelf that extends approximately 100 m from shore. Figure 22 is an aerial photograph of the Kaloko-Honokohau area that clearly shows the extent of the basaltic shelf that extends off of Aimakapa Pond (as denoted by green, rather than blue water). The surface of the platform contains holes and fissures, and small sand-filled channels, but relatively low cover of living corals. At the seaward termination of the shelf, a reef crest consisting of a shallower ridge of limestone separates the inner bench from the outer reef, which is similar to that described above off of Kaloko Pond.

3.3.2 Coral Communities

The predominant taxon of macrobenthos (bottom-dwellers) throughout the reef zones off of Kaloko Pond are Scleractinian (reef- building) corals. In total, eight species of "stony" corals,

and two "soft corals" were observed throughout the region of study. Table 6 shows summary data of coral coverage at all calibration-validation sites, while Figure 23 shoes the map of coral abundance. Overall coral cover consisted of 40% of bottom cover, with bare basalt rock comprising 33% of bottom cover. The dominant species in all of the zones off Kaloko-Aimakapa was *Porites lobata* which comprised 66% of coral cover. The next most abundant species were *Porites lutea (11%), Porites compressa* (10%), and *Pocillopora meandrina (9%)*. These four species comprised 96% of all coral cover. Other species that occurred across the reef were *Montipora capitata, M. patula* and *Pavona varians*.

The mid-depth reef platform zone had the highest number of coral species at both survey sites. In the mid-depth zone, dominant species were *Porites lobata* and *Porites compressa*. *Porites lobata* occurs in various growth forms including flat encrustations and large dome-shaped colonies, which are responsible for much of the true "reef" accumulation in the mid-depth zones. The abundance of suitable solid surfaces for coral settlement and growth, as well as the reduced wave stress compared to the shallower boulder zones provides a suitable setting for a variety of smaller encrusting coral species. Coral cover on the outer reef platform comprised approximately 40-60% of bottom cover (Figure 23).

3.3.3 Other Benthic Macroinvertebrates

The other dominant group of macroinvertebrates are the sea urchins (Class Echinoidea). The most common urchin was *Echinometra matheai*, which occurred in all reef zones. *E. matheai* are small urchins that are generally found within interstitial spaces bored into basaltic and limestone substrata. *Tripneustes gratilla*, and *Heterocentrotus mammillatus* were other species of urchins that occurred commonly throughout the reef. Both of these urchins occur as larger individuals (compared with *E. matheai*) that are generally found on the reef surface, rather than within interstitial spaces.

Sea cucumbers (Holothurians) observed during the survey consisted of three species, *Holothuria atra*, *H. nobilis*, and *Actinopyga obesa*. Individuals of these species were distributed sporadically across the mid-reef and deep reef zones. Numerous sponges were also observed on the reef surface, often under ledges and in interstitial spaces.

Frondose benthic algal occurrence was extremely limited throughout the study area off of Kaloko. However, encrusting red calcareous algae (*Porolithon spp.*, *Peysonellia rubra*, *Hydrolithon spp.*) were common on the boulders and exposed rocks throughout the study area. These algae were also abundant on bared limestone surfaces, and on the nonliving parts of coral colonies.

The design of the reef survey was such that no cryptic organisms or species living within interstitial spaces of the reef surface were enumerated. Since this is the habitat of the majority of mollusks and crustacea, detailed species counts were not included in the assessment. No dominant communities of these classes of biota were observed during the reef surveys at any of the study stations.

3.3.4 Reef Fish Community Structure

Reef fish community structure was largely determined by the topography and composition of the benthos. The reef fish community off Kaloko-Aimakapa is typical of that found along most of the Kona Coast, as described by Hobson (1974), and Walsh (1984). Fish community structure can be divided into six general categories: juveniles, planktivorous damselfishes, herbivores, rubble-dwelling fish, swarming tetrodonts, and surge-zone fish. Table 7 shows results of fish surveys on the Kaloko-Honokohau reefs.

Pomocentridae (Damselfish) were the most abundant family of fish. Planktivorous damselfish, principally of the genera *Chromis* and *Abudefduf* were abundant in all areas surveyed. The next most abundant family was the Acanthuridae (surgeonfish), with the most common species including the yellow tang (*Zebrasoma flavescens*), the goldring surgeonfish (*Ctenochaetus strigosus*), and the brown surgeonfish (*Acanthurus nigrofuscus*). On the shallower reef terrace, adult whitebar surgeonfish (*Acanthurus leucopareius*), orangeband surgeonfish (*A. olivaceus*), and parrotfish (*Chlorurus sp.*) were also common in areas where coral rubble was abundant.

Surge zone fish consisted principally of herbivores such as rudderfish (*Kyphosus bigibbus*), surgeonfish (*Acanthurus spp.*), and unicornfish (mostly *Naso lituratus*). Saddle wrasse (*Thallassoma duperry*) and surge wrasse (*T. purpureum*) were also abundant in the surge zone. Trigger fish (Family Balistidae) including the black durgeon (*Melanichthys niger*) and pinktail durgeon (*M. vidula*) and the boomerang trigger (*Sufflamen bursa*) were also observed congregating in the water column over the reef platform. A variety of butterfly fish (Family Chaetodontidae) were also observed throughout the survey region.

Overall, fish community structure at Kaloko appeared fairly typical of the assemblages found in West Hawaii reef environments.

3.3.5 Endangered and Protected Species

Several species of marine animals that occur in Hawaiian waters have been declared threatened or endangered by Federal jurisdiction. The threatened green sea turtle (*Chelonia mydas*) occurs commonly along the Kona Coast, and is known to feed on selected species of macroalgae. The endangered hawksbill turtle (*Eretmochelys imbricata*) is known infrequently from waters off the Kona Coast. The area off of Aimakapa Pond is clearly a preferred habitat for green turtles, as at least eight individuals were observed in the nearshore zone during the survey. In addition, at least ten turtles were observed hauled out on the basalt shelf to the south of the pond during a low tidal stand when much of the basaltic bench in this area was exposed.

Populations of the endangered humpback whale (*Megaptera novaeangliae*) are known to winter in the Hawaiian Islands from December to April. The present survey was conducted in March, when whales were present in Hawaiian waters. No whales were observed during the course of the survey. Similarly, no Hawaiian monk seals (*Monachus schlauslandi*) were observed in the area.

4.0 DISCUSSION and CONCLUSIONS

4.1 General Considerations of Effects to Pond Chemistry from Existing Development

The purpose of this baseline survey is to provide the information to make valid estimates of the potential for impact to the marine and pond environments at Kaloko Honokohau National Historical Park, and possibly NELHA, from development of the Kaloko-Honokohau Business Park. The information collected for this study provides the basis to understand the processes that are operating in the pond-ocean system, and to specifically address the concerns raised in the planning process.

To summarize, it is generally accepted that the two large fishponds within the Kaloko-Honokohau National Historical Park function in a similar manner to smaller anchialine ponds that occur on the west coast of Hawaii. By definition anchialine ponds are surface exposures of the water table with no direct connection to the ocean that contain brackish water which is a mixture of seaward flowing groundwater and landward flowing seawater. Anchialine ponds in early successional stages usually have sediment-free bottoms which allow for relatively rapid exchange of water. It is important to note that healthy anchialine ponds are NOT nutrient limited systems, and contain high concentrations of plant nutrients. The excess nutrients do not lead to algal dominated water columns (at least until late stages of pond senescence), however, as a result of a balance between short residence time of water within the ponds, and production and consumption by pond biota. Rapid flux of water through the ponds, and grazing by resident populations prevent plankton buildup within the water column.

In the later stages of the anchialine pond cycle, infilling by sediment reduces the rate of water exchange and the balance between production and consumption is lost. Ultimately, in the last stages of pond senescence infilling is complete and ponds transitions to wetlands.

The results of this survey, as well as others (Brock and Kam 1997), indicate that Kaloko Pond is not technically an anchialine pond because it contains direct connections to the ocean. Water in the pond is near oceanic in salinity, indicating that groundwater comprises a very small component of the pond makeup. Groundwater flux into the pond is mixed with ocean water that is driven by wave action carrying water landward through the rock wall.

Aimakapa Pond, on the other hand, can be considered an anchialine pond because it is sealed from direct exchange with the ocean by a sand berm of low permeability. The nearly vertical gradients in salinity between the pond and nearshore ocean provide evidence that the sand berm is essentially impermeable to water exchange (a good analogy is the use of sand bags for flood control levees).

During surveys of Aimakapa Pond conducted in 2000 and 2007 restricted groundwater flow into Aimakapa Pond was borne out by the near complete lack of both vertical and horizontal gradients within the ponds. Such lack of detectable inputs suggested that the pond is essentially a closed system which is accumulating sediment and metabolic decay products which cannot be naturally flushed from the enclosed pond basin. Continued metabolic activity will produce increasing sediment deposition which will elevate rates of nutrient release from sediment decomposition, which will in turn allow for increased phytoplankton growth. Eventually organic

sediment deposition will completely dominate the pond to the point where the water column disappears, and the area transitions to a marsh or wetland. Such a progression has been described as the natural "life history" of anchialine ponds.

During a survey in early 2012 conducted for the present report, evidence of groundwater input at stations within the inshore half of Aimakapa Pond was detected as steep horizontal gradients of salinity and inorganic nutrients found in groundwater. To determine whether this situation was an anomaly, another sampling was conducted in November 2012. Results of this sampling indicated an even stronger flux of groundwater into Aimakapa Pond than was previously measured. These results suggest that Aimakapa Pond may be experiencing either increased groundwater input, or at least not a decrease in groundwater input relative to a decade earlier. As the existing development in the Kaloko Industrial area upslope of the KAHO ponds has been in place for the last decade, water quality in the ponds changes can be assumed to be influenced by the present level of development upslope from the KAHO ponds.

Hence, while all data indicate that while the enclosed basin of Aimakapa is characterized by long water residence time, resulting in continued deposition of organic sediment, the recent detection of increased groundwater flux suggests that the pond is still functioning in part as an anchialine system, and has no yet reached a final stage of senescence.

4.2 Sedimentation and Runoff

A potential mechanism for negative impact to nearshore marine and pond systems is increased sedimentation from wind and surface runoff as a consequence of grading and changes in land use. There appears to be little potential for alteration to the pond and marine communities offshore of Kaloko Makai from increased sedimentation associated with the project for several reasons. The climate of the Kaloko area is one of the driest in the Hawaiian Islands. On an annual basis rainfall is likely to be far exceeded by evaporation at the proposed project site. Surface water runoff from storm events is infrequent. The basaltic composition of the land surface is highly porous and is capable of absorbing rainfall with little or no surface runoff. Even in the event of heavy rainfall, the porous nature of the soil ground cover is such that sheet flow carrying suspended sediment toward the ocean would be expected to be relatively small. Rather, most rainwater that would enter the ocean as runoff would do so following percolation through the surface rock layers to the water table, followed by groundwater extrusion at the shoreline.

The project site is presently comprised of extensive areas of exposed soil and rock, with relatively little vegetative groundcover. During the construction phases, it is likely that permit regulations will limit the area of excavation at any particular time, and require dust control measures. In addition, the predominant direction of wind (land breezes) generated by thermal convection from solar heating of the land mass is inland, resulting in transport of dust inland, and not toward the ocean. As a result, it appears that there is little potential for significant input of sediment to the marine and pond environment resulting from the proposed project.

The entire floor of Aimakapa Ponds is covered with a thick layer of fine-grained flocculent sediment. As described above, the sediment layer plays an important role in the metabolic

functioning of the ponds. Pond biota are adapted to this high sediment composition. Should a small amount of sediment reach the pond as a result of construction activity, it is not likely that there will be any qualitative change to sediment composition.

Within the marine environment, the nearshore area contains locally high regions of cover of calcareous sands of marine origin. Corals and other reef organisms are capable of removing sediment suspended by natural phenomena, up to threshold levels of deposition where cleaning mechanisms are overwhelmed and organisms become buried. Because of the existence of natural sands, and the normally turbulent conditions which continually resuspend natural sediment, biotic community structure is presently adapted to extremes in sediment stress from natural conditions. Organisms that do occur in the region are therefore capable of withstanding the stress associated with large natural sediment loads. In comparison to the frequent natural sediment resuspension within the study area, any additional input from land resulting from construction activity would probably not have the potential to accumulate to the point where organisms could be buried.

4.3 Alteration of Groundwater Flow and Composition

TNWRE (2012) provides a detailed description of the hydrology of the Kaloko area and the potential for changes that may occur to groundwater discharge to the ponds and ocean as a result of the Kaloko Makai project. Five aspects of the project development have the potential to change the groundwater flowrate and/or chemistry:

1) consumptive use of potable quality groundwater.
2) disposal of excess R-1 treated effluent in onsite injection wells.
3) potential disposal of RO (reverse osmosis).
4) percolation of excess landscape irrigation.
5) change in local rainfall-recharge.

Detailed consideration of these five factors is discussed in TNWRE (2012). Post-development total changes to basal groundwater flowing beneath the Kaloko Makai Project site are summarized as follows:

Change in groundwater flowrate = 2.125 mgd = + 6.2% change over present
Change in salinity = 1.661‰ = -5.1%
Change in nitrogen = 19.652 lbs per day = +5.2 ‰
Change in phosphorus = 2.889 lbs per day = +2.1 ‰

Based on the results of the water chemistry analyses discussed above, these changes in groundwater parameters can be considered in terms of impacts to the ponds at KAHO. In terms of groundwater flow, it is estimated that the project will result in increased groundwater flux through the aquifer, as well as a decrease in salinity of basal groundwater, primarily as a result of increases in irrigation rates. As the linkage between the physical and metabolic dynamics of the ponds depends on flux of fresh groundwater, the potential increase in flow rate and decrease in salinity cannot be viewed as a negative impact to the ponds. Rather, increased groundwater flux can be viewed as a positive effect as it will enhance water

exchange and decrease residence time within the ponds. Potential lowering of salinity of water entering the ponds will not result in effects to pond biota in terms of exceeding an upper salinity tolerance. As noted above, recent surveys indicate an apparent progressive increase in groundwater flux in Aimakapa Pond which is reflected in nutrient concentrations, and a net reduction in metabolic decay products. With projected increased flux from the proposed development, conditions in the ponds could potentially improve further in a direction away from sediment deposition and senescence.

Wastewater generated at the project site and treated in an on-site treatment plant would be reused for irrigation, with the excess disposed of in injection wells if other uses are not found. Using typical nutrient concentrations in wastewater, fertilizers and basal groundwater, as well as changes in local rainfall and recharge and removal rates associated with lateral travel with groundwater to the shoreline, TNWRE (2012) estimated that total nitrogen and total phosphorus will increase by 5.2% and 2.1%, respectively over existing conditions.

Such increases in nutrient loading of about 5% for N and 2% for P will not result in changes to the ponds or nearshore ocean. As described above, healthy anchialine ponds are not nutrient limited, and already contain an excess of nutrients that are not utilized within the biogeochemical cycles within the ponds. So the small projected increases would be inconsequential to anchialine pools.

If all of the metabolically relevant nitrogen and phosphorus in groundwater is considered as NO_3^- and PO_4^{3-}, then the projected increases would result in basal groundwater concentrations would be 75 μM for NO_3^-, and 5.0 μM for PO_4^{3-}. Such changes are well within the natural variability of the system, and essentially represent no change to present conditions. As an example, the average concentration of NO_3^- in high groundwater at present (80 μM) exceeds the projected increase value for NO_3^- in basal groundwater that would reach the shoreline (75 μM) Other areas of West Hawaii also have been shown to have concentrations of NO_3^- in basal groundwater that exceed 75 μM (Dollar and Atkinson 1992). Thus, the projected increase cannot be considered of a magnitude to present any king of potentially problematic situation. As long as there are no changes to the physical structure of healthy anchialine ponds (e.g., infilling) or changes to the balance of native biotic assemblages (e.g., introduction of alien species) the small increase in nutrient concentrations in groundwater entering the ponds would have no effect.

4.4 Effects to the Nearshore Marine Environment

It is also unlikely that there would be any effects to the nearshore marine environment as a result of increases in nutrient concentrations in groundwater. Dollar and Atkinson (1992) modeled the input of nutrients to the ocean downslope from two golf courses in West Hawaii over a four-year period. Results of the studies showed that at a location where fertilizer nutrients entered an embayment (Keauhou Bay) with restricted circulation relative to open coastal shorelines, nitrates increased by about 100% and phosphate increased by about 20% over natural input. However, because the nutrients were retained within a surface layer, there was no exposure to the benthos. Circulation within the embayment was also rapid enough to prevent phytoplankton blooms. These results indicated that even with long-term input of

extremely high nutrient subsidies, there are situations where there are no negative effects to the receiving environment. Similar lack of impact would be expected at the Kaloko-Honokohau region where nutrient subsidies would be far less than have occurred at Keauhou.

Several other important points are also worth mentioning with respect to impacts to coral reef ecosystems. Seasonal long-period swells result in turbulence at the shoreline off the entirety of Kaloko-Honokohau Park, including the nearshore areas off of Aimakapa and Kaloko Ponds. Such wave turbulence is the reason coral communities are poorly developed in the nearshore area. Hence, owing to the high and consistent rates of mixing, as well as minimal input of materials from land to the ocean, it is not likely that nutrient concentrations in the waters downslope from the project site will have any effect on marine communities.

In addition, some clarification on the actual extent of potential damage to coral reefs from nutrients is also important to note. While the perception is that elevated nutrient concentrations are universally detrimental to corals and other reef organisms, the scientific literature does not bear this out as fact. Atkinson et al. (1995) showed that 57 species of corals have grown at in seawater with consistent nutrient concentrations about 10-fold higher than is normally found on Hawaiian reefs. Growth rates of these corals were near the upper rates reported from the field, demonstrating that corals can and do flourish in relatively high nutrient water. Atkinson et al. (1995) conclude that "Statements implying that corals can only grow in low nutrient oligotrophic waters are oversimplifications of the processes that govern growth of these organisms."

Another clear example of the lack of impact to corals from nutrients associated with sewage effluent is illustrated in Figure 24. In the photographs in this figure, corals can be seen covering sewage diffuser that are actively discharging primary treated effluent within Hilo Bay. Similar situations have been noted in Hawaii, where the elevated nutrient concentrations in waters adjacent to ocean sewage outfalls has not impacted corals or coral communities (Dollar 1999, Grigg 1994).

4.5 Potential effects to Endangered and Protected Marine Species

As mentioned above there are several protected marine species that may inhabit the offshore environment. Because there is no plan for any work in the nearshore region, there is no potential for blasting or excavation that might affect behavior of whales, monk seals and other marine mammals. Similarly, as described above, there is little potential for changes in water quality resulting from construction. The Kaloko Makai project will not alter access to the shoreline. Thus, there is little potential for any negative factors associated with the project that may affect turtles or marine mammals

5.0 SUMMARY

A major concern in the planning process for the Kaloko Makai is addressing the potential for impacts to pond and marine environments within the Kaloko-Honokohau National Historical

Park, which lies directly downgradient from the project site. As there will be no alterations of any of the pond or marine habitats by the project, potential impacts could only result from alteration of groundwater that flows under the project site to the ocean. The potential for impact to marine and pond communities as a result of development of the Kaloko Makai project appears to be minimal or non-existent. Kaloko Pond is separated from the ocean by a man-made rock wall that contains openings to promote exchange of pond water and ocean water. Aimakapa Pond is sealed from the ocean by an unbroken sand berm. The distinct discontinuities between concentrations of water chemistry constituents between the seaward end of Aimakapa Pond and the nearshore ocean indicate that the sand berm is an effective barrier preventing free exchange between the pond and ocean.

While Aimakapa previously exhibited little vertical and horizontal stratification, recent studies reveal input of groundwater along the landward shoreline of the pond, resulting in steep gradients of salinity and inorganic nutrients found in groundwater. Tidal oscillations in the ponds result in landward flow of water out of the ponds during periods when pond levels are higher than groundwater in surrounding lava formations, and flow into the pond when pond levels are lower than in surrounding rock. Hence, the differences in groundwater dynamics within the ponds over the 12-year interval of studies may reflect the relationship between sampling and tidal state. In any event, the sequential results indicate that at a minimum the fishponds are not in a more senescent state at present than in previous years. Hence, based on these data, it can be concluded that there does not appear to be any increasing negative effects from the existing development upslope from the Kaloko-Honokohau National Historical Park.

Concentrations of inorganic nutrients, particularly NO_3^- and PO_4^{3-}, which are high in basal groundwater are substantially lower in most of the pond waters. Measurements of metabolism within Aimakapa Pond indicates high rates of both gross production and respiration. Even with no consideration of the limited input of groundwater to the ponds, the maximum amount of metabolism that can be attributed to groundwater nutrients is about 5%. Therefore, a minimum of 95% of pond metabolism is driven by nutrients recycled within the pond. Such a scenario is consistent with the apparent rapid uptake of groundwater nutrients within the pond, lack of stratification throughout the entire width of the ponds, high phytoplankton biomass, and thick flocculent organic sediment that lines the floor of the pond.

In addition, it has been repeatedly documented that healthy anchialine ponds are not nutrient limited, so increases in nutrient concentrations will no effect as long as the physical and biological components of the ponds are kept intact. Estimates of changes in groundwater flow volume that would occur from the Kaloko Makai project are within the range of natural variability. Increases in nutrient concentrations to groundwater from irrigation and other land use factors result in an increase in groundwater flow and nutrient loading to groundwater, along with a reduction in salinity. Such changes are within the natural variability of groundwater composition. In addition, because Aimakapa Pond potentially utilizes groundwater nutrients for only a small percentage of metabolic requirements, the small changes to groundwater composition will not result in detectable differences in pond function.

Scaling nutrients concentrations to salinity indicate that there are no nutrient subsidies to the ponds from sources other than naturally occurring groundwater. These results indicate that under the present scenario, the existing development upslope of KAHO is not causing detectable input of nutrient subsidies, or reduction in groundwater flux to the ponds. Rather, conditions in the ponds appear at present to represent more open systems with respect to hydraulic and nutrient fluxes. Estimates of changes of hydrologic factors resulting from the project indicate increased hydraulic flow, decreased salinity, and minor increases in nutrient concentrations. Hence, both the analyses of shoreline ponds at KAHO that are influenced by the existing level of upslope development, as well as the projections of changes to groundwater dynamics from the Kaloko Makai Project indicate that there is little or no potential for the project to produce negative impacts to the pond or marine environments.

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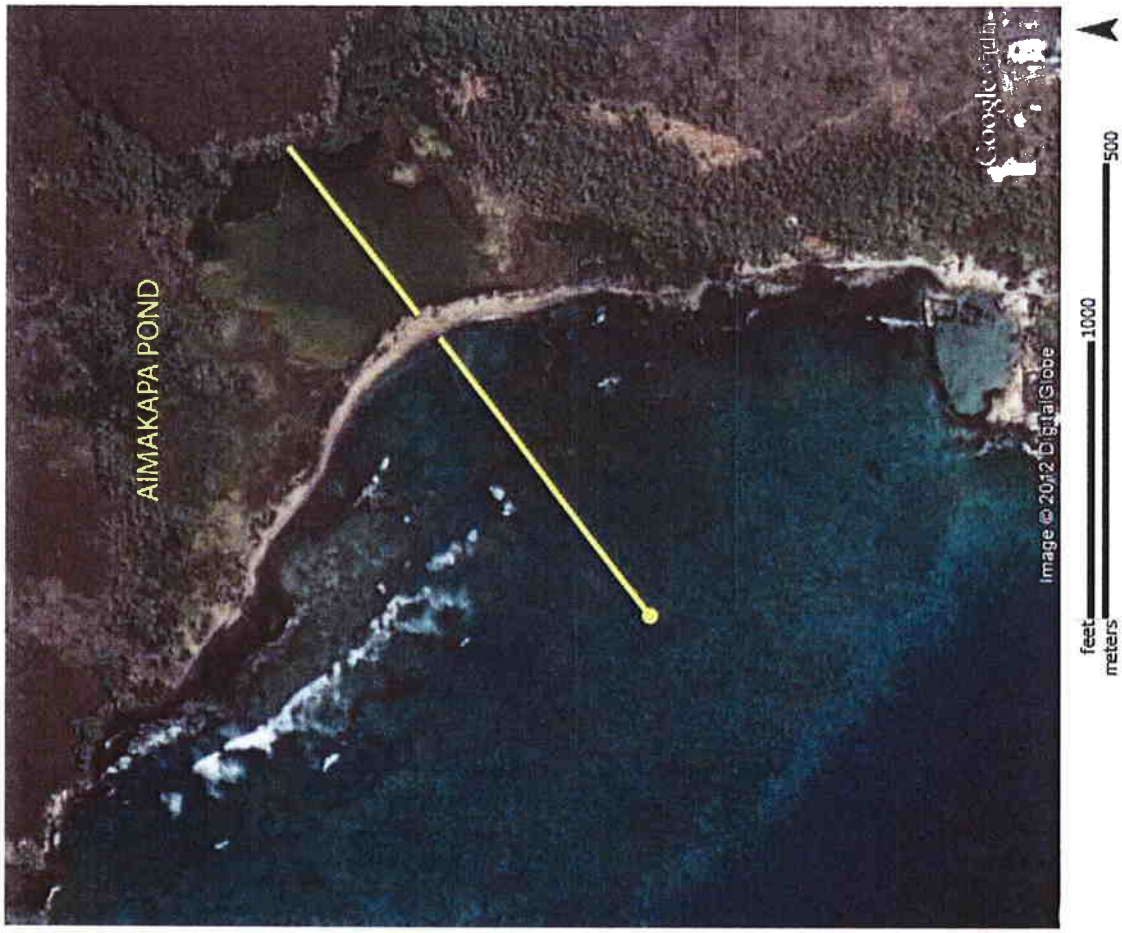

FIGURE 2. Aerial photograph of Aimakapa Pond in Kaloko-Honokohau National Historical Park showing location of transects (yellow lines) on which water samples were collected through the pond and extending into the ocean. While exact locations of sample collection differed between sampling years, the location of the sampling transects were consistent.

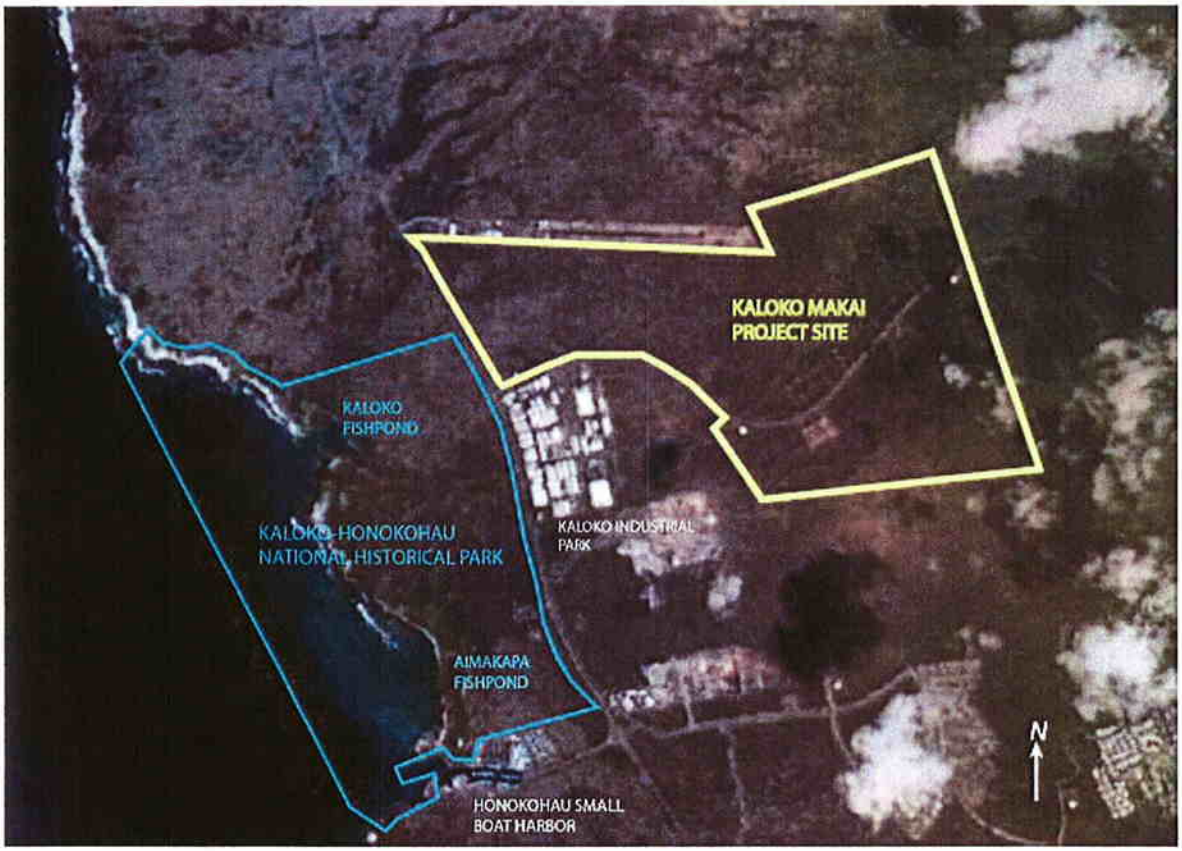

FIGURE 1. Aerial photograph of section of North Kona, Island of Hawaii showing approximate boundaries of Kaloko Makai Project site (yellow line). The legislated boundary of Kaloko-Honokohau National Historical Park is shown in blue. Also shown are locations of Aimakapa and Kaloko Fishponds, the existing Koloko Industrial Park, and Honokohau Small Boat Harbor.

TABLE 1. Results of water chemistry measurements in Aimakapa Pond and the coastal ocean directly off of the ponds collected in February 23, 2012. "S" indicates surface sample; "B" indicates bottom sample. "DFS" indicates "distance from shore";negative values indicate distance inland from the beach berm; positive values indicate distance seaward from the beach berm. Nutrient concentrations are shown in micromolar units."Bdl" stands for "below detection limit."For station sampling locations, see

	SAMPLING STATION	DFS (m)	PO_4^{3-} (µM)	NO_3^- (µM)	NH_4^+ (µM)	Si (µM)	TOP (µM)	TON (µM)	TP (µM)	TN (µM)	Turb (ntu)	Salt (o/oo)	pH (rel)	Chl-a (µg/l)	TEMP (deg C)	O2 (%sat)
AIMAKAPA POND	1-S	-230-S	1.30	13.24	3.62	495.68	1.24	34.60	2.54	51.46	1.67	12.097	7.91	0.76	24.3	100.9
	1-B	-230-B	1.52	10.30	2.50	495.84	1.24	34.20	2.76	47.00	1.90	12.152	8.01	1.08	24.4	91.0
	2-S	-205-S	1.52	11.08	2.30	479.02	1.10	28.26	2.62	41.64	1.52	12.074	8.02	0.80	24.5	102.0
	2-B	-205-B	1.44	9.20	2.56	481.30	1.38	35.92	2.82	47.68	1.77	12.115	8.07	1.68	24.4	107.8
	3-S	-190-S	1.42	9.12	3.74	488.06	1.26	32.92	2.68	45.78	2.08	12.155	8.18	1.21	24.3	99.9
	3-B	-190-B	1.16	0.60	3.52	473.82	1.42	36.92	2.58	41.04	2.21	12.422	8.22	2.14	24.3	98.3
	4-S	-170-S	1.02	0.46	4.52	475.46	1.40	37.04	2.42	42.02	2.11	12.322	8.20	1.28	24.2	99.9
	4-B	-170-B	1.16	0.80	3.80	481.10	1.48	39.42	2.64	44.02	1.86	12.343	8.12	1.76	24.3	104.7
	5-S	-150-S	1.34	3.32	3.62	485.78	1.26	34.56	2.60	41.50	2.48	12.345	8.10	1.26	23.9	99.6
	5-B	-150-B	1.46	4.82	3.56	479.40	1.32	34.00	2.78	42.38	2.11	12.712	8.07	1.65	24.0	101.5
	6-S	-130-S	1.08	0.08	1.32	479.06	1.36	39.92	2.44	41.32	2.67	12.507	8.23	1.67	23.8	100.1
	6-B	-130-B	0.80	0.06	1.18	470.98	1.26	36.42	2.06	37.66	2.73	12.512	8.21	3.93	24.2	86.9
	7-S	-110-S	1.02	0.14	1.44	475.56	1.36	39.90	2.38	41.48	2.61	12.535	8.25	1.31	24.0	99.9
	7-B	-110-B	0.88	0.06	1.42	478.84	1.30	38.32	2.18	39.80	2.51	12.525	8.19	1.10	24.0	101.0
	8-S	-80-S	1.02	0.08	1.22	472.68	1.28	38.44	2.30	39.74	2.70	12.605	8.26	1.37	24.0	99.7
	8-B	-80-B	0.96	0.08	1.38	475.16	1.22	37.10	2.18	38.56	2.93	12.574	8.26	2.26	24.3	99.5
	9-S	-40-S	0.98	0.08	1.60	472.86	1.24	37.80	2.22	39.48	2.68	12.686	8.27	1.59	24.2	100.0
	9-B	-40-B	0.88	0.06	1.12	467.24	1.28	38.00	2.16	39.18	2.77	12.672	8.26	2.20	24.3	101.7
	10-S	-1-S	0.94	0.08	1.64	470.12	1.18	38.72	2.12	40.44	2.53	12.717	8.26	1.75	24.6	100.0
	10-B	-1-B	0.96	0.06	1.68	475.50	1.26	39.22	2.22	40.96	2.62	12.720	8.26	1.65	24.8	104.7
OCEAN	11-S	0	0.38	3.52	0.28	75.66	0.24	8.62	0.62	12.42	0.46	31.754	8.03	0.36	25.4	102.2
	12-S	1	0.30	3.54	0.30	77.30	0.20	8.08	0.50	11.92	0.34	31.585	8.04	0.59	25.0	101.9
	13-S	3	0.36	3.16	0.16	72.42	0.18	8.26	0.54	11.58	0.32	31.733	8.05	0.25	24.9	100.4
	14-S	5	0.32	3.16	0.28	69.50	0.24	7.66	0.56	11.10	0.37	31.838	8.05	0.58	24.9	99.2
	15-S	10-S	0.08	1.67	0.01	39.74	0.41	7.49	0.49	9.17	0.19	33.191	8.20	0.12	24.6	100.6
	15-B	10-B	0.19	0.51	0.06	20.15	0.39	6.78	0.58	7.35	0.27	34.013	8.23	0.18	24.4	99.3
	16-S	25-S	0.24	4.73	0.01	60.04	0.43	6.50	0.67	11.24	0.30	32.297	8.25	0.08	24.3	101.2
	16-B	25-B	0.17	0.48	0.03	6.29	0.40	5.01	0.57	5.52	0.18	34.655	8.17	0.10	24.2	100.2
	17-S	50-S	0.25	2.80	0.03	41.13	0.40	5.83	0.65	8.66	0.26	33.131	8.20	0.08	24.3	102.6
	17-B	50-B	0.12	0.18	0.02	5.38	0.44	5.04	0.56	5.24	0.18	34.663	8.15	0.14	24.1	100.4
	18-S	75-S	0.18	1.91	0.01	29.46	0.40	4.65	0.58	6.57	0.27	33.672	8.17	0.07	24.1	99.2
	18-B	75-B	0.15	0.15	0.02	4.35	0.39	4.62	0.54	4.79	0.12	34.759	8.16	0.10	24.1	101.0
	19-S	100-S	0.26	1.71	0.03	10.07	0.36	4.08	0.62	5.82	0.08	34.491	8.13	0.07	23.8	100.3
	19-B	100-B	0.18	0.59	0.03	5.86	0.33	6.66	0.51	7.28	0.11	34.644	8.16	0.07	24.0	100.5
	20-S	200-S	0.19	1.22	0.04	6.81	0.33	5.98	0.52	7.24	0.06	34.554	8.12	0.04	23.9	101.2
	20-B	200-B	0.17	0.10	0.07	3.37	0.32	5.51	0.49	5.68	0.06	34.613	8.12	0.05	23.7	98.2
	21-S	300-S	0.15	0.09	0.04	1.67	0.36	5.68	0.51	5.81	0.04	34.738	8.12	0.04	23.6	99.2
	21-B	300-B	0.15	0.03	0.04	1.63	0.31	5.63	0.46	5.70	0.04	34.869	8.13	0.03	23.4	98.3
ANCHIALINE POOLS	119		2.36	61.02	0.60	457.68	0.03	2.94	2.39	64.56	0.10	14.568	7.56	0.35		
	123		2.98	55.28	4.66	447.48	0.22	24.04	3.20	83.98	0.80	8.360	7.66	1.73		
	96		2.60	52.76	0.68	430.02	0.02	6.58	2.62	60.02	0.26	14.861	7.58	0.40		

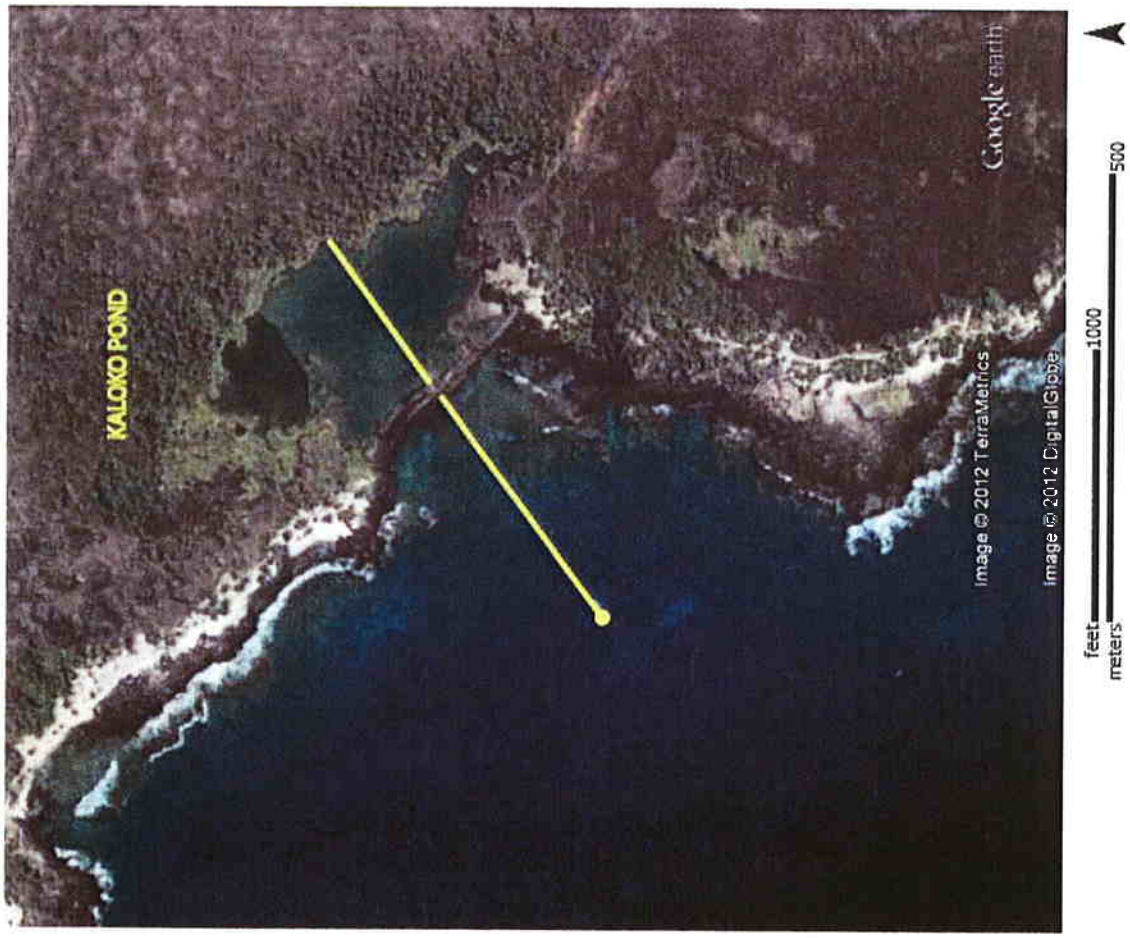

FIGURE 3. Aerial photograph of Kaloko Fish Pond in Kaloko-Honokohau National Historical Park showing location of transects (yellow lines) on which water samples were collected through the pond and extending into the ocean. While exact locations of sample collection differed between sampling years, the location of the sampling transects were consistent.

TABLE 2. Results of water chemistry measurements in Kaloko Pond and the coastal ocean directly off of the ponds collected in February 23, 2012. "S" indicates surface sample; "B" indicates bottom sample. "DFS" indicates "distance from shore";negative values indicate distance inland from the beach berm; positive values indicate distance seaward from the beach berm. Nutrient concentrations are shown in micromolar units. For station sampling locations, see Figure 1.

	SAMPLING STATION	DFS (m)	PO_4^{3-} (µM)	NO_3^- (µM)	NH_4^+ (µM)	Si (µM)	TOP (µM)	TON (µM)	TP (µM)	TN (µM)	Turb (ntu)	Salt (o/oo)	pH (rel)	Chl-a (µg/l)	TEMP (deg. C)	O2 (%sat)
KALOKO POND	1-S	-200-S	1.02	7.08	2.22	319.84	0.72	25.16	1.74	34.46	1.88	20.240	8.12	3.67	24.7	97.9
	2-S	-175-S	0.90	8.00	3.16	317.48	0.70	25.42	1.60	36.58	2.66	20.319	8.10	2.94	24.5	93.5
	2-B	-175-B	1.52	0.20	0.66	168.14	1.08	33.16	2.60	34.02	5.72	27.519	8.22	4.43	25.7	114.7
	3-S	-150-S	1.04	6.30	2.54	306.00	0.84	25.82	1.88	34.66	2.67	21.005	8.12	3.28	24.8	94.6
	3-B	-150-B	0.86	0.14	0.62	163.28	0.98	28.16	1.84	28.92	3.13	27.962	8.15	2.87	25.4	110.0
	4-S	-125-S	1.02	7.04	2.46	310.40	0.68	23.42	1.70	32.92	2.29	20.822	8.12	3.31	24.9	94.3
	4-B	-125-B	0.88	0.28	2.24	163.50	0.56	21.52	1.44	24.04	3.39	28.044	8.12	3.19	24.8	94.3
	5-S	-100-S	0.88	7.12	2.42	305.26	0.66	22.92	1.54	32.46	2.20	21.087	8.12	2.84	25.1	95.7
	5-B	-100-B	0.46	0.14	0.52	167.52	0.74	20.30	1.20	20.96	2.31	27.735	8.16	2.59	24.7	84.1
	6-S	-75-S	0.72	2.98	1.64	266.76	0.66	21.74	1.38	26.36	1.99	22.728	8.18	2.90	25.4	95.4
	6-B	-75-B	0.42	0.10	0.50	153.72	0.74	18.68	1.16	19.28	1.52	27.998	8.16	2.21	24.4	72.7
	7-S	-50-S	0.72	0.64	1.26	264.14	0.74	25.38	1.46	27.28	2.05	23.035	8.20	3.25	25.5	91.6
	7-B	-50-B	0.46	0.08	1.00	176.84	0.88	21.54	1.34	22.62	1.57	27.195	8.19	2.45	24.5	81.5
	8-S	-25-S	0.60	0.14	1.18	229.94	0.68	21.04	1.28	22.36	2.40	24.280	8.26	2.96	25.8	93.0
	8-B	-25-B	0.46	0.06	0.84	156.34	0.82	22.56	1.28	23.46	2.21	28.041	8.22	2.18	24.9	108.9
	9-S	-10-S	0.68	1.78	1.30	247.78	0.70	22.90	1.38	25.98	2.55	23.831	8.24	3.05	26.0	92.9
	9-B	-10-B	0.40	0.26	1.00	218.96	0.78	20.48	1.18	21.74	1.76	25.091	8.29	3.13	26.1	121.5
	10-S	-1	0.50	0.32	1.24	228.10	0.72	22.28	1.22	23.84	1.41	24.565	8.28	3.55	26.1	94.0
OCEAN	11-S	10-S	0.08	1.67	0.01	39.74	0.41	7.49	0.49	9.17	0.19	33.191	8.20	0.12	25.6	101.3
	12-S	10-B	0.19	0.51	0.06	20.15	0.39	6.78	0.58	7.35	0.27	34.013	8.23	0.18	25.3	100.6
	13-S	25-S	0.24	4.73	0.01	60.04	0.43	6.50	0.67	11.24	0.30	32.297	8.25	0.08	25.9	100.4
	14-S	25-B	0.17	0.48	0.03	6.29	0.40	5.01	0.57	5.52	0.18	34.655	8.17	0.10	24.9	99.9
	15-S	75-S	0.20	1.64	0.06	25.36	0.30	4.75	0.50	6.45	0.12	33.999	8.17	0.08	24.8	100.2
	15-B	75-B	0.17	0.25	0.07	4.99	0.32	4.88	0.49	5.20	0.05	34.728	8.11	0.06	24.8	98.4
	16-S	100-S	0.15	1.56	0.09	25.60	0.31	5.14	0.46	6.79	0.14	33.998	8.15	0.10	24.7	99.2
	16-B	100-B	0.16	0.26	0.10	5.30	0.31	5.68	0.47	6.04	0.06	34.707	8.11	0.05	24.8	101.0
	17-S	200-S	0.20	0.49	0.07	9.89	0.29	6.59	0.49	7.15	0.09	34.516	8.11	0.08	24.8	100.3
	17-B	200-B	0.19	0.03	0.10	2.57	0.26	7.06	0.45	7.19	0.06	34.843	8.12	0.05	24.7	99.4
	18-S	300-S	0.19	0.81	0.08	6.92	0.27	12.03	0.46	12.92	0.11	34.590	8.12	0.06	24.9	101.2
	18-B	300-B	0.13	0.02	0.03	2.80	0.29	6.60	0.42	6.65	0.07	34.819	8.12	0.04	24.7	100.5

TABLE 1-A. Results of water chemistry measurements in Aimakapa Pond and the coastal ocean directly off of the ponds collected in February 23, 2012. "S" indicates surface sample; "B" indicates bottom sample. "DFS" indicates "distance from shore";negative values indicate distance inland from the beach berm; positive values indicate distance seaward from the beach berm. Nutrient concentrations are shown in units of micrograms per liter (µg/L). For station sampling locations, see Figure 1.

	SAMPLING STATION	DFS (m)	PO_4^{3-} (µg/L)	NO_3^- (µg/L)	NH_4^+ (µg/L)	Si (µg/L)	TOP (µg/L)	TON (µg/L)	TP (µg/L)	TN (µg/L)	Turb (ntu)	Salt (o/oo)	pH (rel)	Chl-a (µg/l)	TEMP (deg C)	O2 (%sat)
AIMAKAPA POND	1-S	-230-S	40.30	185.36	50.68	13879	38.44	484.40	78.74	720.44	1.67	12.097	7.91	0.76	24.3	100.9
	1-B	-230-B	47.12	144.20	35.00	13884	38.44	478.80	85.56	658.00	1.90	12.152	8.01	1.08	24.4	91.0
	2-S	-205-S	47.12	155.12	32.20	13413	34.10	395.64	81.22	582.96	1.52	12.074	8.02	0.80	24.5	102.0
	2-B	-205-B	44.64	128.80	35.84	13476	42.78	502.88	87.42	667.52	1.77	12.115	8.07	1.68	24.4	107.8
	3-S	-190-S	44.02	127.68	52.36	13666	39.06	460.88	83.08	640.92	2.08	12.155	8.18	1.21	24.3	99.9
	3-B	-190-B	35.96	8.40	49.28	13267	44.02	516.88	79.98	574.56	2.21	12.422	8.22	2.14	24.3	98.3
	4-S	-170-S	31.62	6.44	63.28	13313	43.40	518.56	75.02	588.28	2.11	12.322	8.20	1.28	24.2	99.9
	4-B	-170-B	35.96	11.20	53.20	13471	45.88	551.88	81.84	616.28	1.86	12.343	8.12	1.76	24.3	104.7
	5-S	-150-S	41.54	46.48	50.68	13602	39.06	483.84	80.60	581.00	2.48	12.345	8.10	1.26	23.9	99.6
	5-B	-150-B	45.26	67.48	49.84	13423	40.92	476.00	86.18	593.32	2.11	12.712	8.07	1.65	24.0	101.5
	6-S	-130-S	33.48	1.12	18.48	13414	42.16	558.88	75.64	578.48	2.67	12.507	8.23	1.67	23.8	100.1
	6-B	-130-B	24.80	0.84	16.52	13187	39.06	509.88	63.86	527.24	2.73	12.512	8.21	3.93	24.2	86.9
	7-S	-110-S	31.62	1.96	20.16	13316	42.16	558.60	73.78	580.72	2.61	12.535	8.25	1.31	24.0	99.9
	7-B	-110-B	27.28	0.84	19.88	13408	40.30	536.48	67.58	557.20	2.51	12.525	8.19	1.10	24.0	101.0
	8-S	-80-S	31.62	1.12	17.08	13235	39.68	538.16	71.30	556.36	2.70	12.605	8.26	1.37	24.0	99.7
	8-B	-80-B	29.76	1.12	19.32	13304	37.82	519.40	67.58	539.84	2.93	12.574	8.26	2.26	24.3	99.5
	9-S	-40-S	30.38	1.12	22.40	13240	38.44	529.20	68.82	552.72	2.68	12.686	8.27	1.59	24.2	100.0
	9-B	-40-B	27.28	0.84	15.68	13083	39.68	532.00	66.96	548.52	2.77	12.672	8.26	2.20	24.3	101.7
	10-S	-1-S	29.14	1.12	22.96	13163	36.58	542.08	65.72	566.16	2.53	12.717	8.26	1.75	24.6	100.0
	10-B	-1-B	29.76	0.84	23.52	13314	39.06	549.08	68.82	573.44	2.62	12.720	8.26	1.65	24.8	104.7
OCEAN	11-S	0	11.78	49.28	3.92	2118	7.44	120.68	19.22	173.88	0.46	31.754	8.03	0.36	25.4	102.2
	12-S	1	9.30	49.56	4.20	2164	6.20	113.12	15.50	166.88	0.34	31.585	8.04	0.59	25.0	101.9
	13-S	3	11.16	44.24	2.24	2028	5.58	115.64	16.74	162.12	0.32	31.733	8.05	0.25	24.9	100.4
	14-S	5	9.92	44.24	3.92	1946	7.44	107.24	17.36	155.40	0.37	31.838	8.05	0.58	24.9	99.2
	15-S	10-S	2.48	23.38	0.14	1113	12.71	104.86	15.19	128.38	0.19	33.191	8.20	0.12	24.6	100.6
	15-B	10-B	5.89	7.14	0.84	564	12.09	94.92	17.98	102.90	0.27	34.013	8.23	0.18	24.4	99.3
	16-S	25-S	7.44	66.22	0.14	1681	13.33	91.00	20.77	157.36	0.30	32.297	8.25	0.08	24.3	101.2
	16-B	25-B	5.27	6.72	0.42	176	12.40	70.14	17.67	77.28	0.18	34.655	8.17	0.10	24.2	100.2
	17-S	50-S	7.75	39.20	0.42	1152	12.40	81.62	20.15	121.24	0.26	33.131	8.20	0.08	24.3	102.6
	17-B	50-B	3.72	2.52	0.28	151	13.64	70.56	17.36	73.36	0.18	34.663	8.15	0.14	24.1	100.4
	18-S	75-S	5.58	26.74	0.14	825	12.40	65.10	17.98	91.98	0.27	33.672	8.17	0.07	24.1	99.2
	18-B	75-B	4.65	2.10	0.28	122	12.09	64.68	16.74	67.06	0.12	34.759	8.16	0.10	24.1	101.0
	19-S	100-S	8.06	23.94	0.42	282	11.16	57.12	19.22	81.48	0.08	34.491	8.13	0.07	23.8	100.3
	19-B	100-B	5.58	8.26	0.42	164	10.23	93.24	15.81	101.92	0.11	34.644	8.16	0.07	24.0	100.5
	20-S	200-S	5.89	17.08	0.56	191	10.23	83.72	16.12	101.36	0.06	34.554	8.12	0.04	23.9	101.2
	20-B	200-B	5.27	1.40	0.98	94	9.92	77.14	15.19	79.52	0.06	34.613	8.12	0.05	23.7	98.2
	21-S	300-S	4.65	1.26	0.56	47	11.16	79.52	15.81	81.34	0.04	34.738	8.12	0.04	23.6	99.2
	21-B	300-B	4.65	0.42	0.56	46	9.61	78.82	14.26	79.80	0.04	34.869	8.13	0.03	23.4	98.3
ANCHIALINE POOLS	119		73.16	854.28	8.40	12815	0.93	41.16	74.09	903.84	0.10	14.568	7.56	0.35		
	123		92.38	773.92	65.24	12529	6.82	336.56	99.20	1175.72	0.80	8.360	7.66	1.73		
	96		80.60	738.64	9.52	12041	0.62	92.12	81.22	840.28	0.26	14.861	7.58	0.40		

TABLE 3. Results of water chemistry measurements in Aimakapa and Kaloko Ponds collected in November 19, 2012. "S" indicates surface sample; "B" indicates bottom sample. "DFS" indicates "distance from shore";negative values indicate distance inland from the beach berm; positive values indicate distance seaward from the beach berm. Nutrient concentrations are shown in micromolar units.For station sampling locations, see Figure 1.

	SAMPLING STATION	DFS (m)	PO_4^{3-} (µM)	NO_3^- (µM)	NH_4^+ (µM)	Si (µM)	TOP (µM)	TON (µM)	TP (µM)	TN (µM)	Turb (ntu)	Salt (o/oo)	pH (rel)	Chl-a (µg/l)	TEMP (deg C)	O2 (%sat)
AIMAKAPA POND	1-S	-230-S	3.20	47.34	6.56	530.10	0.50	17.50	3.70	71.40	0.37	11.669	7.60	0.13	25.7	99.3
	1-B	-230-B	3.70	49.16	0.60	529.76	0.22	13.52	3.92	63.28	0.34	11.673	7.60	0.12	25.1	62.4
	2-S	-205-S	3.98	50.48	0.08	544.62	0.18	9.36	4.16	59.92	0.20	11.547	7.54	0.12	24.5	96.7
	2-B	-205-B	3.50	33.28	4.88	541.14	0.68	18.10	4.18	56.26	0.97	12.101	7.76	0.49	24.9	93.1
	3-S	-190-S	4.14	39.88	3.48	537.16	0.22	13.56	4.36	56.92	0.38	11.666	7.52	0.25	24.6	102.7
	3-B	-190-B	3.50	27.12	6.88	546.94	0.90	26.90	4.40	60.90	1.66	12.111	7.86	0.74	25.0	110.0
	4-S	-170-S	3.82	35.42	3.72	540.50	0.26	16.62	4.08	55.76	0.79	11.907	7.63	0.37	24.8	106.3
	4-B	-170-B	2.94	12.72	12.68	550.56	1.10	30.76	4.04	56.16	2.58	12.476	8.02	1.17	24.6	136.7
	5-S	-150-S	2.36	0.90	11.48	554.62	1.92	49.78	4.28	62.16	4.70	12.853	8.27	1.24	24.9	100.4
	5-B	-150-B	2.40	0.44	9.08	556.22	2.08	58.00	4.48	67.52	4.89	12.857	8.29	1.69	24.6	103.1
	6-S	-130-S	2.42	0.24	18.28	557.50	1.70	42.80	4.12	61.32	4.07	12.751	8.28	1.34	24.9	100.0
	6-B	-130-B	2.30	0.20	11.72	553.80	2.10	51.60	4.40	63.52	4.42	12.807	8.30	1.44	24.3	82.7
	7-S	-110-S	2.16	0.34	9.24	550.72	2.40	61.16	4.56	70.74	4.85	12.798	8.38	1.48	25.0	113.9
	7-B	-110-B	2.08	0.16	7.96	551.28	2.04	54.22	4.12	62.34	5.06	12.822	8.38	1.26	24.3	100.6
	8-S	-80-S	2.18	0.78	10.24	558.46	2.10	53.66	4.28	64.68	4.70	12.851	8.32	1.41	24.8	98.9
	8-B	-80-B	2.08	0.46	10.60	553.84	1.84	55.02	3.92	66.08	4.92	12.853	8.33	1.55	24.3	81.9
	9-S	-40-S	2.20	0.32	10.76	546.58	1.98	62.46	4.18	73.54	4.22	12.751	8.36	1.43	25.6	118.0
	9-B	-40-B	2.00	0.50	5.56	555.42	1.86	62.84	3.86	68.90	4.79	12.834	8.40	1.74	24.4	127.5
	10-S	-1-S	2.24	0.62	4.28	545.60	1.74	64.08	3.98	68.98	4.85	12.869	8.40	1.40	25.2	117.5
	10-B	-1-B	2.14	0.24	6.68	547.52	1.90	61.98	4.04	68.90	5.43	12.862	8.43	1.65	25.0	120.2
KALOKO POND	1-S	-200-S	3.28	47.32	1.80	475.04	0.14	10.68	3.42	59.80	0.83	14.848	7.73	1.49	21.7	96.8
	1-B	-200-B	3.06	41.00	3.20	436.28	0.02	10.96	3.08	55.16	1.40	16.233	7.84	2.37	26.0	148.4
	2-S	-175-S	2.54	33.14	4.32	411.88	0.16	11.78	2.70	49.24	1.20	17.601	7.95	2.21	23.7	96.5
	2-B	-175-B	1.96	17.02	7.68	337.20	0.32	15.38	2.28	40.08	2.42	20.915	8.19	2.84	26.5	168.6
	3-S	-150-S	1.74	15.92	6.60	354.50	0.34	18.06	2.08	40.58	1.72	20.160	8.18	2.48	24.7	94.2
	3-B	-150-B	1.30	4.30	7.36	274.40	0.62	23.44	1.92	35.10	1.87	23.650	8.32	3.39	26.2	142.1
	4-S	-125-S	1.42	4.22	10.52	302.82	0.64	19.12	2.06	33.86	1.98	22.339	8.32	3.40	25.3	92.3
	4-B	-125-B	0.94	0.88	6.76	243.98	0.76	18.68	1.70	26.32	2.03	24.795	8.38	3.29	25.9	77.6
	5-S	-100-S	1.04	0.50	9.04	268.58	0.72	21.36	1.76	30.90	1.26	23.615	8.38	3.42	25.5	93.1
	5-B	-100-B	0.74	0.60	6.56	223.40	0.90	20.16	1.64	27.32	2.94	25.631	8.39	3.14	25.9	106.9
	6-S	-75-S	0.94	0.32	9.60	258.60	0.66	17.92	1.60	27.84	4.33	23.916	8.38	3.23	25.6	98.9
	6-B	-75-B	1.06	0.44	11.60	263.18	0.64	16.82	1.70	28.86	2.13	23.950	8.38	3.35	26.1	122.8
	7-S	-50-S	0.84	0.18	8.84	255.80	0.74	17.08	1.58	26.10	2.84	24.158	8.38	3.23	25.7	97.3
	7-B	-50-B	0.76	0.10	7.16	218.64	0.74	17.18	1.50	24.44	2.69	25.910	8.39	2.81	26.0	115.0
	8-S	-25-S	0.96	0.38	8.96	249.68	0.60	17.52	1.56	26.86	2.26	24.447	8.39	3.08	25.7	93.7
	8-B	-25-B	0.64	0.10	7.28	241.78	0.68	18.22	1.32	25.60	2.76	24.942	8.39	3.06	26.0	116.2
	9-S	-10-S	0.90	0.08	7.48	244.00	0.76	20.70	1.66	28.26	2.40	24.741	8.39	3.41	25.7	92.5
	9-B	-10-B	0.78	0.06	7.36	212.16	0.74	21.64	1.52	29.06	2.08	26.160	8.38	2.85	26.2	111.1
	10-S	-1-S	0.90	0.10	7.32	242.40	0.72	20.00	1.62	27.42	2.06	24.662	8.41	3.29	25.8	94.4
	10-B	-1-B	0.62	0.06	5.60	214.94	0.76	17.58	1.38	23.24	2.09	25.989	8.40	2.94	26.0	111.3

TABLE 2-A. Results of water chemistry measurements in Kaloko Pond and the coastal ocean directly off of the ponds collected in February 23, 2012. "S" indicates surface sample; "B" indicates bottom sample. "DFS" indicates "distance from shore";negative values indicate distance inland from the beach berm; positive values indicate distance seaward from the beach berm. Nutrient concentrations are shown in units of micrograms per liter (µg/L). For station sampling locations, see Figure 1.

	SAMPLING STATION	DFS (m)	PO_4^{3-} (µg/L)	NO_3^- (µg/L)	NH_4^+ (µg/L)	Si (µg/L)	TOP (µg/L)	TON (µg/L)	TP (µg/L)	TN (µg/L)	Turb (ntu)	Salt (o/oo)	pH (rel)	Chl-a (µg/l)	TEMP (deg. C)	O2 (%sat)
KALOKO POND	1-S	-200-S	31.62	99.12	31.08	8956	22.32	352.24	53.94	482.44	1.88	20.240	8.12	3.67	24.7	97.9
	2-S	-175-S	27.90	112.00	44.24	8889	21.70	355.88	49.60	512.12	2.66	20.319	8.10	2.94	24.5	93.5
	2-B	-175-B	47.12	2.80	9.24	4708	33.48	464.24	80.60	476.28	5.72	27.519	8.22	4.43	25.7	114.7
	3-S	-150-S	32.24	88.20	35.56	8568	26.04	361.48	58.28	485.24	2.67	21.005	8.12	3.28	24.8	94.6
	3-B	-150-B	26.66	1.96	8.68	4572	30.38	394.24	57.04	404.88	3.13	27.962	8.15	2.87	25.4	110.0
	4-S	-125-S	31.62	98.56	34.44	8691	21.08	327.88	52.70	460.88	2.29	20.822	8.12	3.31	24.9	94.3
	4-B	-125-B	27.28	3.92	31.36	4578	17.36	301.28	44.64	336.56	3.39	28.044	8.12	3.19	24.8	94.3
	5-S	-100-S	27.28	99.68	33.88	8547	20.46	320.88	47.74	454.44	2.20	21.087	8.12	2.84	25.1	95.7
	5-B	-100-B	14.26	1.96	7.28	4691	22.94	284.20	37.20	293.44	2.31	27.735	8.16	2.59	24.7	84.1
	6-S	-75-S	22.32	41.72	22.96	7469	20.46	304.36	42.78	369.04	1.99	22.728	8.18	2.90	25.4	95.4
	6-B	-75-B	13.02	1.40	7.00	4304	22.94	261.52	35.96	269.92	1.52	27.998	8.16	2.21	24.4	72.7
	7-S	-50-S	22.32	8.96	17.64	7396	22.94	355.32	45.26	381.92	2.05	23.035	8.20	3.25	25.5	91.6
	7-B	-50-B	14.26	1.12	14.00	4952	27.28	301.56	41.54	316.68	1.57	27.195	8.19	2.45	24.5	81.5
	8-S	-25-S	18.60	1.96	16.52	6438	21.08	294.56	39.68	313.04	2.40	24.280	8.26	2.96	25.8	93.0
	8-B	-25-B	14.26	0.84	11.76	4378	25.42	315.84	39.68	328.44	2.21	28.041	8.22	2.18	24.9	108.9
	9-S	-10-S	21.08	24.92	18.20	6938	21.70	320.60	42.78	363.72	2.55	23.831	8.24	3.05	26.0	92.9
	9-B	-10-B	12.40	3.64	14.00	6131	24.18	286.72	36.58	304.36	1.76	25.091	8.29	3.13	26.1	121.5
	10-S	-1	15.50	4.48	17.36	6387	22.32	311.92	37.82	333.76	1.41	24.565	8.28	3.55	26.1	94.0
OCEAN	11-S	10-S	2.48	23.38	0.14	1113	12.71	104.86	15.19	128.38	0.19	33.191	8.20	0.12	25.6	101.3
	12-S	10-B	5.89	7.14	0.84	564	12.09	94.92	17.98	102.90	0.27	34.013	8.23	0.18	25.3	100.6
	13-S	25-S	7.44	66.22	0.14	1681	13.33	91.00	20.77	157.36	0.30	32.297	8.25	0.08	25.9	100.4
	14-S	25-B	5.27	6.72	0.42	176	12.40	70.14	17.67	77.28	0.18	34.655	8.17	0.10	24.9	99.9
	15-S	75-S	6.20	22.96	0.84	710	9.30	66.50	15.50	90.30	0.12	33.999	8.17	0.08	24.8	100.2
	15-B	75-B	5.27	3.50	0.98	140	9.92	68.32	15.19	72.80	0.05	34.728	8.11	0.06	24.8	98.4
	16-S	100-S	4.65	21.84	1.26	717	9.61	71.96	14.26	95.06	0.14	33.998	8.15	0.10	24.7	99.2
	16-B	100-B	4.96	3.64	1.40	148	9.61	79.52	14.57	84.56	0.06	34.707	8.11	0.05	24.8	101.0
	17-S	200-S	6.20	6.86	0.98	277	8.99	92.26	15.19	100.10	0.09	34.516	8.11	0.08	24.8	100.3
	17-B	200-B	5.89	0.42	1.40	72	8.06	98.84	13.95	100.66	0.06	34.843	8.12	0.05	24.7	99.4
	18-S	300-S	5.89	11.34	1.12	194	8.37	168.42	14.26	180.88	0.11	34.590	8.12	0.06	24.9	101.2
	18-B	300-B	4.03	0.28	0.42	78	8.99	92.40	13.02	93.10	0.07	34.819	8.12	0.04	24.7	100.5

TABLE 4. Results of water chemistry measurements in Aimakapa Pond (top) and Kaloko Pond (bottom) and the coastal ocean directly off of the ponds collected on November 14, 2007. "S" indicates surface sample; "B" indicates bottom sample. "DFS" indicates "distance from shore";negative values indicate distance inland from the beach berm; positive values indicate distance seaward from the beach berm. Nutrient concentrations are shown in micromolar units. "Bdl" stands for "below detection limit."For station sampling locations, see Figure 1.

	SAMPLING STATION	DFS (m)	PO_4^{3-} (µM)	NO_3^- (µM)	NH_4^+ (µM)	Si (µM)	TOP (µM)	TON (µM)	TP (µM)	TN (µM)	Turb (ntu)	Salt (o/oo)	pH (rel)	Chl-a (µg/l)
AIMAKAPA POND	1-S	-230 s	1.85	2.75	2.35	582.20	1.65	50.75	3.50	55.85	0.92	12.673	8.154	7.280
	2-S	-220 s	1.00	0.05	3.40	595.25	1.85	43.65	2.85	47.10	1.07	12.741	8.302	9.28
	3-S	-190 s	1.60	bdl	3.95	597.95	1.90	51.00	3.50	54.95	1.11	12.740	8.394	6.545
	3-B	-190 b	1.45	bdl	3.10	593.75	1.65	51.45	3.10	54.55	1.08	12.710	8.431	6.241
	4-s	-150 s	1.35	0.05	1.30	594.70	2.00	48.00	3.35	49.35	1.05	12.647	8.417	6.409
	5-S	-140 s	0.50	0.10	5.05	592.40	1.70	48.30	2.20	53.45	1.15	12.626	8.422	5.33
	6-S	-120 s	2.05	0.10	9.45	588.25	1.35	40.20	3.40	49.75	1.04	12.639	8.426	6.61
	7-S	-50 s	1.00	0.15	4.65	584.45	2.00	53.80	3.00	58.60	0.94	12.641	8.426	7.24
	8-S	-20 s	1.45	0.15	4.60	582.60	1.75	44.65	3.20	49.40	0.96	12.632	8.410	5.92
	9-S	-1 s	0.45	0.15	2.75	592.90	1.95	45.80	2.40	48.70	1.03	12.681	8.447	6.26
OCEAN	8-S	0	0.28	1.41	0.23	42.23	0.21	8.61	0.49	10.25	1.01	33.507	8.079	0.241
	9-S	1 s	0.31	1.48	0.33	44.39	0.22	9.26	0.53	11.07	0.93	33.364	8.088	0.199
	10-S	3 s	0.22	1.01	0.22	36.67	0.24	9.40	0.46	10.63	0.87	33.717	8.073	0.157
	11-S	10 s	0.24	1.07	0.21	31.73	0.23	9.12	0.47	10.40	1.85	33.916	8.118	0.210
	12-S	20 s	0.18	0.59	0.15	19.98	0.24	8.31	0.42	9.05	0.71	34.306	8.183	0.126
	13-B	50 s	0.15	0.39	0.18	15.37	0.25	8.69	0.40	9.26	0.47	34.448	8.164	0.126
	14-S	100 s	0.19	0.91	0.24	31.57	0.26	8.88	0.45	10.03	0.67	33.815	8.045	0.136
	14-B	100b	0.17	0.39	0.32	16.60	0.40	10.05	0.57	10.76	1.13	34.417	8.062	0.210
	15-S	250 s	0.10	0.37	0.13	26.11	0.27	9.22	0.37	9.72	0.52	34.025	8.100	0.115
	15-B	250 b	0.14	0.26	0.13	21.58	0.25	8.88	0.39	9.27	0.57	34.181	8.105	0.105
	16-S	500 s	0.13	0.12	0.10	16.90	0.23	7.36	0.36	7.58	0.33	34.374	8.028	0.157
	16-B	500b	0.12	bdl	0.41	6.13	0.26	8.21	0.38	8.62	0.26	34.820	8.066	0.168

	SAMPLING STATION	DFS (m)	PO_4^{3-} (µM)	NO_3^- (µM)	NH_4^+ (µM)	Si (µM)	TOP (µM)	TON (µM)	TP (µM)	TN (µM)	Turb (ntu)	Salt (o/oo)	pH (rel)	Chl-a (µg/l)
KALOKO POND	1-S	-200 s	3.20	56.45	0.95	596.05	0.55	25.75	3.75	83.15	0.11	10.765	7.433	0.766
	2-S	-175 s	2.35	50.80	1.25	560.15	0.50	7.80	2.85	59.85	0.08	13.068	7.457	0.283
	3-S	-160 s	1.40	48.45	1.65	546.25	0.70	14.60	2.10	64.70	0.08	14.296	7.467	0.399
	4-S	-140 s	2.30	31.35	0.30	475.25	0.50	18.05	2.80	49.70	0.20	16.455	7.720	2.171
	5-S	-120 s	2.90	45.35	2.20	549.20	0.35	14.20	3.25	61.75	0.18	13.478	7.337	1.259
	6-S	-100 s	2.10	28.00	1.75	458.40	0.90	21.80	3.00	51.55	0.25	17.516	7.689	1.636
	7-S	-80 s	2.05	31.20	0.90	495.50	0.65	19.65	2.70	51.75	0.19	16.450	7.574	0.892
	7-B	-80 b	0.60	0.45	0.55	181.00	1.30	34.00	1.90	35.00	1.47	28.086	8.041	5.549
	8-S	-60 s	1.75	28.55	0.40	485.20	0.75	16.30	2.50	45.25	0.21	16.876	7.610	1.122
	8-B	-60 b	0.70	0.45	4.35	173.60	0.95	31.85	1.65	36.65	0.66	28.635	7.992	3.881
	9-S	-20 s	2.00	25.55	2.40	465.75	0.50	13.70	2.50	41.65	0.50	17.088	7.809	3.892
	9-B	-20 b	0.30	0.35	6.75	171.30	1.10	29.65	1.40	36.75	0.84	28.645	8.063	5.759
	10-S	-10 s	1.55	20.75	4.70	434.80	0.85	26.80	2.40	52.25	0.58	18.284	7.882	4.804
	10-B	-10 b	0.60	0.40	2.85	185.90	1.00	31.35	1.60	34.60	0.39	27.899	8.133	2.392
	11-S	-5 s	1.45	11.75	4.50	367.40	0.65	24.15	2.10	40.40	0.46	21.022	8.060	2.968
	11-B	-5 b	0.95	0.35	2.95	185.15	0.70	26.75	1.65	30.05	0.87	27.755	8.164	1.909
	12-S	-1 s	2.45	40.85	1.85	472.85	0.25	19.75	2.70	62.45	0.12	16.675	8.147	0.996
OCEAN	13-S	1	1.20	11.85	1.40	258.20	0.70	28.85	1.90	42.10	0.28	25.682	8.108	0.462
	14-S	3	1.00	8.35	1.70	237.45	0.80	23.70	1.80	33.75	0.30	26.135	8.135	0.409
	15-S	10	0.59	5.81	0.43	124.43	0.22	9.00	0.81	15.24	0.31	30.081	8.134	0.524
	16-S	20	0.43	4.39	0.41	92.45	0.22	9.41	0.65	14.21	0.23	31.405	8.147	0.378
	17-S	30	0.40	2.90	0.30	63.38	0.20	9.93	0.60	13.13	0.21	32.599	8.142	0.262
	18-S	50 s	0.05	2.39	bdl	57.54	0.27	9.07	0.32	11.46	0.21	32.820	8.141	0.199
	18-B	50 b	0.05	0.38	bdl	9.91	0.27	8.33	0.32	8.71	0.16	34.710	8.103	0.094
	19-S	100 s	0.20	2.34	0.46	56.69	0.28	10.24	0.48	13.04	0.14	32.861	8.127	0.178
	19-B	100 b	0.06	0.27	0.39	7.98	0.26	9.32	0.32	9.98	0.13	34.773	8.107	0.105
	20-S	500 s	0.06	1.45	0.83	35.23	0.32	7.44	0.38	9.72	0.14	33.802	8.120	0.126
	20-B	500 b	0.04	0.37	0.54	10.64	0.30	9.66	0.34	10.57	0.11	34.662	8.122	0.073

TABLE 4-A. Results of water chemistry measurements in Aimakapa Pond (top) and Kaloko Pond (bottom) and the coastal ocean directly off of the ponds collected on November 14, 2007. "S" indicates surface sample; "B" indicates bottom sample. "DFS" indicates "distance from shore";negative values indicate distance inland from the beach berm; positive values indicate distance seaward from the beach berm. Nutrient concentrations are shown in units of micrograms per liter (µg/L)."Bdl" stands for "below detection limit."For station sampling locations, see Figure 1.

	SAMPLING STATION	DFS (m)	PO_4^{3-} (µg/L)	NO_3^- (µg/L)	NH_4^+ (µg/L)	Si (µg/L)	TOP (µg/L)	TON (µg/L)	TP (µg/L)	TN (µg/L)	Turb (ntu)	Salt (o/oo)	pH (rel)	Chl-a (µg/l)
AIMAKAPA POND	1-S	-230 s	57.35	38.50	32.90	16302	51.15	710.50	108.50	781.90	0.92	12.673	8.154	7.280
	2-S	-220 s	31.00	0.70	47.60	16667	57.35	611.10	88.35	659.40	1.07	12.741	8.302	9.28
	3-S	-190 s	49.60	bdl	55.30	16743	58.90	714.00	108.50	769.30	1.11	12.740	8.394	6.545
	3-B	-190 b	44.95	bdl	43.40	16625	51.15	720.30	96.10	763.70	1.08	12.710	8.431	6.241
	4-s	-150 s	41.85	0.70	18.20	16652	62.00	672.00	103.85	690.90	1.05	12.647	8.417	6.409
	5-S	-140 s	15.50	1.40	70.70	16587	52.70	676.20	68.20	748.30	1.15	12.626	8.422	5.33
	6-S	-120 s	63.55	1.40	132.30	16471	41.85	562.80	105.40	696.50	1.04	12.639	8.426	6.61
	7-S	-50 s	31.00	2.10	65.10	16365	62.00	753.20	93.00	820.40	0.94	12.641	8.426	7.24
	8-S	-20 s	44.95	2.10	64.40	16313	54.25	625.10	99.20	691.60	0.96	12.632	8.410	5.92
	9-S	-1 s	13.95	2.10	38.50	16601	60.45	641.20	74.40	681.80	1.03	12.681	8.447	6.26
OCEAN	8-S	0	8.68	19.74	3.22	1182	6.51	120.54	15.19	143.50	1.01	33.507	8.079	0.241
	9-S	1 s	9.61	20.72	4.62	1243	6.82	129.64	16.43	154.98	0.93	33.364	8.088	0.199
	10-S	3 s	6.82	14.14	3.08	1027	7.44	131.60	14.26	148.82	0.87	33.717	8.073	0.157
	11-S	10 s	7.44	14.98	2.94	888	7.13	127.68	14.57	145.60	1.85	33.916	8.118	0.210
	12-S	20 s	5.58	8.26	2.10	559	7.44	116.34	13.02	126.70	0.71	34.306	8.183	0.126
	13-B	50 s	4.65	5.46	2.52	430	7.75	121.66	12.40	129.64	0.47	34.448	8.164	0.126
	14-S	100 s	5.89	12.74	3.36	884	8.06	124.32	13.95	140.42	0.67	33.815	8.045	0.136
	14-B	100b	5.27	5.46	4.48	465	12.40	140.70	17.67	150.64	1.13	34.417	8.062	0.210
	15-S	250 s	3.10	5.18	1.82	731	8.37	129.08	11.47	136.08	0.52	34.025	8.100	0.115
	15-B	250 b	4.34	3.64	1.82	604	7.75	124.32	12.09	129.78	0.57	34.181	8.105	0.105
	16-S	500 s	4.03	1.68	1.40	473	7.13	103.04	11.16	106.12	0.33	34.374	8.028	0.157
	16-B	500b	3.72	0.00	5.74	172	8.06	114.94	11.78	120.68	0.26	34.820	8.066	0.168

	SAMPLING STATION	DFS (m)	PO_4^{3-} (µg/L)	NO_3^- (µg/L)	NH_4^+ (µg/L)	Si (µg/L)	TOP (µg/L)	TON (µg/L)	TP (µg/L)	TN (µg/L)	Turb (ntu)	Salt (o/oo)	pH (rel)	Chl-a (µg/l)
KALOKO POND	1-S	-200 s	99.20	790.30	13.30	16689	17.05	360.50	116.25	1164.10	0.11	10.765	7.433	0.766
	2-S	-175 s	72.85	711.20	17.50	15684	15.50	109.20	88.35	837.90	0.08	13.068	7.457	0.283
	3-S	-160 s	43.40	678.30	23.10	15295	21.70	204.40	65.10	905.80	0.08	14.296	7.467	0.399
	4-S	-140 s	71.30	438.90	4.20	13307	15.50	252.70	86.80	695.80	0.20	16.455	7.720	2.171
	5-S	-120 s	89.90	634.90	30.80	15378	10.85	198.80	100.75	864.50	0.18	13.478	7.337	1.259
	6-S	-100 s	65.10	392.00	24.50	12835	27.90	305.20	93.00	721.70	0.25	17.516	7.689	1.636
	7-S	-80 s	63.55	436.80	12.60	13874	20.15	275.10	83.70	724.50	0.19	16.450	7.574	0.892
	7-B	-80 b	18.60	6.30	7.70	5068	40.30	476.00	58.90	490.00	1.47	28.086	8.041	5.549
	8-S	-60 s	54.25	399.70	5.60	13586	23.25	228.20	77.50	633.50	0.21	16.876	7.610	1.122
	8-B	-60 b	21.70	6.30	60.90	4861	29.45	445.90	51.15	513.10	0.66	28.635	7.992	3.881
	9-S	-20 s	62.00	357.70	33.60	13041	15.50	191.80	77.50	583.10	0.50	17.088	7.809	3.892
	9-B	-20 b	9.30	4.90	94.50	4796	34.10	415.10	43.40	514.50	0.84	28.645	8.063	5.759
	10-S	-10 s	48.05	290.50	65.80	12174	26.35	375.20	74.40	731.50	0.58	18.284	7.882	4.804
	10-B	-10 b	18.60	5.60	39.90	5205	31.00	438.90	49.60	484.40	0.39	27.899	8.133	2.392
	11-S	-5 s	44.95	164.50	63.00	10287	20.15	338.10	65.10	565.60	0.46	21.022	8.060	2.968
	11-B	-5 b	29.45	4.90	41.30	5184	21.70	374.50	51.15	420.70	0.87	27.755	8.164	1.909
	12-S	-1 s	75.95	571.90	25.90	13240	7.75	276.50	83.70	874.30	0.12	16.675	8.147	0.996
OCEAN	13-S	1	37.20	165.90	19.60	7230	21.70	403.90	58.90	589.40	0.28	25.682	8.108	0.462
	14-S	3	31.00	116.90	23.80	6649	24.80	331.80	55.80	472.50	0.30	26.135	8.135	0.409
	15-S	10	18.29	81.34	6.02	3484	6.82	126.00	25.11	213.36	0.31	30.081	8.134	0.524
	16-S	20	13.33	61.46	5.74	2589	6.82	131.74	20.15	198.94	0.23	31.405	8.147	0.378
	17-S	30	12.40	40.60	4.20	1775	6.20	139.02	18.60	183.82	0.21	32.599	8.142	0.262
	18-S	50 s	1.55	33.46	bdl	1611	8.37	126.98	9.92	160.44	0.21	32.820	8.141	0.199
	18-B	50 b	1.55	5.32	bdl	277	8.37	116.62	9.92	121.94	0.16	34.710	8.103	0.094
	19-S	100 s	6.20	32.76	6.44	1587	8.68	143.36	14.88	182.56	0.14	32.861	8.127	0.178
	19-B	100 b	1.86	3.78	5.46	223	8.06	130.48	9.92	139.72	0.13	34.773	8.107	0.105
	20-S	500 s	1.86	20.30	11.62	986	9.92	104.16	11.78	136.08	0.14	33.802	8.120	0.126
	20-B	500 b	1.24	5.18	7.56	298	9.30	135.24	10.54	147.98	0.11	34.662	8.122	0.073

TABLE 5. Results of water chemistry measurements in Aimakapa Pond (top) and Kaloko Pond (bottom) and the coastal ocean directly off of the ponds collected in 2000. "S" indicates surface sample; "B" indicates bottom sample. "DFS" indicates "distance from shore";negative values indicate distance inland from the beach berm; positive values indicate distance seaward from the beach berm. Nutrient concentrations are shown in micromolar units. "Bdl" stands for "below detection limit."For station sampling locations, see Figure 1.

	SAMPLING STATION	DFS (m)	PO_4^{3-} (µM)	NO_3^- (µM)	NH_4^+ (µM)	Si (µM)	TOP (µM)	TON (µM)	TP (µM)	TN (µM)	Turb (ntu)	TSS (mg/l)	Salt (o/oo)	pH (rel)	Chl-a (µg/l)	O2 (%sat)
AIMAKAPA POND	1-S	-230-S	0.51	0.16	bdl	439.57	3.28	79.37	3.79	79.53	4.10	6.00	12.855	8.195	2.815	88.1
	1-B	-230-B	0.55	0.19	0.01	439.23	5.71	129.89	6.26	130.09	13.20	85.60	12.864	8.225	15.57	81.9
	2-S	-190-S	0.64	0.25	0.04	403.45	3.58	102.90	4.22	103.19	6.00	13.20	13.158	8.509	5.064	91.3
	2-B	-190-B	0.63	0.29	0.04	403.48	3.61	102.31	4.24	102.64	6.10	22.71	13.164	8.585	9.021	93.0
	3-S	-150-S	0.63	0.28	0.03	402.61	3.57	102.21	4.20	102.52	6.20	16.00	13.169	8.548	5.203	93.7
	3-B	-150-B	0.63	0.28	0.08	382.35	4.19	117.16	4.82	117.52	36.00	290.2	13.184	8.445	59.33	72.7
	4-S	-110-S	0.65	0.30	0.06	397.99	3.72	107.52	4.37	107.88	6.60	19.80	13.248	8.538	16.28	91.3
	4-B	-110-B	0.66	0.28	0.08	393.74	3.83	108.90	4.49	109.26	20.40	203.0	13.253	8.569	49.26	87.5
	5-S	-80-S	0.67	0.32	0.07	397.31	3.77	106.84	4.44	107.23	6.20	9.87	13.175	8.599	23.45	90.6
	5-B	-80-B	0.77	0.32	0.16	405.77	4.86	135.26	5.63	135.74	24.60	283.0	13.179	8.517	51.82	80.7
	6-S	-40-S	0.66	0.31	0.11	395.68	3.83	108.31	4.49	108.73	6.80	15.40	13.223	8.609	16.87	91.7
	6-B	-40-B	0.67	0.32	0.13	395.74	3.83	107.03	4.50	107.48	7.80	180.4	13.239	8.606	26.52	93.8
	7-S	-1-S	0.64	0.28	0.12	397.33	3.58	102.56	4.22	102.96	6.30	8.93	13.253	8.652	4.699	97.7
	7-B	-1-B	0.64	0.35	0.16	394.13	7.31	175.63	7.95	176.14	28.00	278.3	13.369	8.517	106.4	76.9
OCEAN	8-S	1-S	0.26	1.81	0.09	68.18	0.32	9.49	0.58	11.39	0.40	4.40	32.413	8.112	0.751	96.2
	9-S	3-S	0.24	1.81	0.23	68.66	0.30	9.28	0.54	11.32	0.33	3.27	32.287	8.098	0.323	97.6
	10-S	10-S	0.33	2.80	0.08	80.40	0.27	8.98	0.60	11.86	0.21	2.93	31.733	8.152	0.206	102.6
	10-B	10-B	0.30	2.07	0.12	68.01	0.27	8.69	0.57	10.88	0.30	2.29	32.283	8.107	0.260	98.9
	11-S	25-S	0.24	4.09	0.29	138.35	0.31	9.16	0.55	13.54	0.42	9.40	29.343	8.270	0.239	123.6
	11-B	25-B	0.32	2.19	0.36	93.10	0.42	11.68	0.74	14.23	0.35	11.20	31.032	8.226	0.772	117.2
	12-S	50-S	0.28	2.35	0.23	91.72	0.29	9.09	0.57	11.67	0.25	5.20	31.090	8.207	0.696	114.2
	12-B	50-B	0.22	1.35	0.22	61.10	0.32	9.76	0.54	11.33	0.40	2.47	32.305	8.279	0.273	131.3
	13-S	100-S	0.27	0.99	0.13	48.52	0.29	10.48	0.56	11.60	0.19	2.93	32.755	8.229	0.206	112.4
	13-B	100-B	0.14	0.23	0.22	26.78	0.30	9.10	0.44	9.55	0.27	5.67	33.549	8.234	0.210	110.9
	14-S	150-S	0.19	0.70	0.15	11.80	0.24	6.98	0.43	7.83	0.08	2.87	33.956	8.164	0.089	119.7
	14-B	150-B	0.14	0.30	0.03	3.99	0.31	5.99	0.45	6.32	0.11	3.74	34.178	8.163	0.054	99.8

	SAMPLING STATION	DFS (m)	PO_4^{3-} (µM)	NO_3^- (µM)	NH_4^+ (µM)	Si (µM)	TOP (µM)	TON (µM)	TP (µM)	TN (µM)	Turb (ntu)	TSS (mg/l)	Salt (o/oo)	pH (rel)	Chl-a (µg/l)	O2 (%sat)
KALOKO POND	1-S	-200-S	0.35	0.08	0.04	77.57	0.72	23.17	1.07	23.29	0.70	8.87	32.184	8.327	4.800	94.9
	1-B	-200-B	0.30	0.06	0.13	76.27	0.48	18.03	0.78	18.22	0.80	14.80	32.240	8.349	8.979	96.5
	2-S	-170-S	0.23	0.05	0.18	76.71	0.49	17.18	0.72	17.41	0.69	11.20	32.195	8.351	3.633	97.0
	2-B	-170-B	0.39	0.05	0.25	44.03	0.43	16.70	0.82	17.00	0.72	10.80	33.513	8.351	7.951	97.7
	3-S	-140-S	0.24	0.04	0.17	66.69	0.45	17.33	0.69	17.54	0.62	8.20	32.618	8.360	3.143	96.4
	3-B	-140-B	0.35	0.06	0.21	45.37	0.47	16.70	0.82	16.97	0.66	10.80	33.409	8.361	2.903	98.5
	4-S	-110-S	0.24	0.06	0.15	60.35	0.49	17.16	0.73	17.37	0.58	8.93	32.841	8.365	2.941	98.7
	4-B	-110-B	0.31	0.05	0.54	40.77	0.42	15.56	0.73	16.15	0.63	11.86	33.595	8.342	2.530	94.5
	5-S	-80-S	0.21	0.03	0.13	59.51	0.52	17.62	0.73	17.78	0.61	7.60	32.889	8.360	2.618	99.3
	5-B	-80-B	0.36	0.04	0.18	37.85	0.53	18.25	0.89	18.47	0.59	7.27	33.736	8.297	2.736	82.6
	6-S	-50-S	0.28	0.04	0.15	59.68	0.46	17.71	0.74	17.90	0.56	9.40	32.926	8.355	2.564	97.9
	6-B	-50-B	0.26	0.06	0.18	44.48	0.51	16.76	0.77	17.00	0.62	12.40	33.477	8.341	4.116	93.4
	7-S	-20-S	0.24	0.07	0.31	56.38	0.55	17.06	0.79	17.44	0.53	5.80	33.034	8.361	2.316	95.0
	7-B	-20-B	0.30	0.03	0.18	51.81	0.45	15.53	0.75	15.74	0.56	8.93	33.233	8.356	2.622	96.4
	8-S	-1-S	0.23	0.09	0.19	52.00	0.51	18.46	0.74	18.74	0.58	8.40	33.213	8.351	3.415	93.8
	8-B	-1-B	0.23	0.26	0.38	50.39	0.48	16.57	0.71	17.21	0.54	6.47	33.277	8.335	3.176	91.8
OCEAN	9-S	1-S	0.37	3.04	0.40	62.65	0.37	14.27	0.74	17.71	0.31	14.20	32.418	8.408	7.636	94.3
	10-S	3-S	0.33	3.39	0.57	66.43	0.24	9.25	0.57	13.21	0.28	4.80	32.401	8.377	0.885	98.3
	11-S	10-S	0.34	3.67	0.62	66.57	0.25	9.12	0.59	13.41	0.38	2.93	32.418	8.355	0.730	95.9
	12-S	25-S	0.31	5.88	0.25	115.18	0.29	8.66	0.60	14.79	0.19	4.27	30.685	8.333	0.331	115.6
	12-B	25-B	0.73	5.64	0.53	108.98	0.34	19.95	1.07	26.12	0.17	2.80	30.918	8.336	0.470	124.4
	13-S	50-S	0.30	4.13	0.25	83.02	0.29	9.26	0.59	13.64	0.20	3.20	31.791	8.298	0.466	119.1
	13-B	50-B	0.25	3.15	0.20	25.43	0.30	8.15	0.50	11.46	0.14	2.90	32.538	8.289	0.387	117.3
	14-S	100-S	0.17	2.10	0.18	47.33	0.30	7.95	0.47	10.23	0.12	1.80	33.107	8.260	0.277	111.3
	14-B	100-B	0.15	0.48	0.15	12.20	0.30	8.07	0.45	8.70	0.13	1.67	34.298	8.238	0.239	108.8
	15-S	150-S	0.15	0.77	0.13	14.51	0.27	6.36	0.42	7.26	0.13	1.98	33.798	8.180	0.096	112.0
	15-B	150-B	0.11	0.19	0.08	3.87	0.26	6.34	0.37	6.61	0.05	1.78	34.183	8.160	0.075	109.4

TABLE 3-A. Results of water chemistry measurements in Aimakapa and Kaloko Ponds collected in November 19, 2012. "S" indicates surface sample; "B" indicates bottom sample. "DFS" indicates "distance from shore";negative values indicate distance inland from the beach berm; positive values indicate distance seaward from the beach berm. Nutrient concentrations are shown in units of micrograms per liter (µg/L). For station sampling locations, see Figure 1.

	SAMPLING STATION	DFS (m)	PO_4^{3-} (µg/L)	NO_3^- (µg/L)	NH_4^+ (µg/L)	Si (µg/L)	TOP (µg/L)	TON (µg/L)	TP (µg/L)	TN (µg/L)	Turb (ntu)	Salt (o/oo)	pH (rel)	Chl-a (µg/l)	TEMP (deg C)	O2 (%sat)
AIMAKAPA POND	1-S	-230-S	99.20	662.76	91.84	14843	15.50	245.00	114.70	999.60	0.37	11.669	7.60	0.13	25.7	99.3
	1-B	-230-B	114.70	688.24	8.40	14833	6.82	189.28	121.52	885.92	0.34	11.673	7.60	0.12	25.1	62.4
	2-S	-205-S	123.38	706.72	1.12	15249	5.58	131.04	128.96	838.88	0.20	11.547	7.54	0.12	24.5	96.7
	2-B	-205-B	108.50	465.92	68.32	15152	21.08	253.40	129.58	787.64	0.97	12.101	7.76	0.49	24.9	93.1
	3-S	-190-S	128.34	558.32	48.72	15040	6.82	189.84	135.16	796.88	0.38	11.666	7.52	0.25	24.6	102.7
	3-B	-190-B	108.50	379.68	96.32	15314	27.90	376.60	136.40	852.60	1.66	12.111	7.86	0.74	25.0	110.0
	4-S	-170-S	118.42	495.88	52.08	15134	8.06	232.68	126.48	780.64	0.79	11.907	7.63	0.37	24.8	106.3
	4-B	-170-B	91.14	178.08	177.52	15416	34.10	430.64	125.24	786.24	2.58	12.476	8.02	1.17	24.6	136.7
	5-S	-150-S	73.16	12.60	160.72	15529	59.52	696.92	132.68	870.24	4.70	12.853	8.27	1.24	24.9	100.4
	5-B	-150-B	74.40	6.16	127.12	15574	64.48	812.00	138.88	945.28	4.89	12.857	8.29	1.69	24.6	103.1
	6-S	-130-S	75.02	3.36	255.92	15610	52.70	599.20	127.72	858.48	4.07	12.751	8.28	1.34	24.9	100.0
	6-B	-130-B	71.30	2.80	164.08	15506	65.10	722.40	136.40	889.28	4.42	12.807	8.30	1.44	24.3	82.7
	7-S	-110-S	66.96	4.76	129.36	15420	74.40	856.24	141.36	990.36	4.85	12.798	8.38	1.48	25.0	113.9
	7-B	-110-B	64.48	2.24	111.44	15436	63.24	759.08	127.72	872.76	5.06	12.822	8.38	1.26	24.3	100.6
	8-S	-80-S	67.58	10.92	143.36	15637	65.10	751.24	132.68	905.52	4.70	12.851	8.32	1.41	24.8	98.9
	8-B	-80-B	64.48	6.44	148.40	15508	57.04	770.28	121.52	925.12	4.92	12.853	8.33	1.55	24.3	81.9
	9-S	-40-S	68.20	4.48	150.64	15304	61.38	874.44	129.58	1029.56	4.22	12.751	8.36	1.43	25.6	118.0
	9-B	-40-B	62.00	7.00	77.84	15552	57.66	879.76	119.66	964.60	4.79	12.834	8.40	1.74	24.4	127.5
	10-S	-1-S	69.44	8.68	59.92	15277	53.94	897.12	123.38	965.72	4.85	12.869	8.40	1.40	25.2	117.5
	10-B	-1-B	66.34	3.36	93.52	15331	58.90	867.72	125.24	964.60	5.43	12.862	8.43	1.65	25.0	120.2
KALOKO POND	1-S	-200-S	101.68	662.48	25.20	13301	4.34	149.52	106.02	837.20	0.83	14.848	7.73	1.49	21.7	96.8
	1-B	-200-B	94.86	574.00	44.80	12216	0.62	153.44	95.48	772.24	1.40	16.233	7.84	2.37	26.0	148.4
	2-S	-175-S	78.74	463.96	60.48	11533	4.96	164.92	83.70	689.36	1.20	17.601	7.95	2.21	23.7	96.5
	2-B	-175-B	60.76	238.28	107.52	9442	9.92	215.32	70.68	561.12	2.42	20.915	8.19	2.84	26.5	168.6
	3-S	-150-S	53.94	222.88	92.40	9926	10.54	252.84	64.48	568.12	1.72	20.160	8.18	2.48	24.7	94.2
	3-B	-150-B	40.30	60.20	103.04	7683	19.22	328.16	59.52	491.40	1.87	23.650	8.32	3.39	26.2	142.1
	4-S	-125-S	44.02	59.08	147.28	8479	19.84	267.68	63.86	474.04	1.98	22.339	8.32	3.40	25.3	92.3
	4-B	-125-B	29.14	12.32	94.64	6831	23.56	261.52	52.70	368.48	2.03	24.795	8.38	3.29	25.9	77.6
	5-S	-100-S	32.24	7.00	126.56	7520	22.32	299.04	54.56	432.60	1.26	23.615	8.38	3.42	25.5	93.1
	5-B	-100-B	22.94	8.40	91.84	6255	27.90	282.24	50.84	382.48	2.94	25.631	8.39	3.14	25.9	106.9
	6-S	-75-S	29.14	4.48	134.40	7241	20.46	250.88	49.60	389.76	4.33	23.916	8.38	3.23	25.6	98.9
	6-B	-75-B	32.86	6.16	162.40	7369	19.84	235.48	52.70	404.04	2.13	23.950	8.38	3.35	26.1	122.8
	7-S	-50-S	26.04	2.52	123.76	7162	22.94	239.12	48.98	365.40	2.84	24.158	8.38	3.23	25.7	97.3
	7-B	-50-B	23.56	1.40	100.24	6122	22.94	240.52	46.50	342.16	2.69	25.910	8.39	2.81	26.0	115.0
	8-S	-25-S	29.76	5.32	125.44	6991	18.60	245.28	48.36	376.04	2.26	24.447	8.39	3.08	25.7	93.7
	8-B	-25-B	19.84	1.40	101.92	6770	21.08	255.08	40.92	358.40	2.76	24.942	8.39	3.06	26.0	116.2
	9-S	-10-S	27.90	1.12	104.72	6832	23.56	289.80	51.46	395.64	2.40	24.741	8.39	3.41	25.7	92.5
	9-B	-10-B	24.18	0.84	103.04	5940	22.94	302.96	47.12	406.84	2.08	26.160	8.38	2.85	26.2	111.1
	10-S	-1-S	27.90	1.40	102.48	6787	22.32	280.00	50.22	383.88	2.06	24.662	8.41	3.29	25.8	94.4
	10-B	-1-B	19.22	0.84	78.40	6018	23.56	246.12	42.78	325.36	2.09	25.989	8.40	2.94	26.0	111.3

TABLE 5-A. Results of water chemistry measurements in Aimakapa Pond (top) and Kaloko Pond (bottom) and the coastal ocean directly off of the ponds collected in 2000. "S" indicates surface sample; "B" indicates bottom sample. "DFS" indicates "distance from shore";negative values indicate distance inland from the beach berm; positive values indicate distance seaward from the beach berm. Nutrient concentrations are shown in units of micrograms per liter (µg/L). "Bdl" stands for "below detection limit."For station sampling locations, see Figure 1.

	SAMPLING STATION	DFS (m)	PO_4^{3-} (µg/L)	NO_3^- (µg/L)	NH_4^+ (µg/L)	Si (µg/L)	TOP (µg/L)	TON (µg/L)	TP (µg/L)	TN (µg/L)	Turb (ntu)	TSS (mg/l)	Salt (o/oo)	pH (rel)	Chl-a (µg/l)	O2 (%sat)
AIMAKAPA POND	1-S	-230-S	15.81	2.24	bdl	12308	101.68	1111.18	117.49	1113.42	4.10	6.00	12.855	8.195	2.815	88.1
	1-B	-230-B	17.05	2.66	0.14	12298	177.01	1818.46	194.06	1821.26	13.20	85.60	12.864	8.225	15.57	81.9
	2-S	-190-S	19.84	3.50	0.56	11297	110.98	1440.60	130.82	1444.66	6.00	13.20	13.158	8.509	5.064	91.3
	2-B	-190-B	19.53	4.06	0.56	11297	111.91	1432.34	131.44	1436.96	6.10	22.71	13.164	8.585	9.021	93.0
	3-S	-150-S	19.53	3.92	0.42	11273	110.67	1430.94	130.20	1435.28	6.20	16.00	13.169	8.548	5.203	93.7
	3-B	-150-B	19.53	3.92	1.12	10706	129.89	1640.24	149.42	1645.28	36.00	290.2	13.184	8.445	59.33	72.7
	4-S	-110-S	20.15	4.20	0.84	11144	115.32	1505.28	135.47	1510.32	6.60	19.80	13.248	8.538	16.28	91.3
	4-B	-110-B	20.46	3.92	1.12	11025	118.73	1524.60	139.19	1529.64	20.40	203.0	13.253	8.569	49.26	87.5
	5-S	-80-S	20.77	4.48	0.98	11125	116.87	1495.76	137.64	1501.22	6.20	9.87	13.175	8.599	23.45	90.6
	5-B	-80-B	23.87	4.48	2.24	11362	150.66	1893.64	174.53	1900.36	24.60	283.0	13.179	8.517	51.82	80.7
	6-S	-40-S	20.46	4.34	1.54	11079	118.73	1516.34	139.19	1522.22	6.80	15.40	13.223	8.609	16.87	91.7
	6-B	-40-B	20.77	4.48	1.82	11081	118.73	1498.42	139.50	1504.72	7.80	180.4	13.239	8.606	26.52	93.8
	7-S	-1-S	19.84	3.92	1.68	11125	110.98	1435.84	130.82	1441.44	6.30	8.93	13.253	8.652	4.699	97.7
	7-B	-1-B	19.84	4.90	2.24	11036	226.61	2458.82	246.45	2465.96	28.00	278.3	13.369	8.517	106.4	76.9
OCEAN	8-S	1-S	8.06	25.34	1.26	1909	9.92	132.86	17.98	159.46	0.40	4.40	32.413	8.112	0.751	96.2
	9-S	3-S	7.44	25.34	3.22	1922	9.30	129.92	16.74	158.48	0.33	3.27	32.287	8.098	0.323	97.6
	10-S	10-S	10.23	39.20	1.12	2251	8.37	125.72	18.60	166.04	0.21	2.93	31.733	8.152	0.206	102.6
	10-B	10-B	9.30	28.98	1.68	1904	8.37	121.66	17.67	152.32	0.30	2.29	32.283	8.107	0.260	98.9
	11-S	25-S	7.44	57.26	4.06	3874	9.61	128.24	17.05	189.56	0.42	9.40	29.343	8.270	0.239	123.6
	11-B	25-B	9.92	30.66	5.04	2607	13.02	163.52	22.94	199.22	0.35	11.20	31.032	8.226	0.772	117.2
	12-S	50-S	8.68	32.90	3.22	2568	8.99	127.26	17.67	163.38	0.25	5.20	31.090	8.207	0.696	114.2
	12-B	50-B	6.82	18.90	3.08	1711	9.92	136.64	16.74	158.62	0.40	2.47	32.305	8.279	0.273	131.3
	13-S	100-S	8.37	13.86	1.82	1359	8.99	146.72	17.36	162.40	0.19	2.93	32.755	8.229	0.206	112.4
	13-B	100-B	4.34	3.22	3.08	750	9.30	127.40	13.64	133.70	0.27	5.67	33.549	8.234	0.210	110.9
	14-S	150-S	5.89	9.80	2.10	330	7.44	97.72	13.33	109.62	0.08	2.87	33.956	8.164	0.089	119.7
	14-B	150-B	4.34	4.20	0.42	112	9.61	83.86	13.95	88.48	0.11	3.74	34.178	8.163	0.054	99.8

	SAMPLING STATION	DFS (m)	PO_4^{3-} (µg/L)	NO_3^- (µg/L)	NH_4^+ (µg/L)	Si (µg/L)	TOP (µg/L)	TON (µg/L)	TP (µg/L)	TN (µg/L)	Turb (ntu)	TSS (mg/l)	Salt (o/oo)	pH (rel)	Chl-a (µg/l)	O2 (%sat)
KALOKO POND	1-S	-200-S	10.85	1.12	0.56	2172	22.32	324.38	33.17	326.06	0.70	8.87	32.184	8.327	4.800	94.9
	1-B	-200-B	9.30	0.84	1.82	2136	14.88	252.42	24.18	255.08	0.80	14.80	32.240	8.349	8.979	96.5
	2-S	-170-S	7.13	0.70	2.52	2148	15.19	240.52	22.32	243.74	0.69	11.20	32.195	8.351	3.633	97.0
	2-B	-170-B	12.09	0.70	3.50	1233	13.33	233.80	25.42	238.00	0.72	10.80	33.513	8.351	7.951	97.7
	3-S	-140-S	7.44	0.56	2.38	1867	13.95	242.62	21.39	245.56	0.62	8.20	32.618	8.360	3.143	96.4
	3-B	-140-B	10.85	0.84	2.94	1270	14.57	233.80	25.42	237.58	0.66	10.80	33.409	8.361	2.903	98.5
	4-S	-110-S	7.44	0.84	2.10	1690	15.19	240.24	22.63	243.18	0.58	8.93	32.841	8.365	2.941	98.7
	4-B	-110-B	9.61	0.70	7.56	1142	13.02	217.84	22.63	226.10	0.63	11.86	33.595	8.342	2.530	94.5
	5-S	-80-S	6.51	0.42	1.82	1666	16.12	246.68	22.63	248.92	0.61	7.60	32.889	8.360	2.618	99.3
	5-B	-80-B	11.16	0.56	2.52	1060	16.43	255.50	27.59	258.58	0.59	7.27	33.736	8.297	2.736	82.6
	6-S	-50-S	8.68	0.56	2.10	1671	14.26	247.94	22.94	250.60	0.56	9.40	32.926	8.355	2.564	97.9
	6-B	-50-B	8.06	0.84	2.52	1245	15.81	234.64	23.87	238.00	0.62	12.40	33.477	8.341	4.116	93.4
	7-S	-20-S	7.44	0.98	4.34	1579	17.05	238.84	24.49	244.16	0.53	5.80	33.034	8.361	2.316	95.0
	7-B	-20-B	9.30	0.42	2.52	1451	13.95	217.42	23.25	220.36	0.56	8.93	33.233	8.356	2.622	96.4
	8-S	-1-S	7.13	1.26	2.66	1456	15.81	258.44	22.94	262.36	0.58	8.40	33.213	8.351	3.415	93.8
	8-B	-1-B	7.13	3.64	5.32	1411	14.88	231.98	22.01	240.94	0.54	6.47	33.277	8.335	3.176	91.8
OCEAN	9-S	1-S	11.47	42.56	5.60	1754	11.47	199.78	22.94	247.94	0.31	14.20	32.418	8.408	7.636	94.3
	10-S	3-S	10.23	47.46	7.98	1860	7.44	129.50	17.67	184.94	0.28	4.80	32.401	8.377	0.885	98.3
	11-S	10-S	10.54	51.38	8.68	1864	7.75	127.68	18.29	187.74	0.38	2.93	32.418	8.355	0.730	95.9
	12-S	25-S	9.61	82.32	3.50	3225	8.99	121.24	18.60	207.06	0.19	4.27	30.685	8.333	0.331	115.6
	12-B	25-B	22.63	78.96	7.42	3051	10.54	279.30	33.17	365.68	0.17	2.80	30.918	8.336	0.470	124.4
	13-S	50-S	9.30	57.82	3.50	2325	8.99	129.64	18.29	190.96	0.20	3.20	31.791	8.298	0.466	119.1
	13-B	50-B	7.75	44.10	2.80	712	9.30	114.10	15.50	160.44	0.14	2.90	32.538	8.289	0.387	117.3
	14-S	100-S	5.27	29.40	2.52	1325	9.30	111.30	14.57	143.22	0.12	1.80	33.107	8.260	0.277	111.3
	14-B	100-B	4.65	6.72	2.10	342	9.30	112.98	13.95	121.80	0.13	1.67	34.298	8.238	0.239	108.8
	15-S	150-S	4.65	10.78	1.82	406	8.37	89.04	13.02	101.64	0.13	1.98	33.798	8.180	0.096	112.0
	15-B	150-B	3.41	2.66	1.12	108	8.06	88.76	11.47	92.54	0.05	1.78	34.183	8.160	0.075	109.4

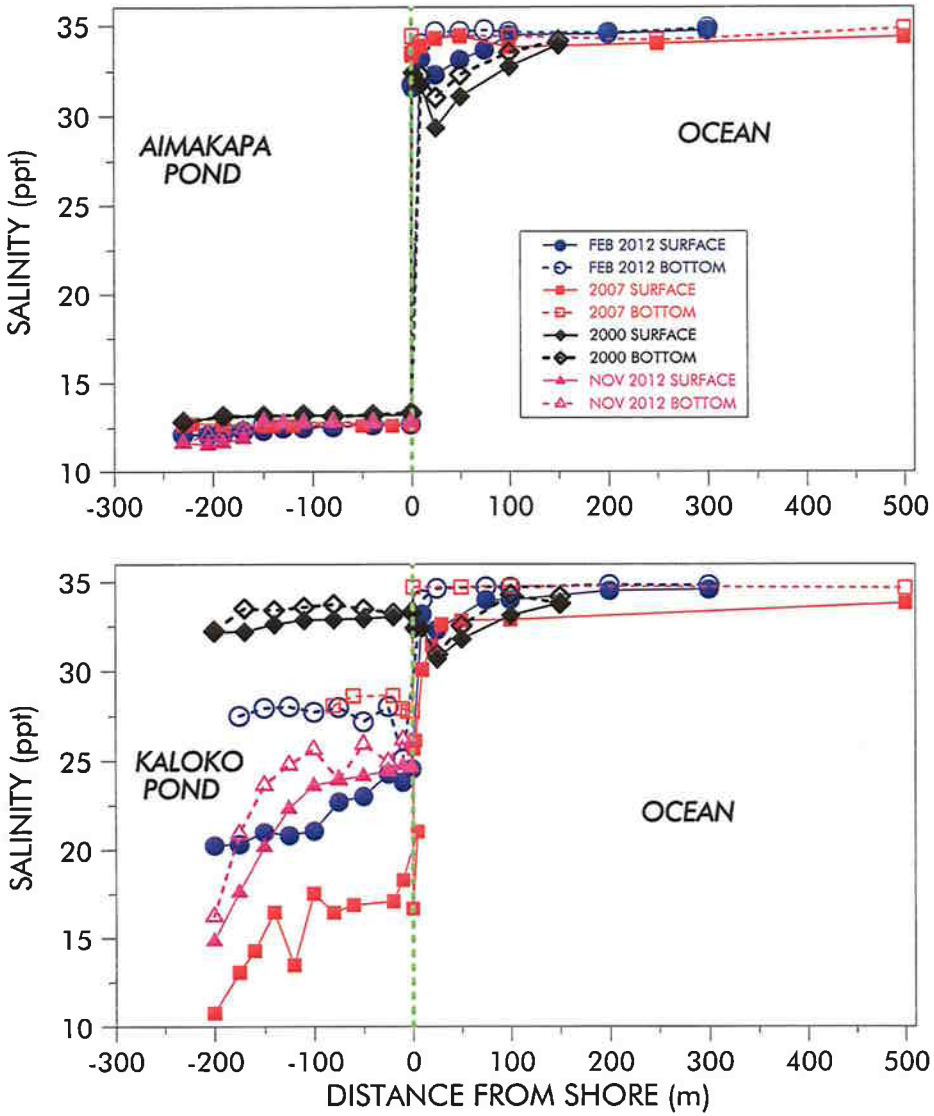

FIGURE 4. Plots of salinity in Aimakapa Pond (top) and Kaloko Pond (bottom) and adjacent offshore ocean as functions of distance from the shoreline measured in 2000, 2007 and 2012 (sampled in February and November). Shoreline is represented by green vertical line; positive values indicate distance seaward from the shoreline in the ocean; negative values indicate distance inland from the shoreline in the ponds. For locations of sampling transects, see Figures 2 and 3.

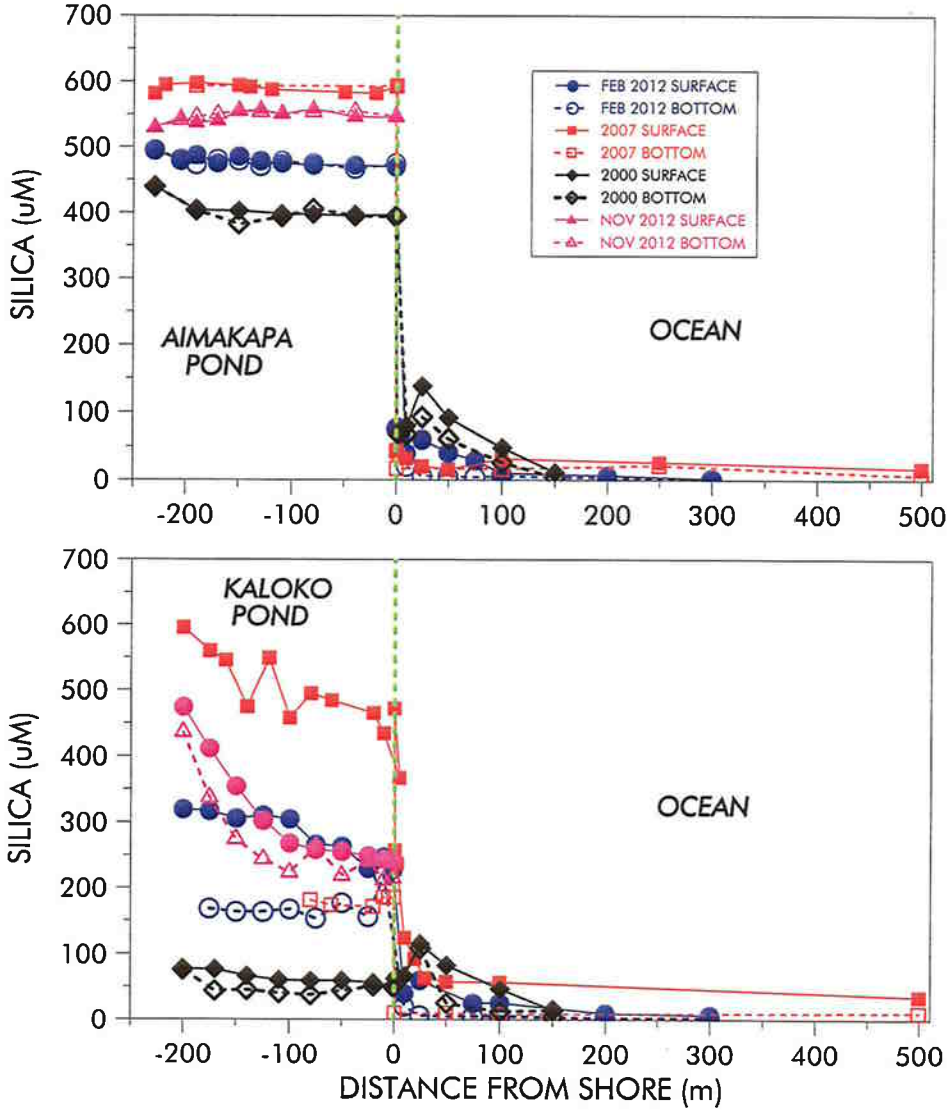

FIGURE 5. Plots of silica in Aimakapa Pond (top) and Kaloko Pond (bottom) and adjacent ocean as functions of distance from the shoreline measured in 2000, 2007 and 2012 (sampled in february and november). The shoreline is represented by the green vertical line; positive values indicate distance seaward from the shoreline in the ocean; negative values indicate distance inland from the shoreline in the ponds. For locations of sampling transects, see Figures 2 and 3.

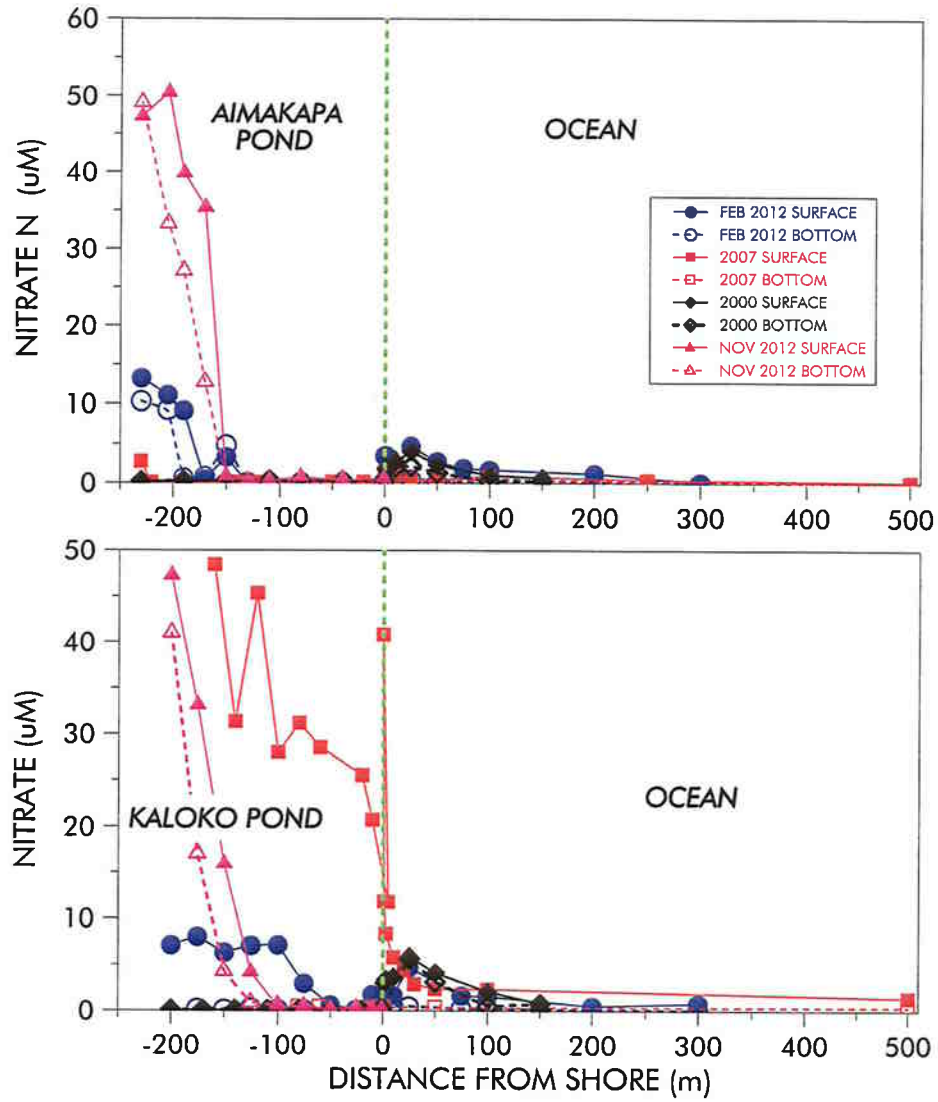

FIGURE 6. Plots of nitrate nitrogen in Aimakapa Pond (top) and Kaloko Pond (bottom) and adjacent ocean as functions of distance from the shoreline measured in 2000, 2007 and 2012 (sampled in February and November. The shoreline is represented by the green vertical line; positive values indicate distance seaward from the shoreline in the ocean; negative values indicate distance inland from the shoreline in the ponds. For locations of sampling transects, see Figures 2 and 3.

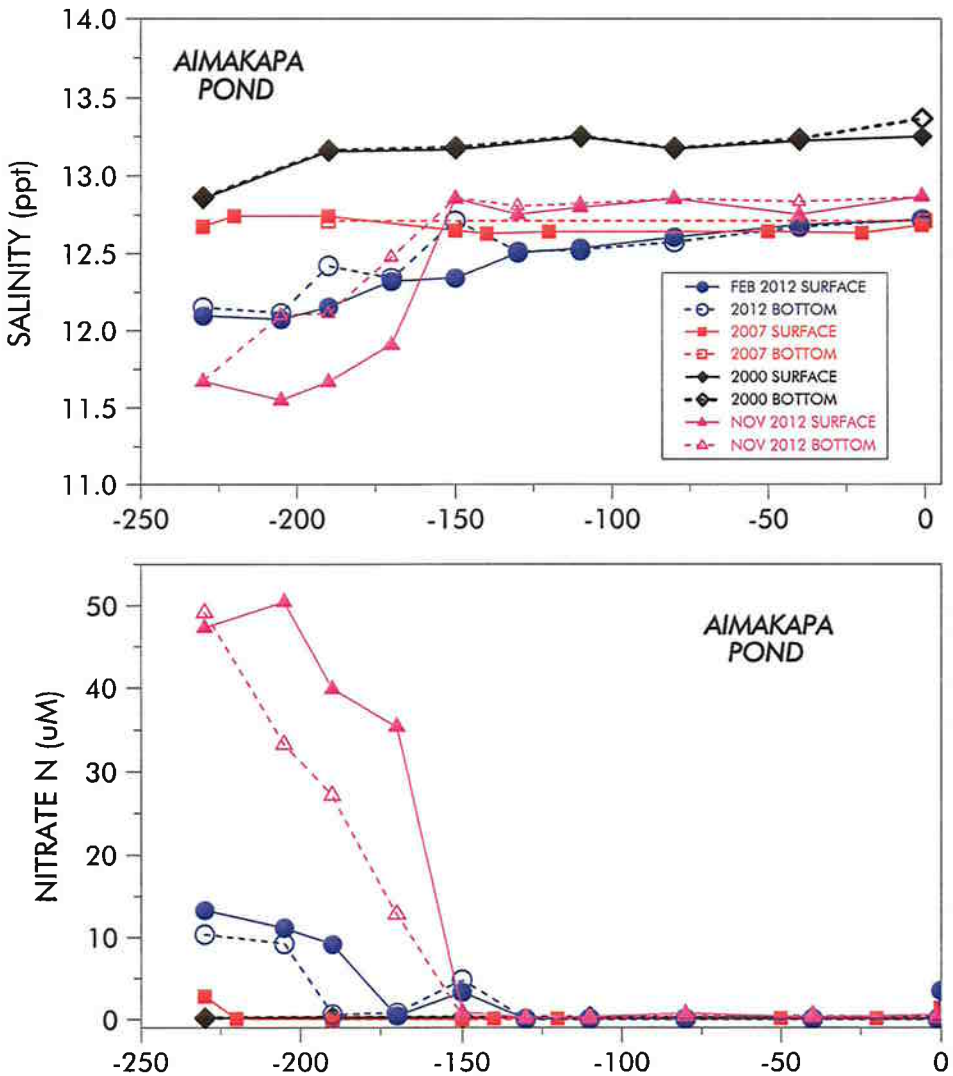

FIGURE 7. Plots of salinity (top) and nitrate nitrogen (bottom) measured in Aimakapa Pond on four occasions (2000, 2007 February 2012 and November 2012). Zero distance indicates the shoreline, or most seaward edge of the Pond, while negative values indicate distance inland from the shoreline. For location of sampling transect in Aimakapa Pond, see Figure 2.

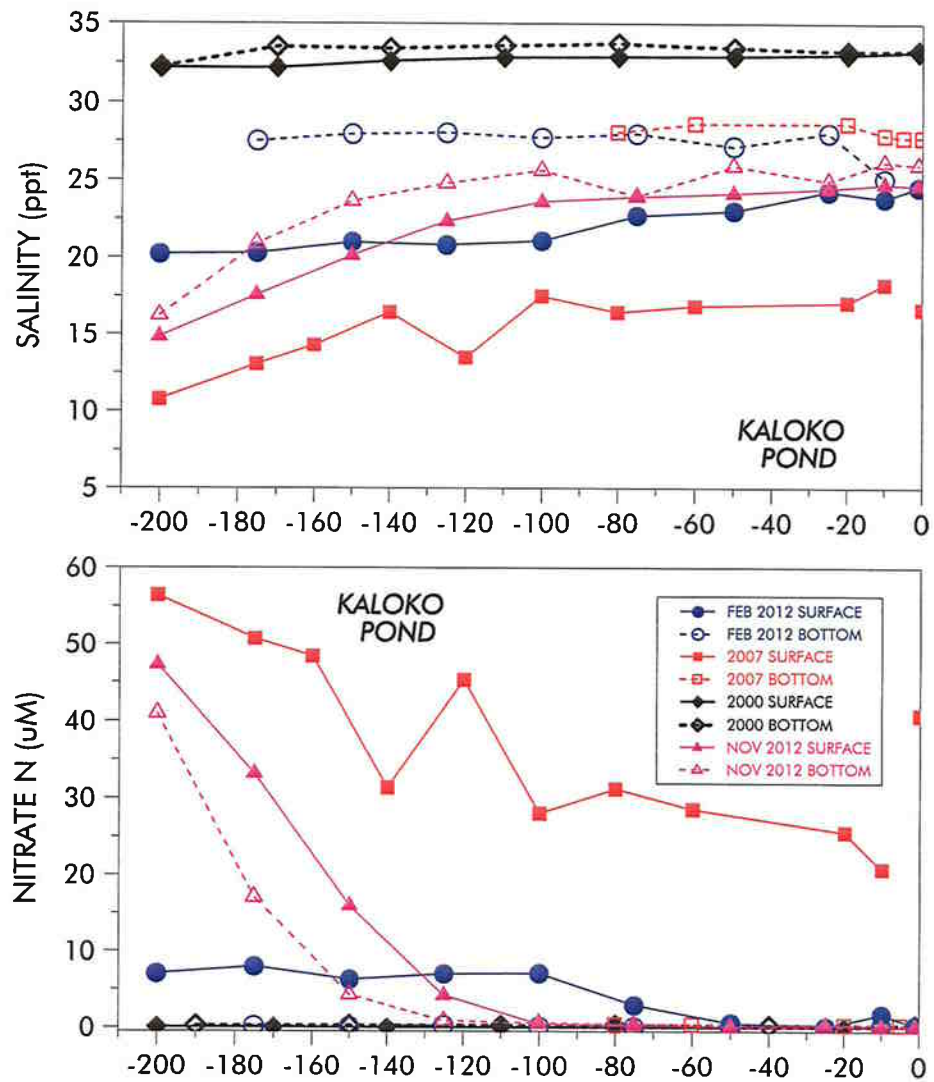

FIGURE 8. Plots of salinity (top) and nitrate nitrogen (bottom) measured in Kaloko Pond on four occasions (2000, 2007, February 2012 and November 2012 Zero distance indicates the shoreline, or most seaward edge of the Pond, while negative values indicate distance inland from the shoreline. For the location of sampling transect in Kaloko Pond, see Figure 3.

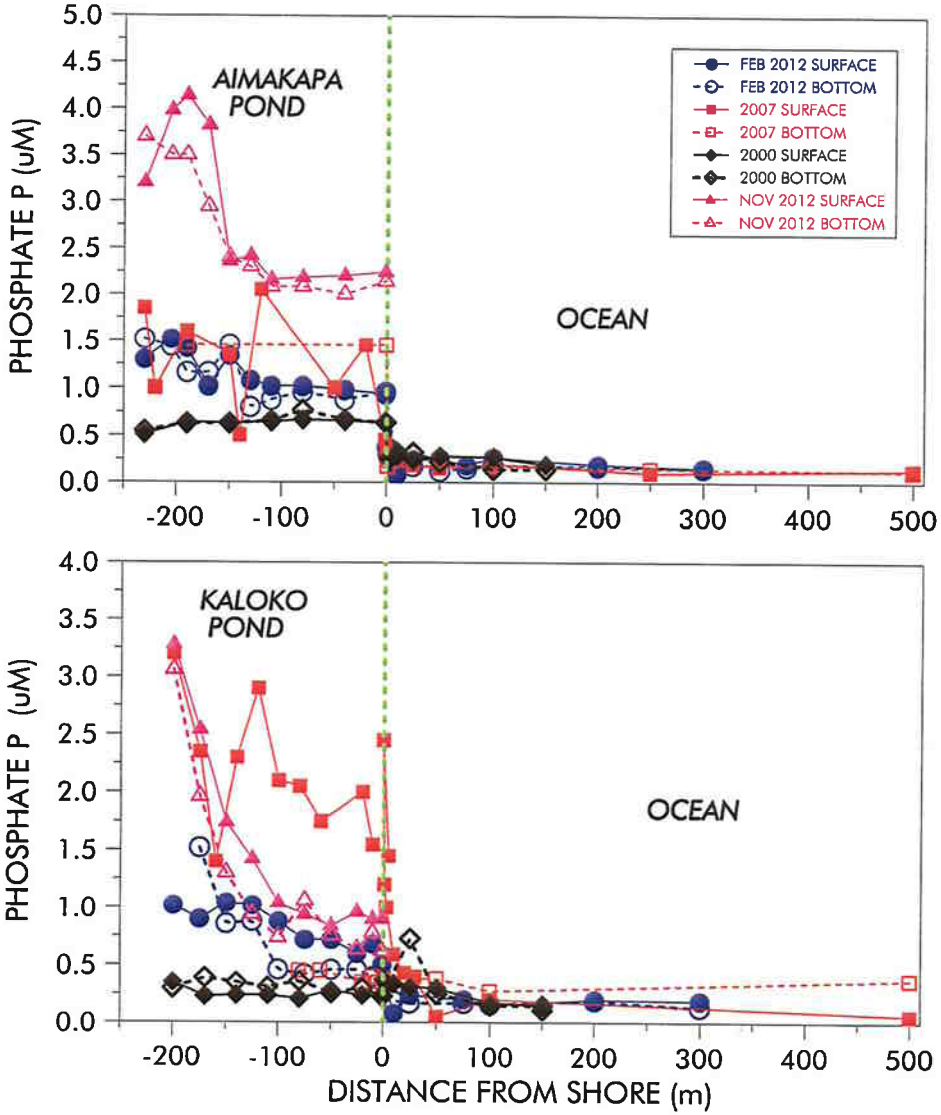

FIGURE 9. Plots of phosphate phosphorus in Aimakapa Pond (top) and Kaloko Pond (bottom) and adjacent ocean as functions of distance from the shoreline measured in 2000, 2007 and 2012 (sampled in February and November). The shoreline is represented by the green vertical line; positive values indicate distance seaward from the shoreline in the ocean; negative values indicate distance inland from the shoreline in the ponds. For locations of sampling transects, see Figures 2 and 3.

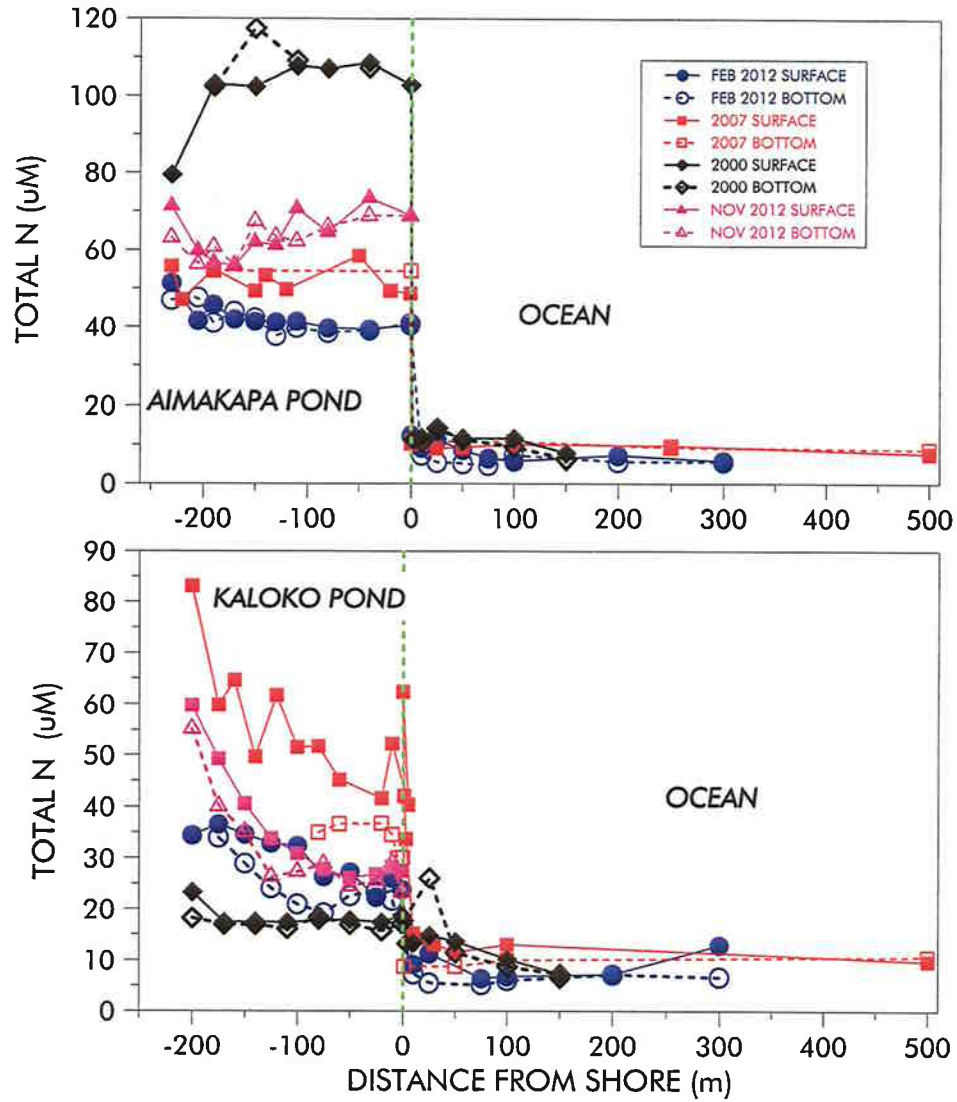

FIGURE 10. Plots of Total Nitrogen in Aimakapa Pond (top) and Kaloko Pond (bottom) and adjacent ocean as functions of distance from the shoreline measured in 2000, 2007 and 2012 (sampled in February and November). The shoreline is represented by the green vertical line; positive values indicate distance seaward from the shoreline in the ocean; negative values indicate distance inland from the shoreline in the ponds. For locations of sampling transects, see Figures 2 and 3.

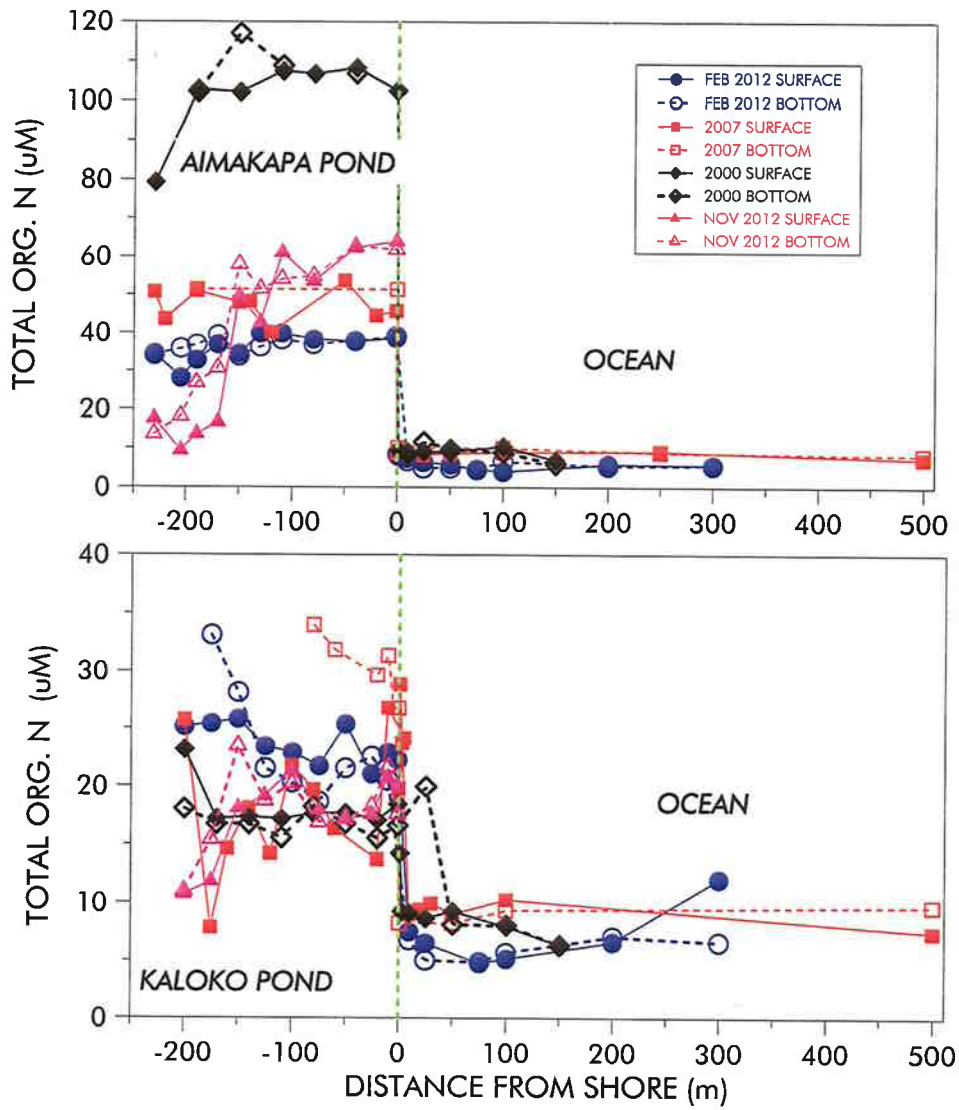

FIGURE 11. Plots of Total Organic Nitrogen in Aimakapa Pond (top) and Kaloko Pond (bottom) and the adjacent ocean as functions of distance from the shoreline measured in 2000, 2007 and 2012 (sampled in February and November). The shoreline is represented by a green vertical line; positive values indicate distance seaward from the shoreline in the ocean; negative values indicate distance inland from the shoreline in the ponds. For locations of sampling transects, see Figures 2 and 3.

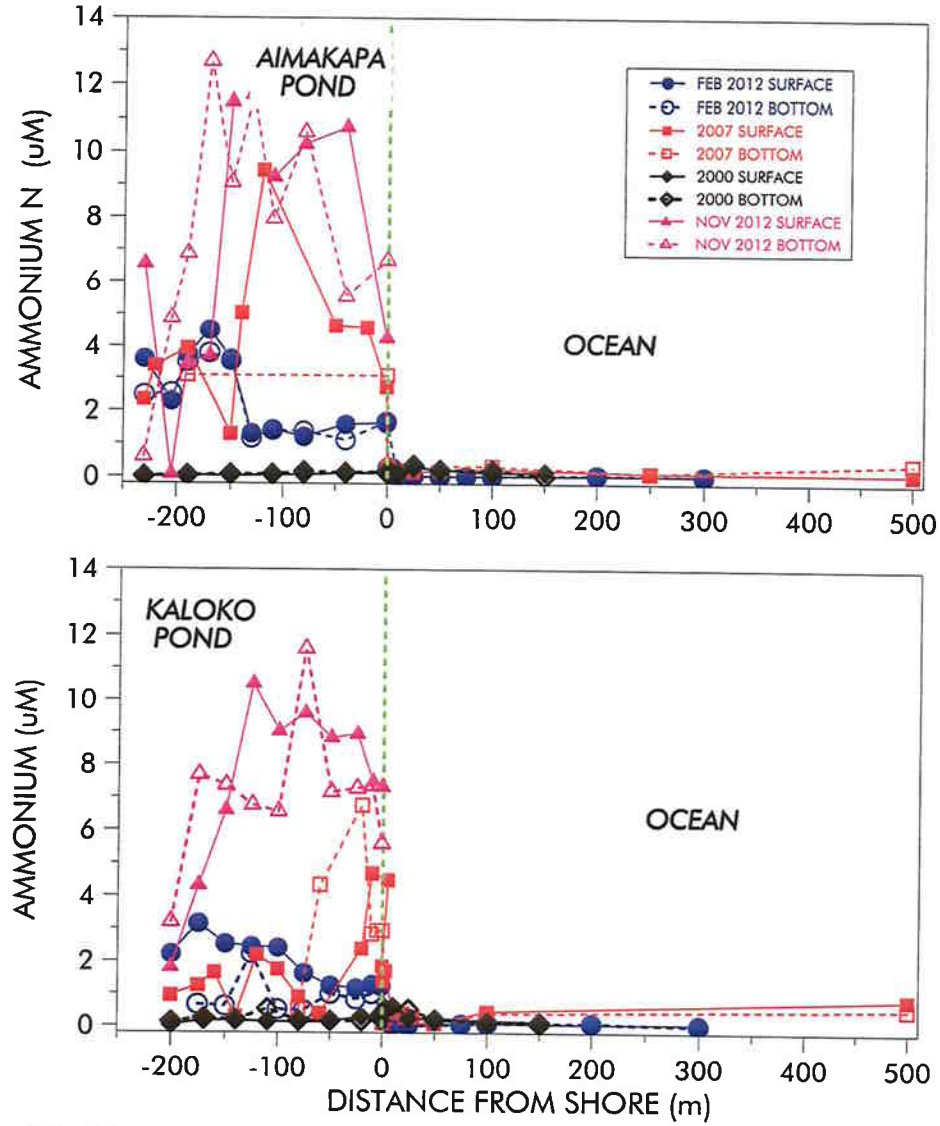

FIGURE 12. Plots of ammonium nitrogen in Aimakapa Pond (top) and Kaloko Pond (bottom) as functions of distance from the shoreline measured in 2000, 2007 and 2012 (sampled in February and November). The shoreline is represented by the green vertical lines; positive values indicate distance seaward from the shoreline in the ocean; negative values indicate distance inland from the shoreline in the ponds. For locations of sampling transects, see Figures 2 and 3.

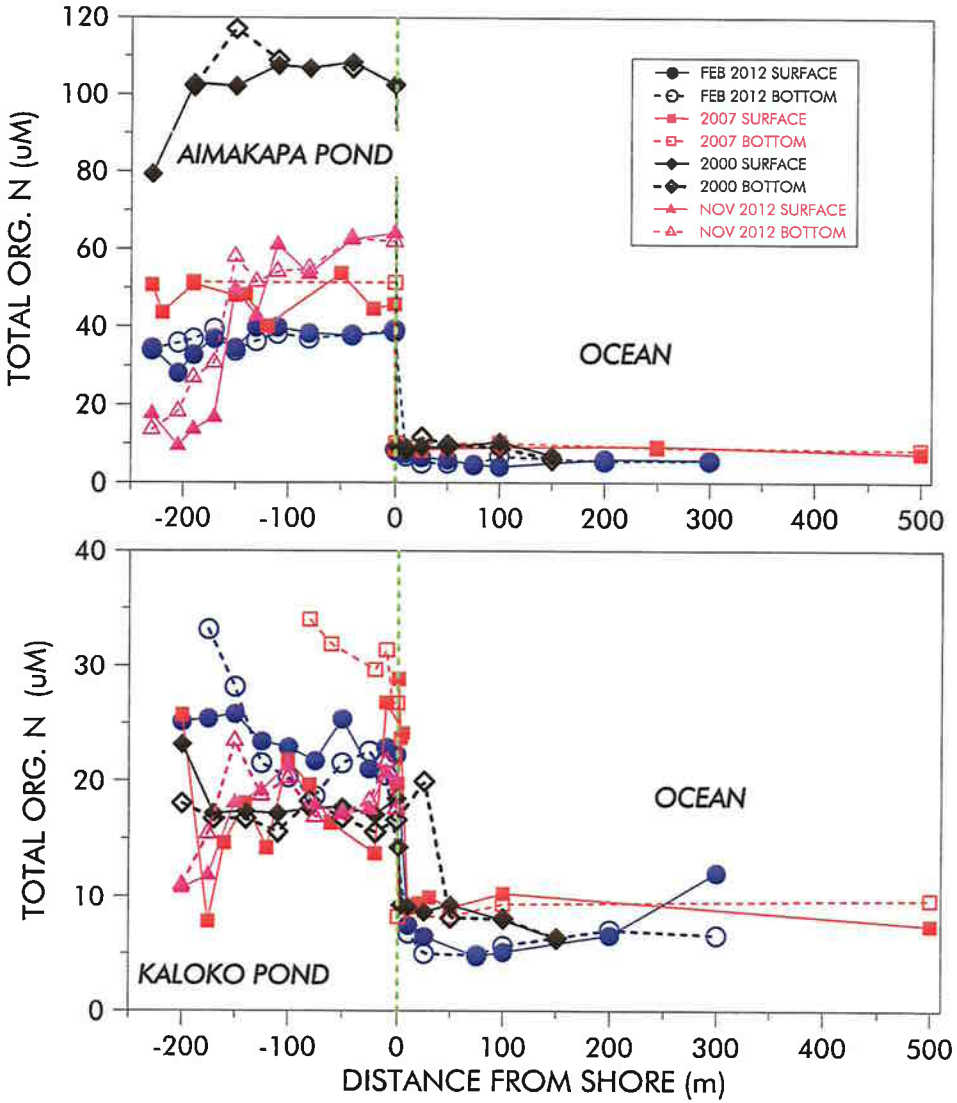

FIGURE 13. Plots of Total Organic Nitrogen in Aimakapa Pond (top) and Kaloko Pond (bottom) and the adjacent ocean as functions of distance from the shoreline measured in 2000, 2007 and 2012 (sampled in February and November). The shoreline is represented by a green vertical line; positive values indicate distance seaward from the shoreline in the ocean; negative values indicate distance inland from the shoreline in the ponds. For locations of sampling transects, see Figures 2 and 3.

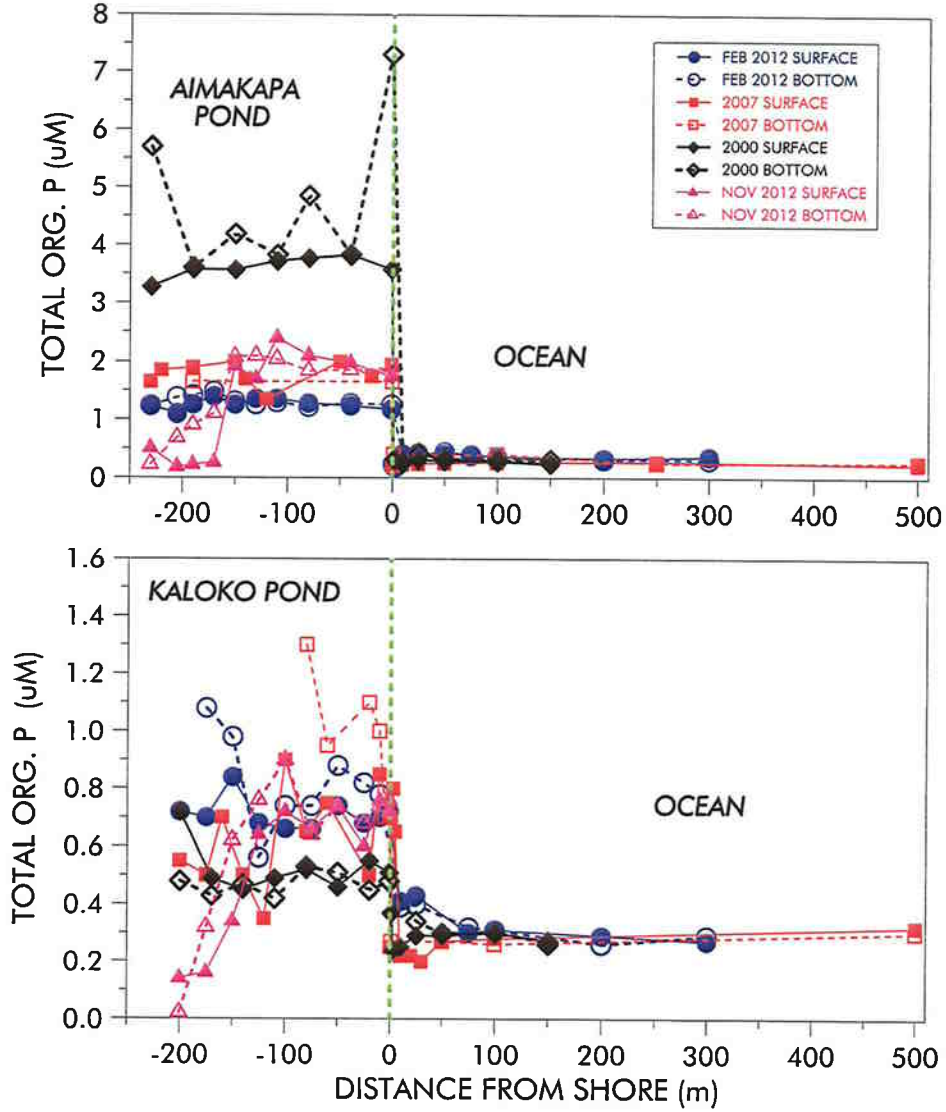

FIGURE 14. Plots of Total Organic Phosphorus in Aimakapa Pond (top) and Kaloko Pond (bottom) and adjacent ocean as functions of distance from the shoreline measured in 2000, 2007 and 2012 (sampled in February and November. Shoreline is represented by green vertical line; positive values indicate distance seaward from the shoreline in the ocean; negative values indicate distance inland from the shoreline in the ponds. For locations of sampling transects, see Figures 2 and 3.

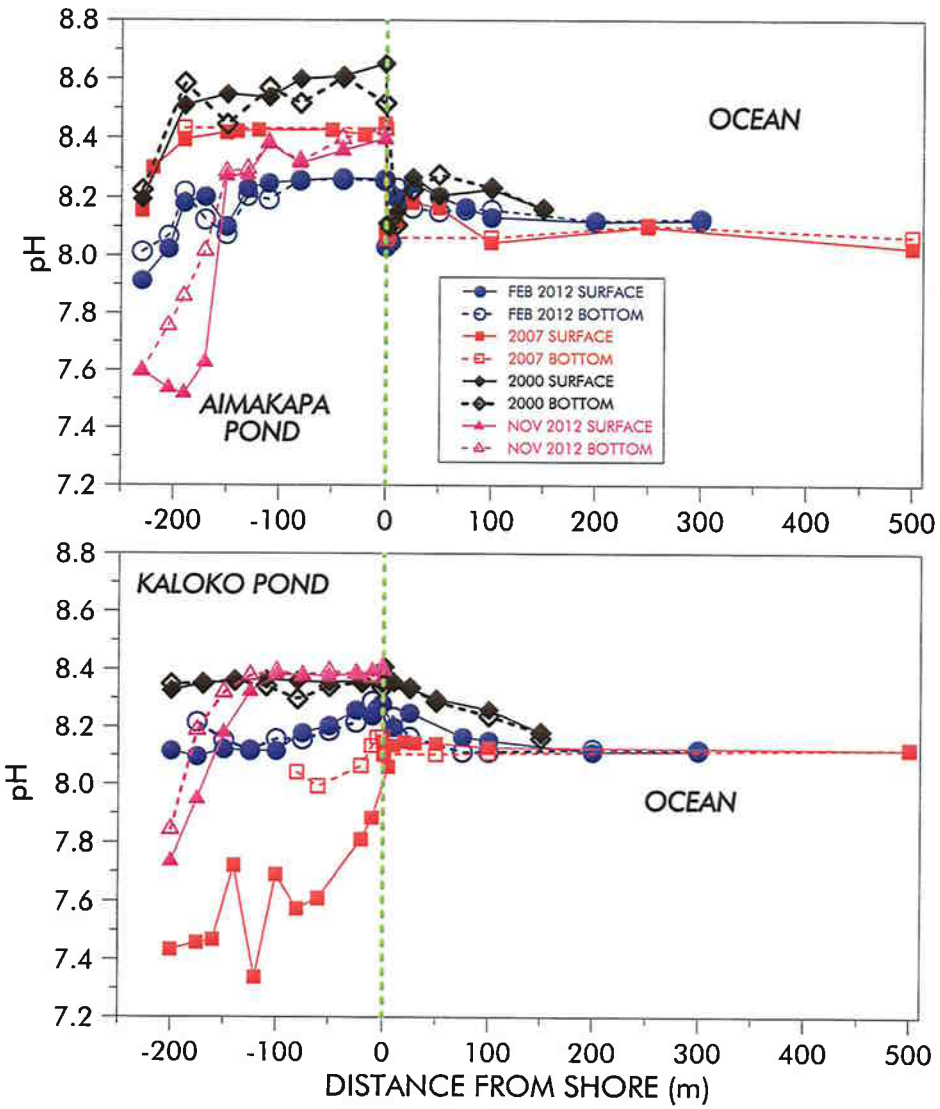

FIGURE 15. Plots of pH in Aimakapa Pond (top) and Kaloko Pond (bottom) and adjacent ocean as functions of distance from the shoreline measured in 2000, 2007 and 2012 (sampled in February and November). Shoreline is represented by green vertical lines; positive values indicate distance seaward from the shoreline in the ocean; negative values indicate distance inland from the shoreline in the ponds. For locations of sampling transects, see Figures 2 and 3.

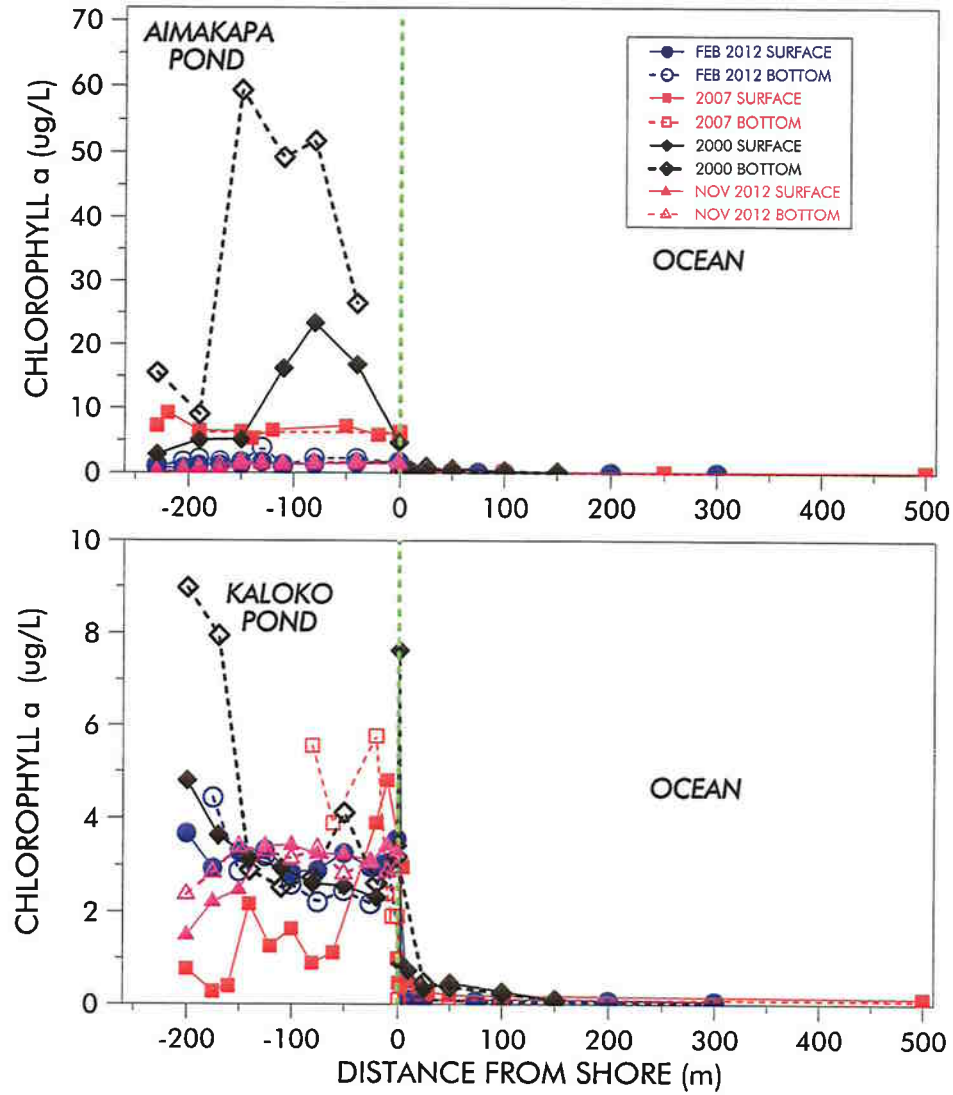

FIGURE 16. Plots of Chlorophyll a in Aimakapa Pond (top) and Kaloko Pond (bottom) as functions of distance from the shoreline measured in 2001, 2007 and 2012 (sampled in February and November). The shoreline is represented by the green vertical lines; positive values indicate distance seaward from the shoreline in the ocean; negative values indicate distance inland from the shoreline in the ponds. For locations of sampling transects, see Figures 2 and 3.

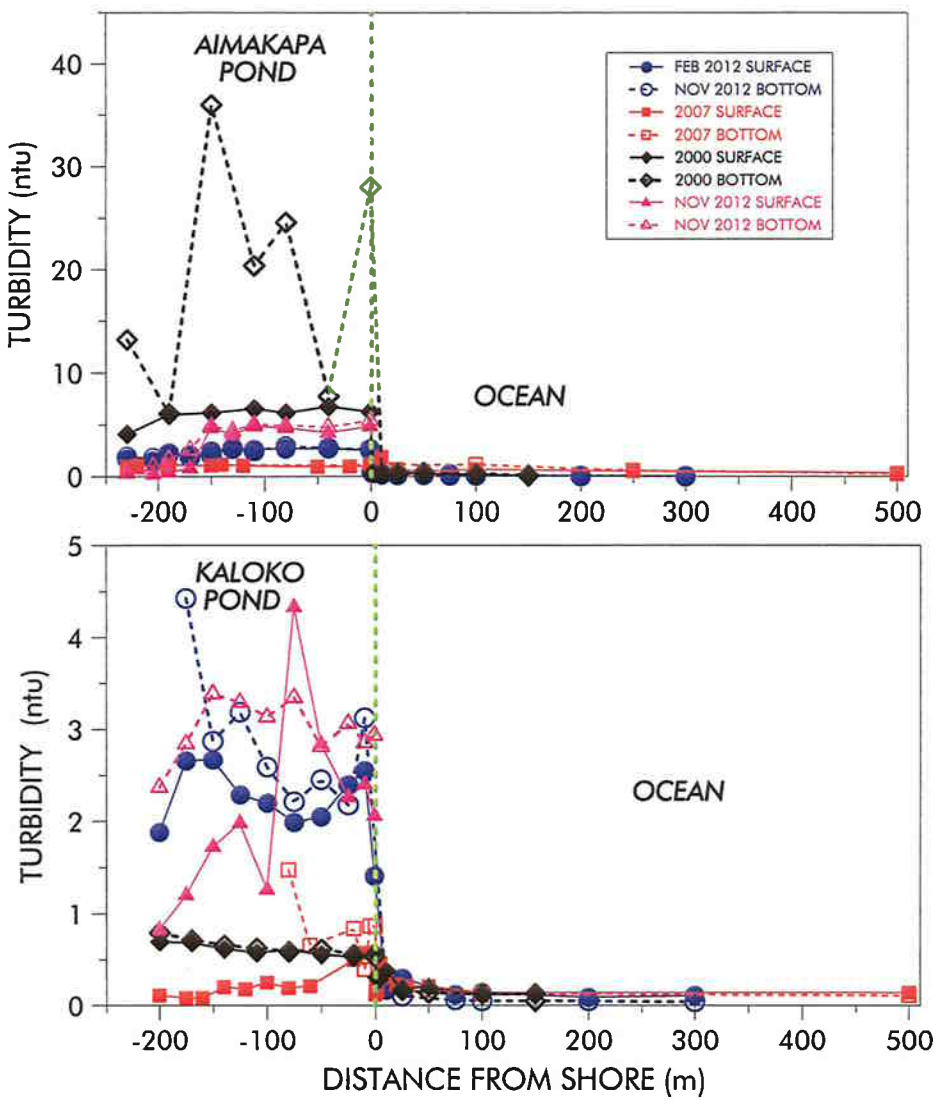

FIGURE 17. Plots of turbidity in Aimakapa Pond (top) and Kaloko Pond (bottom) and adjacent oceanas functions of distance from the shoreline measured in 2000, 2007 and 2012 (sampled in February and November). Shoreline is represented by green vertical line; positive values indicate distance seaward from the shoreline in the ocean; negative values indicate distance inland from the shoreline in the ponds. For locations of sampling transects, see Figures 2 and 3

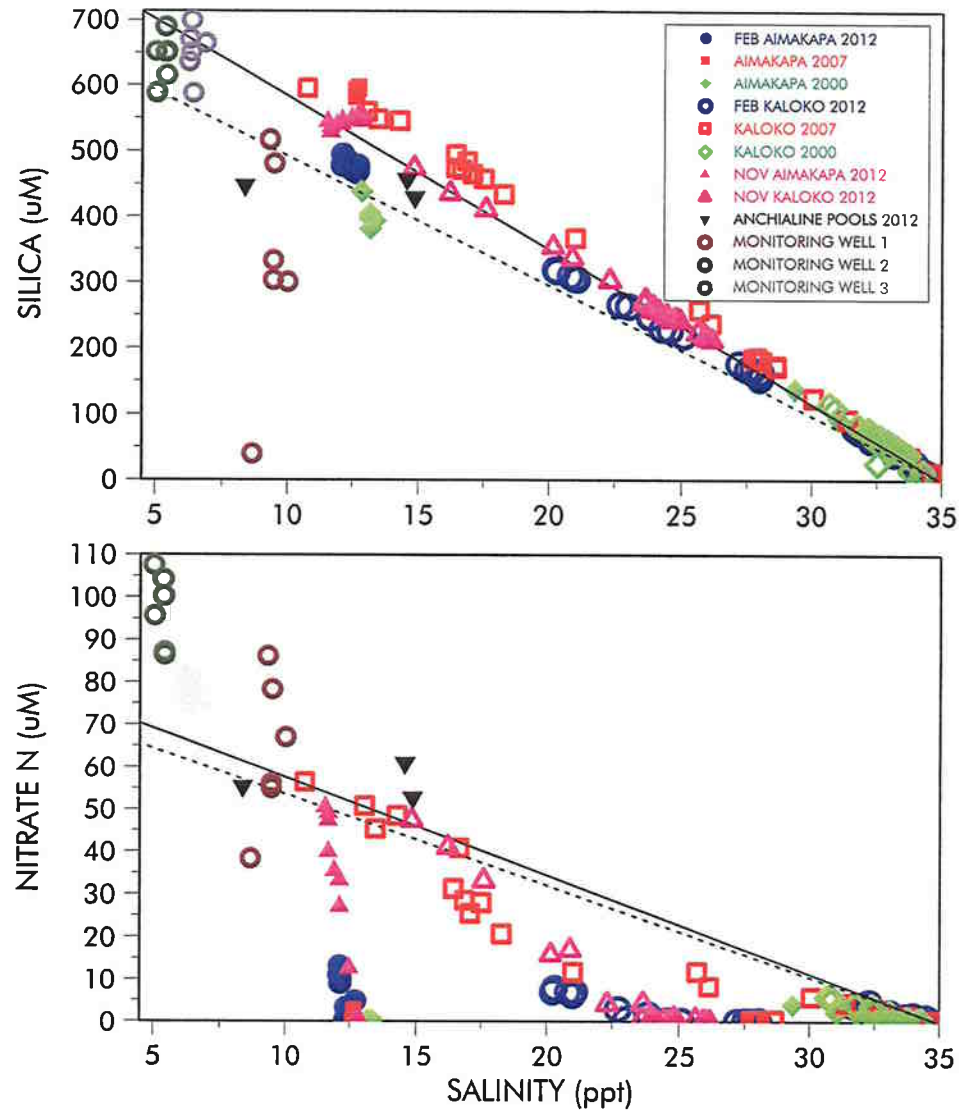

FIGURE 18. Mixing plots showing Silica (top) and nitrate nitrogen as functions of salinity in Aimakapa and Kaloko Fishponds, anchialine pools and the adjacent ocean during four sampling periods (2000, 2007, Feb. 2012 and Nov. 2012). Also shown are data from three KAHO Monitoring wells. Solid line is conservative mixing line connecting endpoint concentrations from the open ocean and high level groundwater from the DWS Honokohau Well (4158-03), while dashed line is conservative mixing line connecting open ocean concentrations to basal groundwater sampled from the Kaloko Irrigation Well (4160-02)

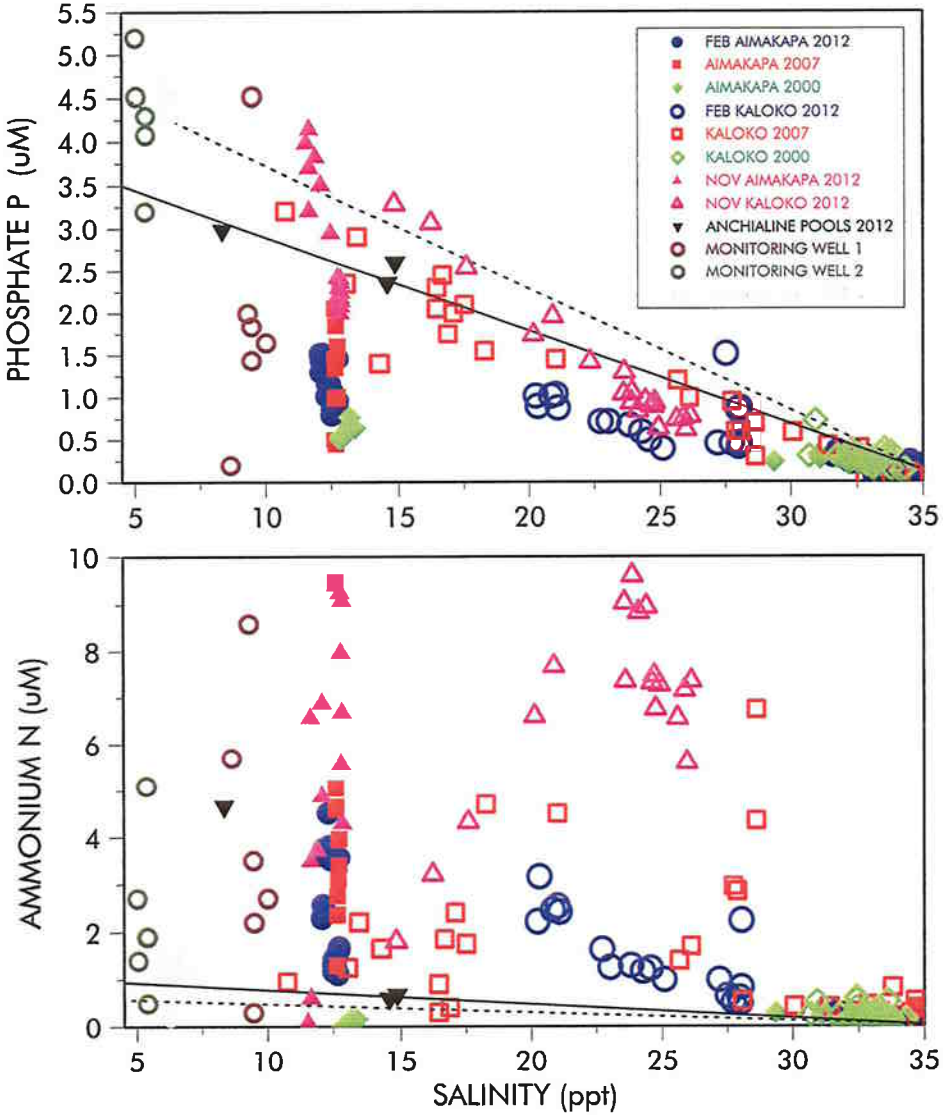

FIGURE 19. Mixing plots showing Phosphate phosphorus (top) and Ammonium nitrogen as functions of salinity in Aimakapa and Kaloko Fishponds, anchialine pools wells and the adjacent ocean during four sampling periods (2000, 2007, Feb. 2012 and Nov. 2012). Also shown are data from KAHO monitoring wells. Solid line is conservative mixing line connecting endpoint concentrations from the open ocean and high level groundwater from the DWS Honokohau Well (4158-03), while dashed line is conservative mixing line connecting open ocean concentrations to basal groundwater sampled from the Kaloko IrrigationWell (4160-02)

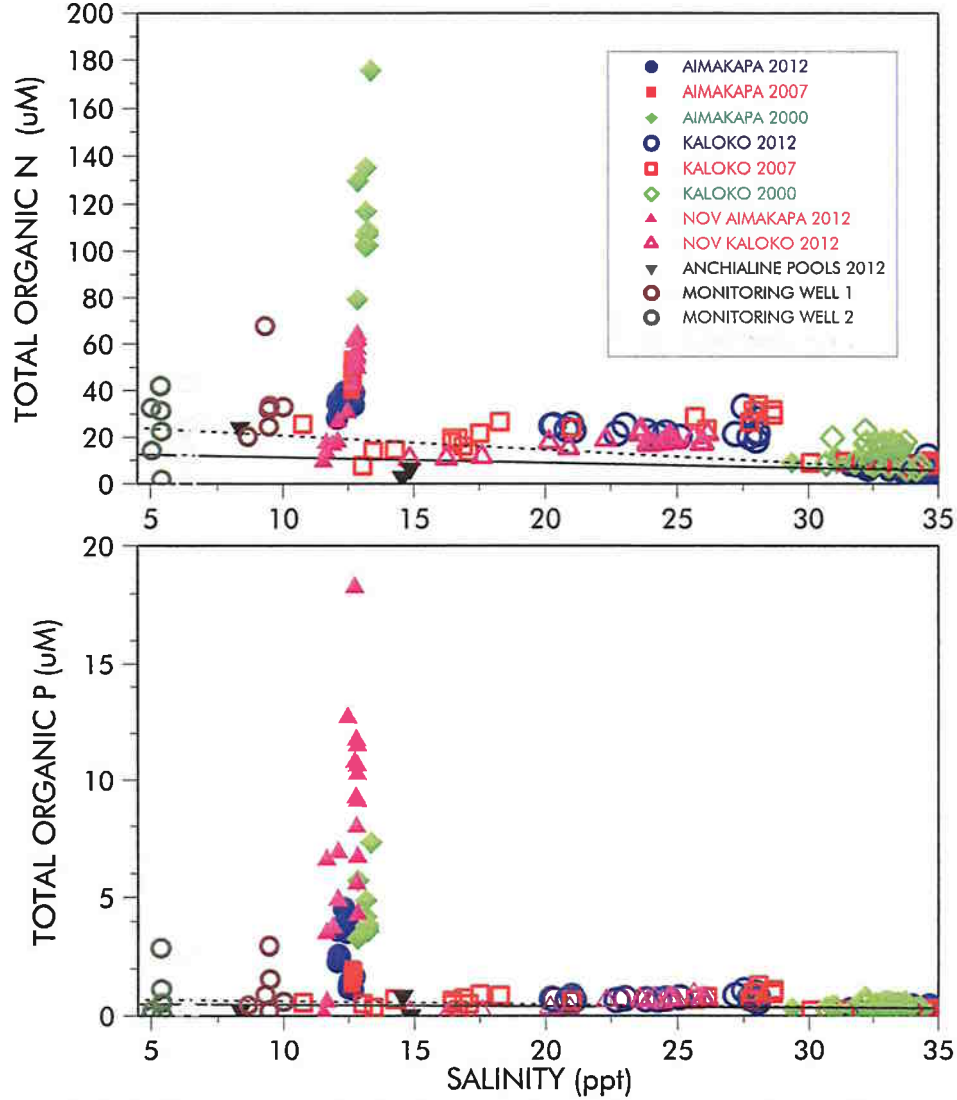

FIGURE 20. Mixing plots showing Total Organic Nitrogen (top) and Total Organic Phosphorus (bottom) functions of salinity in Aimakapa and Kaloko Fishponds, anchialine pools and the adjacent ocean during four sampling periods (2000, 2007, Feb. 2012 and Nov. 2012). Also shown are data from three KAHO monitoring wells. Solid line is conservative mixing line connecting endpoint concentrations from the open ocean and high level groundwater from the DWS Honokohau Well (4158-03), while dashed line is conservative mixing line connecting open ocean concentrations to basal groundwater sampled from the Kaloko Irrigation Well (4160-02)

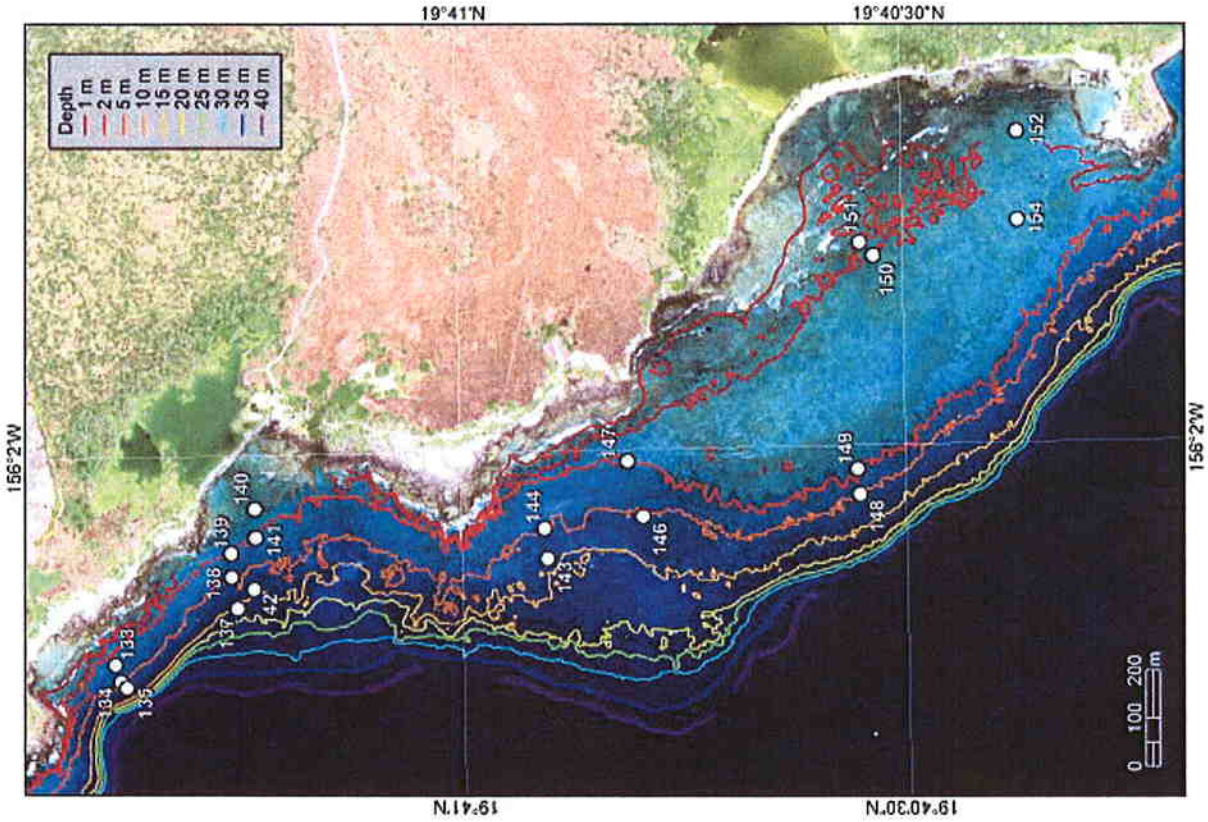

FIGURE 22. Satellite image of Kaloko-Honokohau nearshore marine environment show depth contours. Also shown are locations of calibration/validations points used to gather ground-truth data to construct maps of coral abundance.

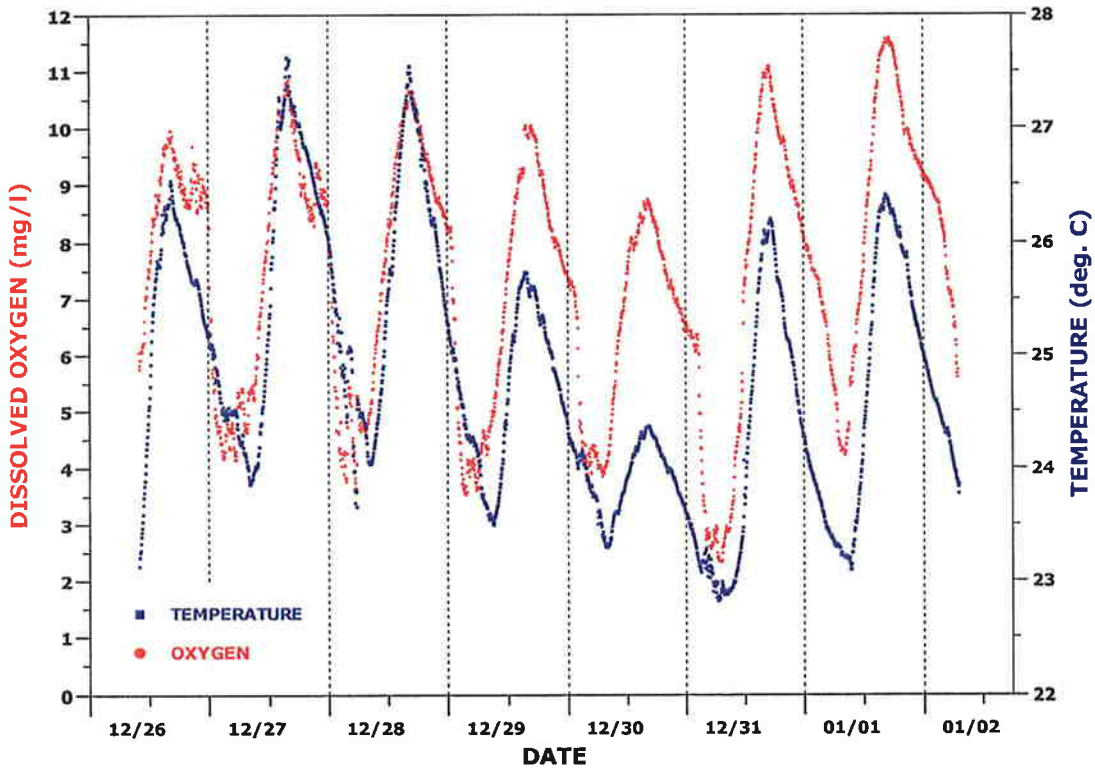

FIGURE 21. Plots of dissolved oxygen and temperature in Aimakapa Pond from Dec. 26, 2001 to January 2, 2002.

TABLE 6. Summar of percent coverage of marine benthic cover of Kaloko Honokohau from in-situ calibration validation photos. See Figure 23 for site locations, and Appendix B for photos.

SITE	Mc	Mp	Pc	Pd	Pe	Pl	Pm	Pv	Zo	TC	A	TUR	SP	SA	R	RU	DC	CCA	TBS	INV
104	0	0	18	0	0	67.8	1.2	0	0	87	1	0	0	0	10.8	0	0	1	0	0.2
105	0	0	37	0	5.4	37.2	0.2	0.2	0	80	1	0	0	0	7	1.6	0	10.4	0	0
106	0.2	0	7.6	0	3.6	39.6	0	0	0	51	10.6	0	0.4	0	29.8	1.2	0	7	0	0
107	0	0	33	0.2	19.2	30.6	0	0	0	83	0	0	0	0	12.6	0	0	4.4	0	0
108	0	0	0	0	14.6	20.6	0.8	0	0	36	2	0	8.2	2	30	0	0.2	20.4	0	1.2
109	0.6	0	0	0	0	20.6	0.4	0	0	21.8	2.6	0	1.6	1.4	66	5.8	0	0.8	0	0
110	0	0	1.2	0	0	44	0.4	0	0	45.6	0	0	0	1.6	38	13.8	0	1	0	0
111	0	0	0.6	0	0	0	0	0	0	0.6	1	0	0	8.8	0	89.6	0	0	0	0
112	6.8	0	0	0	1.8	3.2	10.2	0	0	22	0	0	1.2	3	57.6	0	0	15.6	0	0.6
113	0.4	0	1.4	0	20.2	22	6	0	0	50	0	0	0	0.4	49.2	0	0.4	0	0	0
114	0.4	0	0	0.2	0	4.2	28	0	0	32.8	0	0	0	0	46.6	0	0	20	0	0.6
115	2.8	0	0.8	0	7.6	23	4.2	0	0	38.4	0	41.6	0	9.4	10.6	0	0	0	0	0
117	0.8	0.4	0.6	0	15.6	7.6	9.6	0	0	34.6	0	0	0.4	1.6	53	0	0.4	9.6	0	0.4
118	0.4	0.2	0	0	2.4	3.2	16.4	0	0	22.6	0	0	0	2	73.8	0	0	1.6	0	0
119	0.4	0	2.6	0	28.6	23.8	4	0	0	59.4	2	0	0	1.2	36.4	0	1	0	0	0
120	0	1.4	0	0	1	15.6	14	0	0	32	8	0	0	0	57	0	0	3	0	0
121	1	0	2.6	0	2.8	41.8	1.8	0	0	50	2.2	7	0	8.6	30.6	0	0.8	0.8	0	0
122	3.4	0	0	0.2	3.2	16.6	12.4	0	0	36	0	0	0	0	59.8	0	0	4	0	0.2
123	24	0	0	0	4	31	0	0	0	59	0	0	0	0	12	0	0	29	0	0
126	0	0	0	0	1.4	34	3.6	0	0	39	9	0	0.2	0	37.6	0	0	14	0	0.2
133	0.8	0	0.4	0	9.6	25.6	2.2	0	0	38.6	0	15.8	0	0	29.8	13.4	0	1.4	0	1
134	0.4	0	0	0	0.2	31.6	4.6	0	0	36.8	1	0	0.2	2	53.8	1	1.8	2	0	1.4
135	0	0	0	0	0	0.4	0	0	0	0.4	0	9	1	1	5	82	0	0	0	1.6
137	0	0	31.6	0.2	0	44	0.4	0	0	76.2	0	0	0	0	11.6	0	0	12.2	0	0
138	0	0	8.4	0	6.4	45	1.6	0	0	61.4	1	0	0	0	28.6	0.2	0	1	7.4	0.4
139	0	0	0.8	0	7.4	42.4	0	0.2	0	50.8	0	1	0	0	41.6	0	0	6	0	0.6
140	0	0	0	0	0	0.8	5.8	0	0.4	7	0	0	0	0	71	0	1.6	20.4	0	0
141	0.2	0.6	0	0	7.6	41	1.6	0	0	51	0	0	0	3	29.2	0	0	16.6	0	0.2
142	0	0	14.2	0	0	48.4	3.8	0	0	66.4	0	0	0.2	0	32.4	0	0	1	0	0
143	0	0	0	0	4	16.67	0	0	0	20.667	0	15	0	0	64	0	0	0	0	0.33
144	0.2	0	0	0.2	0	16.2	0	0	0	16.6	0	11.4	0.2	9.6	26.6	9.2	0	12	13.6	0.8
146	0.4	0	0.8	0	2	31.2	0	0	0	34.4	0	30.2	0.2	2.6	22.6	8.4	0	1.2	0	0.4
147	0	0	0	0	0.8	60.2	0	0	0	61	0	14.8	0	0	21	0	0.2	3	0	0
148	0	0	1	0	0.6	16	0	0	0	17.6	2	17	0	0	46	4	0	13	0	0.4
149	0	0	0	0	0	17	3.6	0	0	20.6	0	19.4	1.4	0	42.8	0	0	15.2	0	0.6
150	0	0	0	0	1	55	1.6	0	0	57.6	7.4	29.6	0	0	2.2	0	0	3	0	0.2
151	0	0	0	0	0	4	0	0	0	4	4.4	89.2	0	0	0	0	0	1.6	0	0.8
152	0	0	0	0.4	0	0.8	0	0	0	1.2	0	96.4	0	0	0	0	0	1.2	0	1.2
154	0	0	0	0	0	43	4.2	0	0	47.2	0	9	0.4	0	43.4	0	0	0	0	0
% TC	2.8	0.2	10.5	0.1	11.0	66.2	9.2	0.0	0.0	100.0										
% Bottom	1.1	0.1	4.2	0.0	4.4	26.3	3.7	0.0	0.0	39.8	1.4	10.4	0.4	1.5	33.1	5.9	0.2	6.5	0.5	0.3

Mc = "Montipora capitata"
Mp = "Montipora patula"
Pc = "Porites compressa"
Pd = "Pocillipora damicornis"
Pe = "Porites lutea"
Pl = "Porites lobata"
Pm = "Pocillopora meandrina"
Pv = "Pavona varians"
Zo = "Zooanthid"
TC = "Total Coral Cover"
A = "Algae"
TUR = "Turf"
SP = "Sponge"
SA = "Sand"
R = "Rock"
RU = "Rubble"
DC = "Dead coral"
CCA = "Crustose Coralline Algae"
TBS = "Turf-Bound-Sediment"
INV = "Invertebrate"

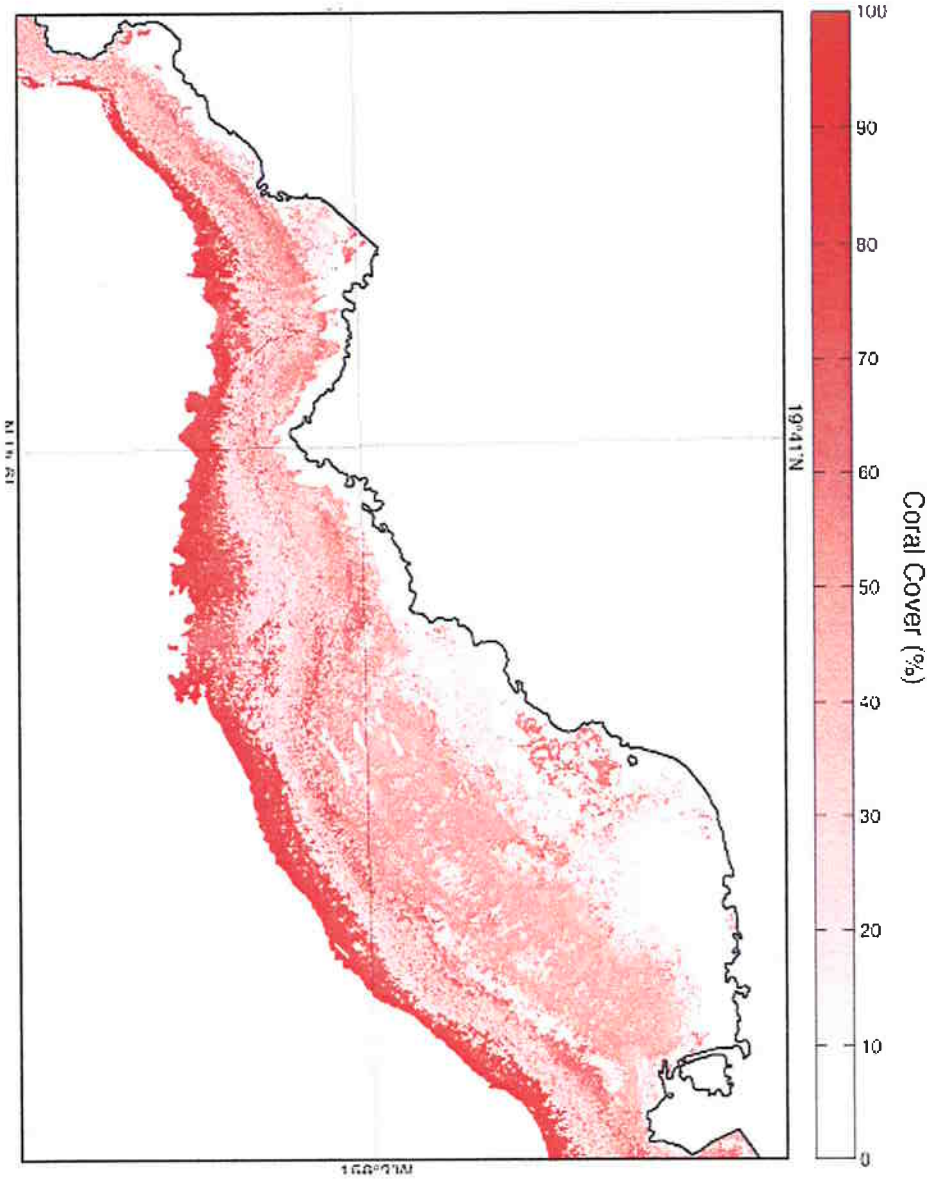

FIGURE 23. Map of coral abundance in Kaloko-Honokohau nearshore marine environment produced using satellite imagery and in-situ groundtruth. Note low levels of coral occurrence in nearshore areas, particularly on the reef flat fronting Aimakapa Pond.

FIGURE 24. Two views of ocean diffuser in Hilo Bay from Hilo Wastewater Treatment Plant. Note abundant coral growth on diffuser pipe and ports that are exposed to effluent plume.

TABLE 7. Fish abundance censused from stationary point counts at calibration-validation stations off Kaloko Makai site. See Figure 22 for locations of sampling stations.

Site ID	104	105	106	107	108	109	110	111	112	113	114	115	117	118	119	120	121	122	125	126
FAMILY																				
Species																				
CIRRHITIDAE																				
Paracirrhites arcatus	1		1	1				1			1		1	4		1	2	1	1	
P. forsteri				1														1		
C pinnulatus																	1			
MULLIDAE																				
Parupeneus bifasciatus											1					2				
P. multifasciatus	1							2			1		2						1	
Mulloidichthysflavolineatus																			10	
CHAETODONTIDAE																				
C. ornitissimus	4		1		2								1							1
C. auriga									2		1									
C. multicinctus	2		2		3	2			4		2	2	1				6	4	3	2
C. unimaculatus													2							
C. lunula				1			2		2		2		2		1	1			3	
C. quadrimaculatus	1								2			1		1	1					
Hemitaurichthys polylepis	1																			
Forcipiger longirostris/flavissimus							1		1	3		1			2		2			2
POMACENTRIDAE																				
Chromis vanderbilti		25		20		30	30		30		30	30	20	40		20	10	50		50
C. agilis			3					50		100	1				50		2		200	
C. hanui															1				2	
C. verater								30					4							
Dascyllus albisella																	1		5	
Plectroglyphidodon johnstonianus															1				1	
Stegastes marginatus	4		3			1														
Abudefduf abdominalis		2		10	2				200				200	50						
LABRIDAE																				
Gomphosus varius						2			2		1		2	1				1		1
Thalassoma duperrey		2			7	5	3				2	4		10	1	3	6	3	1	2
Halichoeres ornatissimus		2			2	2							1					1		
Labroides phthirophagus							3									1		1		2
ACANTHURIDAE																				
Acanthurus olivaceus		2	2		2			1			1	1	1	1				1		1
A. triostegus					5								2	5		3		2		
A. nigrofuscus	3	5	5	2	20	15	20		10	20	5	20	2	3	1		2	15	10	10
A. nigroris													1							
A. leucopareius					20	20						30		2						
A. achilles		2				1						1								
Naso lituratus						1			5	1	1	5	3	2	2	1		2	2	1
N. unicornis						2														
N. hexacanthus	1									3						1			3	
Zebrasoma flavescens	7	8	6	8	40	20	30	20	40	10	20	30	20	20		10	10	5	15	40
Z. veliferum							2						2							
Ctenochaetus strigosus	1			1	20		30	2	20	5	10	20	10	10	5		4	5	15	10
BALISTIDAE																				
Sufflamen bursa			1		2	1					1		2	1	2	2	2	5	2	1
Melichthys niger				3									4	20	5				10	
M. vidua				1						1			2	1	1			1	3	
TETRADONTIDAE																				
Arothron hispidus											1									
Canthigaster jactator											1				1					
SCARIDAE																				
S. psittacus		3																		
Chlorurus spilurus	1					5		1	2	20	2	6	4		1		1			
POMACANTHIDAE																				
Centropyge potteri							1													
AULOSTOMIDAE																				
Aulostomus chinensis		1					1													
ZANCLIDAE																				
Zanclus cornutus							2							2		3				
MONACANTHIDAE																				
Pervagor aspricaudus										1					1					
NUMBER SPECIES	12	10	9	10	12	14	12	8	13	10	19	13	23	17	16	12	13	16	18	13
NUMBER INDIVIDUALS	26	52	23	46	125	107	125	106	320	164	83	151	288	169	76	47	46	96	286	123

APPENDIX A.

Results of Sediment Analyses

Kaloko-Honokohau National Historical Park

Calscience Environmental Laboratories, Inc.
Work Order 12-0201625

Calscience Environmental Laboratories, Inc.

CALSCIENCE
WORK ORDER NUMBER: 12-02-1625

The difference is service

AIR | SOIL | WATER | MARINE CHEMISTRY

Analytical Report For

Client: Marine Research Consultants, Inc.
Client Project Name: C KAHO SEDIMENT PESTICIDES
Attention: Steve Dollar
1039 Waakaua Pl.
Honolulu, HI 96822-1173

Approved for release on 03/15/2012 by:
Danielle Gonsman
Project Manager

ResultLink ›

Email your PM ›

Calscience Environmental Laboratories certifies that the test results provided in this report meet all NELAC requirements for parameters for which accreditation is required or available. Any exceptions to NELAC requirements are noted in the case narrative. The original report of subcontracted analyses, if any, is provided herein, and follows the standard Calscience data package. The results in this analytical report are limited to the samples tested and any reproduction thereof must be made in its entirety. Note that the Chain-of-Custody Record and Sample Receipt Form are integral parts of this report.

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NELAP ID: 03220CA | DoD-ELAP ID: L10-41 | CSDLAC ID: 10109 | SCAQMD ID: 93LA0830

Calscience Environmental Laboratories, Inc.

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Work Order Number: 12-02-1625

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Calscience Environmental Laboratories, Inc.

CASE NARRATIVE

Calscience Work Order No.: 12-02-1625
Project ID: C KAHO SEDIMENT PESTICIDES

Provided below is a narrative of our analytical effort, including any unique features or anomalies encountered as part of the analysis of the sediment samples.

Sample Condition on Receipt

Three sediment samples were received for this project on February 28, 2012. The samples were transferred to the laboratory in an ice-chest with wet ice, following strict chain-of-custody (COC) procedures. The temperature of the samples upon receipt at the laboratory was 5.5°C. All samples were given laboratory identification numbers, logged into the Laboratory Information Management System (LIMS) and then stored under refrigeration pending sediment chemistry testing.

Tests Performed

Chlorinated Pesticides by EPA 8081A
Organophosphorus Pesticides by EPA 8141
Chlorinated Herbicides by EPA 8151
SVOCs by EPA 8270 SIM
Trace Metals by EPA 6020
Mercury by EPA 7471A

Data Summary

All samples were homogenized prior to preparation and analysis.

Holding times

All holding times were met with the following exceptions.

The samples were analyzed past the EPA Method recommended 7-day holding time (in solid samples) for Total Solids (for dry wt. determination). However, the samples were stored frozen prior to holding time expiration and Calscience follows standard industry practice and the Puget Sound Protocol, which states the holding times for sediment samples may be extended up to one year if kept frozen after collection. Therefore, the results have not been flagged as exceeding the EPA recommended extractions holding time.

Calibration

Frequency and control criteria for initial and continuing calibration verifications were met.

Reporting Limits

All reporting limits were met.

Blanks

Concentrations of target analytes in the method blank were found to be below reporting limits for all testing.

Laboratory Control Samples

A Laboratory Control Sample (LCS) analysis was performed at the required frequencies, and unless otherwise noted, all parameters were within the established control limits.

Matrix Spikes

Matrix spiking was performed on both project and non-project samples, and all matrix spike parameters were within the established control limits with the following exceptions.

The MS/MSD and PDS/PDSD recoveries for various metals (by EPA 6020) were outside the established control limits due to matrix interference. However, since the associated LCS/LCSD recoveries and RPDs were in control, the data are released with no further action.

The MS/MSD RPDs for 2,4-D and 2,4,5-T were above the established control limits. However, since the associated LCS/LCSD RPDs were in control, the data are released with no further action.

Surrogates

Surrogate recoveries for all applicable tests and samples were within the established control limits.

Acronyms

LCS/LCSD- Laboratory Control Sample/Laboratory Control Sample Duplicate
PDS/PDSD- Post Digestion Spike/Post Digestion Spike Duplicate
MS/MSD- Matrix Spike/Matrix Spike Duplicate
RPD- Relative Percent Difference

Marine Research Consultants, Inc.
1039 Waakaua Pl.
Honolulu, HI 96822-1173

Date Received:	02/28/12
Work Order No:	12-02-1625
Preparation:	N/A
Method:	SM 2540 B

Project: C KAHO SEDIMENT PESTICIDES

Page 1 of 1

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
KAHO 1	12-02-1625-1-A	02/23/12 10:22	Sediment	N/A	03/14/12	03/14/12 18:00	C0314TSB2

Parameter	Result	RL	DF	Qual	Units
Solids, Total	74.8	0.100	1		%

KAHO 2	12-02-1625-2-A	02/23/12 12:36	Sediment	N/A	03/14/12	03/14/12 18:00	C0314TSB2

Parameter	Result	RL	DF	Qual	Units
Solids, Total	61.3	0.100	1		%

KAHO 3	12-02-1625-3-A	02/23/12 13:42	Sediment	N/A	03/14/12	03/14/12 18:00	C0314TSB2

Parameter	Result	RL	DF	Qual	Units
Solids, Total	8.10	0.100	1		%

Method Blank	099-05-019-1,861	N/A	Solid	N/A	03/14/12	03/14/12 18:00	C0314TSB2

Parameter	Result	RL	DF	Qual	Units
Solids, Total	ND	0.100	1		%

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

Calscience Environmental Laboratories, Inc.

Analytical Report

Marine Research Consultants, Inc.
1039 Waakaua Pl.
Honolulu, HI 96822-1173

Date Received:	02/28/12
Work Order No:	12-02-1625
Preparation:	EPA 3545
Method:	EPA 8081A
Units:	ug/kg

Project: C KAHO SEDIMENT PESTICIDES

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
KAHO 1	12-02-1625-1-A	02/23/12 10:22	Sediment	GC 51	03/01/12	03/07/12 14:58	120301L05

Comment(s): -Results are reported on a dry weight basis.

Parameter	Result	RL	DF	Qual	Parameter	Result	RL	DF	Qual
Aldrin	ND	1.3	1		Endosulfan I	ND	1.3	1	
Alpha-BHC	ND	1.3	1		Endosulfan II	ND	1.3	1	
Beta-BHC	ND	1.3	1		Endosulfan Sulfate	ND	1.3	1	
Delta-BHC	ND	1.3	1		Endrin	ND	1.3	1	
Gamma-BHC	ND	1.3	1		Endrin Aldehyde	ND	1.3	1	
Chlordane	ND	13	1		Endrin Ketone	ND	1.3	1	
Dieldrin	ND	1.3	1		Heptachlor	ND	1.3	1	
Trans-nonachlor	ND	1.3	1		Heptachlor Epoxide	ND	1.3	1	
2,4'-DDD	ND	1.3	1		Methoxychlor	ND	1.3	1	
2,4'-DDE	ND	1.3	1		Toxaphene	ND	27	1	
2,4'-DDT	ND	1.3	1		Alpha Chlordane	ND	1.3	1	
4,4'-DDD	ND	1.3	1		Oxychlordane	ND	1.3	1	
4,4'-DDE	ND	1.3	1		Gamma Chlordane	ND	1.3	1	
4,4'-DDT	ND	1.3	1		Cis-nonachlor	ND	1.3	1	

Surrogates:	REC (%)	Control Limits	Qual	Surrogates:	REC (%)	Control Limits	Qual
2,4,5,6-Tetrachloro-m-Xylene	94	50-130		Decachlorobiphenyl	91	50-130	

KAHO 2	12-02-1625-2-A	02/23/12 12:36	Sediment	GC 51	03/01/12	03/07/12 15:13	120301L05

Comment(s): -Results are reported on a dry weight basis.

Parameter	Result	RL	DF	Qual	Parameter	Result	RL	DF	Qual
Aldrin	ND	1.6	1		Endosulfan I	ND	1.6	1	
Alpha-BHC	ND	1.6	1		Endosulfan II	ND	1.6	1	
Beta-BHC	ND	1.6	1		Endosulfan Sulfate	ND	1.6	1	
Delta-BHC	ND	1.6	1		Endrin	ND	1.6	1	
Gamma-BHC	ND	1.6	1		Endrin Aldehyde	ND	1.6	1	
Chlordane	ND	16	1		Endrin Ketone	ND	1.6	1	
Dieldrin	ND	1.6	1		Heptachlor	ND	1.6	1	
Trans-nonachlor	ND	1.6	1		Heptachlor Epoxide	ND	1.6	1	
2,4'-DDD	ND	1.6	1		Methoxychlor	ND	1.6	1	
2,4'-DDE	ND	1.6	1		Toxaphene	ND	33	1	
2,4'-DDT	ND	1.6	1		Alpha Chlordane	ND	1.6	1	
4,4'-DDD	ND	1.6	1		Gamma Chlordane	ND	1.6	1	
4,4'-DDE	ND	1.6	1		Oxychlordane	ND	1.6	1	
4,4'-DDT	ND	1.6	1		Cis-nonachlor	ND	1.6	1	

Surrogates:	REC (%)	Control Limits	Qual	Surrogates:	REC (%)	Control Limits	Qual
2,4,5,6-Tetrachloro-m-Xylene	79	50-130		Decachlorobiphenyl	87	50-130	

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

Calscience Environmental Laboratories, Inc.

Analytical Report

Marine Research Consultants, Inc.
1039 Waakaua Pl.
Honolulu, HI 96822-1173

Date Received:	02/28/12
Work Order No:	12-02-1625
Preparation:	EPA 3545
Method:	EPA 8081A
Units:	ug/kg

Project: C KAHO SEDIMENT PESTICIDES

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
KAHO 3	12-02-1625-3-A	02/23/12 13:42	Sediment	GC 51	03/01/12	03/07/12 15:42	120301L05

Comment(s): -Results are reported on a dry weight basis.

Parameter	Result	RL	DF	Qual	Parameter	Result	RL	DF	Qual
Aldrin	ND	12	1		Endosulfan I	ND	12	1	
Alpha-BHC	ND	12	1		Endosulfan II	ND	12	1	
Beta-BHC	ND	12	1		Endosulfan Sulfate	ND	12	1	
Delta-BHC	ND	12	1		Endrin	ND	12	1	
Gamma-BHC	ND	12	1		Endrin Aldehyde	ND	12	1	
Chlordane	ND	120	1		Endrin Ketone	ND	12	1	
Dieldrin	ND	12	1		Heptachlor	ND	12	1	
Trans-nonachlor	ND	12	1		Heptachlor Epoxide	ND	12	1	
2,4'-DDD	ND	12	1		Methoxychlor	ND	12	1	
2,4'-DDE	ND	12	1		Toxaphene	ND	250	1	
2,4'-DDT	ND	12	1		Alpha Chlordane	ND	12	1	
4,4'-DDD	ND	12	1		Oxychlordane	ND	12	1	
4,4'-DDE	ND	12	1		Gamma Chlordane	ND	12	1	
4,4'-DDT	ND	12	1		Cis-nonachlor	ND	12	1	

Surrogates:	REC (%)	Control Limits	Qual	Surrogates:	REC (%)	Control Limits	Qual
2,4,5,6-Tetrachloro-m-Xylene	105	50-130		Decachlorobiphenyl	116	50-130	

Method Blank	099-12-858-129	N/A	Solid	GC 51	03/01/12	03/06/12 14:09	120301L05

Parameter	Result	RL	DF	Qual	Parameter	Result	RL	DF	Qual
Aldrin	ND	1.0	1		Endosulfan I	ND	1.0	1	
Alpha-BHC	ND	1.0	1		Endosulfan II	ND	1.0	1	
Beta-BHC	ND	1.0	1		Endosulfan Sulfate	ND	1.0	1	
Delta-BHC	ND	1.0	1		Endrin	ND	1.0	1	
Gamma-BHC	ND	1.0	1		Endrin Aldehyde	ND	1.0	1	
Chlordane	ND	10	1		Endrin Ketone	ND	1.0	1	
Dieldrin	ND	1.0	1		Heptachlor	ND	1.0	1	
Trans-nonachlor	ND	1.0	1		Heptachlor Epoxide	ND	1.0	1	
2,4'-DDD	ND	1.0	1		Methoxychlor	ND	1.0	1	
2,4'-DDE	ND	1.0	1		Toxaphene	ND	20	1	
2,4'-DDT	ND	1.0	1		Alpha Chlordane	ND	1.0	1	
4,4'-DDD	ND	1.0	1		Oxychlordane	ND	1.0	1	
4,4'-DDE	ND	1.0	1		Gamma Chlordane	ND	1.0	1	
4,4'-DDT	ND	1.0	1		Cis-nonachlor	ND	1.0	1	

Surrogates:	REC (%)	Control Limits	Qual	Surrogates:	REC (%)	Control Limits	Qual
2,4,5,6-Tetrachloro-m-Xylene	92	50-130		Decachlorobiphenyl	98	50-130	

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

Calscience Environmental Laboratories, Inc.

Analytical Report

Marine Research Consultants, Inc.
1039 Waakaua Pl.
Honolulu, HI 96822-1173

Date Received:	02/28/12
Work Order No:	12-02-1625
Preparation:	EPA 3545
Method:	EPA 8141B
Units:	mg/kg

Project: C KAHO SEDIMENT PESTICIDES

Page 1 of 2

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
KAHO 1	12-02-1625-1-A	02/23/12 10:22	Sediment	GC 35	02/29/12	03/06/12 20:13	120229L12

Comment(s): -Results are reported on a dry weight basis.

Parameter	Result	RL	DF	Qual	Parameter	Result	RL	DF	Qual
Demeton-o/s	ND	0.67	1		Fenthion	ND	0.67	1	
Azinphos Methyl	ND	0.67	1		Merphos	ND	0.67	1	
Bolstar	ND	0.67	1		Methyl Parathion	ND	0.67	1	
Chlorpyrifos	ND	0.67	1		Mevinphos	ND	0.67	1	
Coumaphos	ND	0.67	1		Naled	ND	5.3	1	
Diazinon	ND	0.67	1		Phorate	ND	0.67	1	
Dichlorvos	ND	0.67	1		Ronnel	ND	0.67	1	
Disulfoton	ND	0.67	1		Stirophos	ND	2.7	1	
Ethoprop	ND	0.67	1		Tokuthion	ND	0.67	1	
Fensulfothion	ND	0.67	1		Trichloronate	ND	0.67	1	

Surrogates:	REC (%)	Control Limits	Qual
Tributylphosphate	108	30-130	

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
KAHO 2	12-02-1625-2-A	02/23/12 12:36	Sediment	GC 35	02/29/12	03/06/12 20:59	120229L12

Comment(s): -Results are reported on a dry weight basis.

Parameter	Result	RL	DF	Qual	Parameter	Result	RL	DF	Qual
Demeton-o/s	ND	0.82	1		Fenthion	ND	0.82	1	
Azinphos Methyl	ND	0.82	1		Merphos	ND	0.82	1	
Bolstar	ND	0.82	1		Methyl Parathion	ND	0.82	1	
Chlorpyrifos	ND	0.82	1		Mevinphos	ND	0.82	1	
Coumaphos	ND	0.82	1		Naled	ND	6.5	1	
Diazinon	ND	0.82	1		Phorate	ND	0.82	1	
Dichlorvos	ND	0.82	1		Ronnel	ND	0.82	1	
Disulfoton	ND	0.82	1		Stirophos	ND	3.3	1	
Ethoprop	ND	0.82	1		Tokuthion	ND	0.82	1	
Fensulfothion	ND	0.82	1		Trichloronate	ND	0.82	1	

Surrogates:	REC (%)	Control Limits	Qual
Tributylphosphate	101	30-130	

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

Calscience Environmental Laboratories, Inc.

Analytical Report

Marine Research Consultants, Inc.
1039 Waakaua Pl.
Honolulu, HI 96822-1173

Date Received:	02/28/12
Work Order No:	12-02-1625
Preparation:	EPA 3545
Method:	EPA 8141B
Units:	mg/kg

Project: C KAHO SEDIMENT PESTICIDES

Page 2 of 2

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
KAHO 3	12-02-1625-3-A	02/23/12 13:42	Sediment	GC 35	02/29/12	03/06/12 21:45	120229L12

Comment(s): -Results are reported on a dry weight basis.

Parameter	Result	RL	DF	Qual	Parameter	Result	RL	DF	Qual
Demeton-o/s	ND	6.2	1		Fenthion	ND	6.2	1	
Azinphos Methyl	ND	6.2	1		Merphos	ND	6.2	1	
Bolstar	ND	6.2	1		Methyl Parathion	ND	6.2	1	
Chlorpyrifos	ND	6.2	1		Mevinphos	ND	6.2	1	
Coumaphos	ND	6.2	1		Naled	ND	49	1	
Diazinon	ND	6.2	1		Phorate	ND	6.2	1	
Dichlorvos	ND	6.2	1		Ronnel	ND	6.2	1	
Disulfoton	ND	6.2	1		Stirophos	ND	25	1	
Ethoprop	ND	6.2	1		Tokuthion	ND	6.2	1	
Fensulfothion	ND	6.2	1		Trichloronate	ND	6.2	1	

Surrogates:	REC (%)	Control Limits	Qual
Tributylphosphate	87	30-130	

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
Method Blank	099-12-465-110	N/A	Solid	GC 35	02/29/12	03/02/12 23:23	120229L12

Parameter	Result	RL	DF	Qual	Parameter	Result	RL	DF	Qual
Demeton-o/s	ND	0.50	1		Fenthion	ND	0.50	1	
Azinphos Methyl	ND	0.50	1		Merphos	ND	0.50	1	
Bolstar	ND	0.50	1		Methyl Parathion	ND	0.50	1	
Chlorpyrifos	ND	0.50	1		Mevinphos	ND	0.50	1	
Coumaphos	ND	0.50	1		Naled	ND	4.0	1	
Diazinon	ND	0.50	1		Phorate	ND	0.50	1	
Dichlorvos	ND	0.50	1		Ronnel	ND	0.50	1	
Disulfoton	ND	0.50	1		Stirophos	ND	2.0	1	
Ethoprop	ND	0.50	1		Tokuthion	ND	0.50	1	
Fensulfothion	ND	0.50	1		Trichloronate	ND	0.50	1	

Surrogates:	REC (%)	Control Limits	Qual
Tributylphosphate	62	30-130	

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

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Analytical Report

ACCREDITED IN ACCORDANCE WITH nelac

Marine Research Consultants, Inc.
1039 Waakaua Pl.
Honolulu, HI 96822-1173

Date Received:	02/28/12
Work Order No:	12-02-1625
Preparation:	EPA 8151A
Method:	EPA 8151A
Units:	mg/kg

Project: C KAHO SEDIMENT PESTICIDES

Page 1 of 2

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
KAHO 1	**12-02-1625-1-A**	**02/23/12 10:22**	**Sediment**	**GC 40**	**03/07/12**	**03/09/12 14:00**	**120307L02**

Comment(s): -Results are reported on a dry weight basis.

Parameter	Result	RL	DF	Qual	Parameter	Result	RL	DF	Qual
Dalapon	ND	0.33	1		2,4-D	ND	0.13	1	
Dicamba	ND	0.013	1		2,4,5-TP (Silvex)	ND	0.013	1	
MCPP	ND	13	1		2,4,5-T	ND	0.013	1	
MCPA	ND	13	1		2,4-DB	ND	0.13	1	
Dichlorprop	ND	0.13	1		Dinoseb	ND	0.067	1	

Surrogates:	REC (%)	Control Limits	Qual
2,4-Dichlorophenylacetic acid	36	30-130	

KAHO 2	12-02-1625-2-A	02/23/12 12:36	Sediment	GC 40	03/07/12	03/09/12 14:33	120307L02

Comment(s): -Results are reported on a dry weight basis.

Parameter	Result	RL	DF	Qual	Parameter	Result	RL	DF	Qual
Dalapon	ND	0.41	1		2,4-D	ND	0.16	1	
Dicamba	ND	0.016	1		2,4,5-TP (Silvex)	ND	0.016	1	
MCPP	ND	16	1		2,4,5-T	ND	0.016	1	
MCPA	ND	16	1		2,4-DB	ND	0.16	1	
Dichlorprop	ND	0.16	1		Dinoseb	ND	0.082	1	

Surrogates:	REC (%)	Control Limits	Qual
2,4-Dichlorophenylacetic acid	43	30-130	

KAHO 3	12-02-1625-3-A	02/23/12 13:42	Sediment	GC 40	03/07/12	03/09/12 15:05	120307L02

Comment(s): -Results are reported on a dry weight basis.

Parameter	Result	RL	DF	Qual	Parameter	Result	RL	DF	Qual
Dalapon	ND	3.1	1		2,4-D	ND	1.2	1	
Dicamba	ND	0.12	1		2,4,5-TP (Silvex)	ND	0.12	1	
MCPP	ND	120	1		2,4,5-T	ND	0.12	1	
MCPA	ND	120	1		2,4-DB	ND	1.2	1	
Dichlorprop	ND	1.2	1		Dinoseb	ND	0.62	1	

Surrogates:	REC (%)	Control Limits	Qual
2,4-Dichlorophenylacetic acid	52	30-130	

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

Calscience Environmental Laboratories, Inc.

Analytical Report

ACCREDITED IN ACCORDANCE WITH nelac

Marine Research Consultants, Inc.
1039 Waakaua Pl.
Honolulu, HI 96822-1173

Date Received:	02/28/12
Work Order No:	12-02-1625
Preparation:	EPA 8151A
Method:	EPA 8151A
Units:	mg/kg

Project: C KAHO SEDIMENT PESTICIDES

Page 2 of 2

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
Method Blank	**095-01-033-992**	**N/A**	**Solid**	**GC 40**	**03/07/12**	**03/09/12 12:23**	**120307L02**

Parameter	Result	RL	DF	Qual	Parameter	Result	RL	DF	Qual
Dalapon	ND	0.25	1		2,4-D	ND	0.10	1	
Dicamba	ND	0.010	1		2,4,5-TP (Silvex)	ND	0.010	1	
MCPP	ND	10	1		2,4,5-T	ND	0.010	1	
MCPA	ND	10	1		2,4-DB	ND	0.10	1	
Dichlorprop	ND	0.10	1		Dinoseb	ND	0.050	1	

Surrogates:	REC (%)	Control Limits	Qual
2,4-Dichlorophenylacetic acid	40	30-130	

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

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Analytical Report

Marine Research Consultants, Inc.
1039 Waakaua Pl.
Honolulu, HI 96822-1173

Date Received:	02/28/12
Work Order No:	12-02-1625
Preparation:	EPA 3545
Method:	EPA 8270C SIM
Units:	mg/kg

Project: C KAHO SEDIMENT PESTICIDES

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
KAHO 1	**12-02-1625-1-A**	**02/23/12 10:22**	**Sediment**	**GC/MS MM**	**03/01/12**	**03/06/12 20:18**	**120301L08**

Comment(s): -Results are reported on a dry weight basis.

Parameter	Result	RL	DF	Qual	Parameter	Result	RL	DF	Qual
2,6-Dimethylnaphthalene	ND	0.013	1		Benzo (a) Anthracene	ND	0.013	1	
Perylene	ND	0.013	1		Benzo (a) Pyrene	ND	0.013	1	
Biphenyl	ND	0.013	1		Benzo (b) Fluoranthene	ND	0.013	1	
Benzo (e) Pyrene	ND	0.013	1		Benzo (g,h,i) Perylene	ND	0.013	1	
1-Methylnaphthalene	ND	0.013	1		Benzo (k) Fluoranthene	ND	0.013	1	
2,4,5-Trichlorophenol	ND	0.013	1		Chrysene	ND	0.013	1	
2,4,6-Trichlorophenol	ND	0.013	1		Dibenz (a,h) Anthracene	ND	0.013	1	
2,4-Dichlorophenol	ND	0.013	1		Fluoranthene	ND	0.013	1	
2,4-Dimethylphenol	ND	0.013	1		Fluorene	ND	0.013	1	
2,4-Dinitrophenol	ND	0.67	1		Indeno (1,2,3-c,d) Pyrene	ND	0.013	1	
2-Chlorophenol	ND	0.013	1		Naphthalene	ND	0.013	1	
2-Methylnaphthalene	ND	0.013	1		Pentachlorophenol	ND	0.67	1	
2-Methylphenol	ND	0.013	1		Phenanthrene	ND	0.013	1	
2-Nitrophenol	ND	0.013	1		Phenol	ND	0.013	1	
3/4-Methylphenol	ND	0.013	1		Pyrene	ND	0.013	1	
4,6-Dinitro-2-Methylphenol	ND	0.67	1		1,6,7-Trimethylnaphthalene	ND	0.013	1	
4-Chloro-3-Methylphenol	ND	0.013	1		2,3,4,6-Tetrachlorophenol	ND	0.013	1	
4-Nitrophenol	ND	0.67	1		2,6-Dichlorophenol	ND	0.013	1	
Acenaphthene	ND	0.013	1		Benzoic Acid	ND	0.13	1	
Acenaphthylene	ND	0.013	1		1-Methylphenanthrene	ND	0.013	1	
Anthracene	ND	0.013	1		Dibenzothiophene	ND	0.013	1	

Surrogates:	REC (%)	Control Limits	Qual	Surrogates:	REC (%)	Control Limits	Qual
2,4,6-Tribromophenol	56	32-143		2-Fluorobiphenyl	51	14-146	
2-Fluorophenol	54	15-138		Nitrobenzene-d5	42	18-162	
p-Terphenyl-d14	58	34-148		Phenol-d6	51	17-141	

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

Calscience Environmental Laboratories, Inc.

Analytical Report

Marine Research Consultants, Inc.
1039 Waakaua Pl.
Honolulu, HI 96822-1173

Date Received:	02/28/12
Work Order No:	12-02-1625
Preparation:	EPA 3545
Method:	EPA 8270C SIM
Units:	mg/kg

Project: C KAHO SEDIMENT PESTICIDES

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
KAHO 2	**12-02-1625-2-A**	**02/23/12 12:36**	**Sediment**	**GC/MS MM**	**03/01/12**	**03/06/12 20:44**	**120301L08**

Comment(s): -Results are reported on a dry weight basis.

Parameter	Result	RL	DF	Qual	Parameter	Result	RL	DF	Qual
Benzo (e) Pyrene	ND	0.016	1		Benzo (a) Anthracene	ND	0.016	1	
Perylene	ND	0.016	1		Benzo (a) Pyrene	ND	0.016	1	
Biphenyl	ND	0.016	1		Benzo (b) Fluoranthene	ND	0.016	1	
2,6-Dimethylnaphthalene	ND	0.016	1		Benzo (g,h,i) Perylene	ND	0.016	1	
1-Methylnaphthalene	ND	0.016	1		Benzo (k) Fluoranthene	ND	0.016	1	
2,4,5-Trichlorophenol	ND	0.016	1		Chrysene	ND	0.016	1	
2,4,6-Trichlorophenol	ND	0.016	1		Dibenz (a,h) Anthracene	ND	0.016	1	
2,4-Dichlorophenol	ND	0.016	1		Fluoranthene	ND	0.016	1	
2,4-Dimethylphenol	ND	0.016	1		Fluorene	ND	0.016	1	
2,4-Dinitrophenol	ND	0.82	1		Indeno (1,2,3-c,d) Pyrene	ND	0.016	1	
2-Chlorophenol	ND	0.016	1		Naphthalene	ND	0.016	1	
2-Methylnaphthalene	ND	0.016	1		Pentachlorophenol	ND	0.82	1	
2-Methylphenol	ND	0.016	1		Phenanthrene	ND	0.016	1	
2-Nitrophenol	ND	0.016	1		Phenol	0.14	0.016	1	
3/4-Methylphenol	0.069	0.016	1		Pyrene	ND	0.016	1	
4,6-Dinitro-2-Methylphenol	ND	0.82	1		1,6,7-Trimethylnaphthalene	ND	0.016	1	
4-Chloro-3-Methylphenol	ND	0.016	1		2,3,4,6-Tetrachlorophenol	ND	0.016	1	
4-Nitrophenol	ND	0.82	1		2,6-Dichlorophenol	ND	0.016	1	
Acenaphthene	ND	0.016	1		1-Methylphenanthrene	ND	0.016	1	
Acenaphthylene	ND	0.016	1		Benzoic Acid	ND	0.16	1	
Anthracene	ND	0.016	1		Dibenzothiophene	ND	0.016	1	

Surrogates:	REC (%)	Control Limits	Qual	Surrogates:	REC (%)	Control Limits	Qual
2,4,6-Tribromophenol	52	32-143		2-Fluorobiphenyl	46	14-146	
2-Fluorophenol	53	15-138		Nitrobenzene-d5	40	18-162	
p-Terphenyl-d14	51	34-148		Phenol-d6	50	17-141	

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

Calscience Environmental Laboratories, Inc.

Analytical Report

Marine Research Consultants, Inc.
1039 Waakaua Pl.
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Date Received:	02/28/12
Work Order No:	12-02-1625
Preparation:	EPA 3545
Method:	EPA 8270C SIM
Units:	mg/kg

Project: C KAHO SEDIMENT PESTICIDES

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
KAHO 3	**12-02-1625-3-A**	**02/23/12 13:42**	**Sediment**	**GC/MS MM**	**03/01/12**	**03/08/12 14:41**	**120301L08**

Comment(s): -Results are reported on a dry weight basis.

Parameter	Result	RL	DF	Qual	Parameter	Result	RL	DF	Qual
Benzo (e) Pyrene	ND	0.12	1		Benzo (a) Anthracene	ND	0.12	1	
2,6-Dimethylnaphthalene	0.53	0.12	1		Benzo (a) Pyrene	ND	0.12	1	
Biphenyl	ND	0.12	1		Benzo (b) Fluoranthene	ND	0.12	1	
Perylene	ND	0.12	1		Benzo (g,h,i) Perylene	ND	0.12	1	
1-Methylnaphthalene	ND	0.12	1		Benzo (k) Fluoranthene	ND	0.12	1	
2,4,5-Trichlorophenol	ND	0.12	1		Chrysene	ND	0.12	1	
2,4,6-Trichlorophenol	ND	0.12	1		Dibenz (a,h) Anthracene	ND	0.12	1	
2,4-Dichlorophenol	ND	0.12	1		Fluoranthene	ND	0.12	1	
2,4-Dimethylphenol	ND	0.12	1		Fluorene	ND	0.12	1	
2,4-Dinitrophenol	ND	6.2	1		Indeno (1,2,3-c,d) Pyrene	ND	0.12	1	
2-Chlorophenol	ND	0.12	1		Naphthalene	ND	0.12	1	
2-Methylnaphthalene	ND	0.12	1		Pentachlorophenol	ND	6.2	1	
2-Methylphenol	ND	0.12	1		Phenanthrene	ND	0.12	1	
2-Nitrophenol	ND	0.12	1		Phenol	ND	0.12	1	
3/4-Methylphenol	ND	0.12	1		Pyrene	ND	0.12	1	
4,6-Dinitro-2-Methylphenol	ND	6.2	1		1,6,7-Trimethylnaphthalene	ND	0.12	1	
4-Chloro-3-Methylphenol	ND	0.12	1		2,3,4,6-Tetrachlorophenol	ND	0.12	1	
4-Nitrophenol	ND	6.2	1		2,6-Dichlorophenol	ND	0.12	1	
Acenaphthene	ND	0.12	1		1-Methylphenanthrene	ND	0.12	1	
Acenaphthylene	ND	0.12	1		Benzoic Acid	ND	1.2	1	
Anthracene	ND	0.12	1		Dibenzothiophene	ND	0.12	1	

Surrogates:	REC (%)	Control Limits	Qual	Surrogates:	REC (%)	Control Limits	Qual
2,4,6-Tribromophenol	62	32-143		2-Fluorobiphenyl	54	14-146	
2-Fluorophenol	54	15-138		Nitrobenzene-d5	52	18-162	
p-Terphenyl-d14	58	34-148		Phenol-d6	58	17-141	

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

Calscience Environmental Laboratories, Inc.

Analytical Report

Marine Research Consultants, Inc.
1039 Waakaua Pl.
Honolulu, HI 96822-1173

Date Received:	02/28/12
Work Order No:	12-02-1625
Preparation:	EPA 3545
Method:	EPA 8270C SIM
Units:	mg/kg

Project: C KAHO SEDIMENT PESTICIDES

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
Method Blank	**099-12-413-362**	**N/A**	**Solid**	**GC/MS MM**	**03/01/12**	**03/06/12 16:26**	**120301L08**

Parameter	Result	RL	DF	Qual	Parameter	Result	RL	DF	Qual
Benzo (e) Pyrene	ND	0.010	1		Benzo (a) Anthracene	ND	0.010	1	
Perylene	ND	0.010	1		Benzo (a) Pyrene	ND	0.010	1	
Biphenyl	ND	0.010	1		Benzo (b) Fluoranthene	ND	0.010	1	
2,6-Dimethylnaphthalene	ND	0.010	1		Benzo (g,h,i) Perylene	ND	0.010	1	
1-Methylnaphthalene	ND	0.010	1		Benzo (k) Fluoranthene	ND	0.010	1	
2,4,5-Trichlorophenol	ND	0.010	1		Chrysene	ND	0.010	1	
2,4,6-Trichlorophenol	ND	0.010	1		Dibenz (a,h) Anthracene	ND	0.010	1	
2,4-Dichlorophenol	ND	0.010	1		Fluoranthene	ND	0.010	1	
2,4-Dimethylphenol	ND	0.010	1		Fluorene	ND	0.010	1	
2,4-Dinitrophenol	ND	0.50	1		Indeno (1,2,3-c,d) Pyrene	ND	0.010	1	
2-Chlorophenol	ND	0.010	1		Naphthalene	ND	0.010	1	
2-Methylnaphthalene	ND	0.010	1		Pentachlorophenol	ND	0.50	1	
2-Methylphenol	ND	0.010	1		Phenanthrene	ND	0.010	1	
2-Nitrophenol	ND	0.010	1		Phenol	ND	0.010	1	
3/4-Methylphenol	ND	0.010	1		Pyrene	ND	0.010	1	
4,6-Dinitro-2-Methylphenol	ND	0.50	1		1,6,7-Trimethylnaphthalene	ND	0.010	1	
4-Chloro-3-Methylphenol	ND	0.010	1		2,3,4,6-Tetrachlorophenol	ND	0.010	1	
4-Nitrophenol	ND	0.50	1		2,6-Dichlorophenol	ND	0.010	1	
Acenaphthene	ND	0.010	1		1-Methylphenanthrene	ND	0.010	1	
Acenaphthylene	ND	0.010	1		Benzoic Acid	ND	0.10	1	
Anthracene	ND	0.010	1		Dibenzothiophene	ND	0.010	1	

Surrogates:	REC (%)	Control Limits	Qual	Surrogates:	REC (%)	Control Limits	Qual
2,4,6-Tribromophenol	59	32-143		2-Fluorobiphenyl	58	14-146	
2-Fluorophenol	67	15-138		Nitrobenzene-d5	70	18-162	
p-Terphenyl-d14	55	34-148		Phenol-d6	54	17-141	

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

Calscience Environmental Laboratories, Inc.

Analytical Report

Marine Research Consultants, Inc.
1039 Waakaua Pl.
Honolulu, HI 96822-1173

Date Received:	02/28/12
Work Order No:	12-02-1625
Preparation:	EPA 3050B
Method:	EPA 6020
Units:	mg/kg

Project: C KAHO SEDIMENT PESTICIDES

Page 1 of 2

Client Sample Number	Lab Sample Number	Date /Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
KAHO 1	**12-02-1625-1-A**	**02/23/12 10:22**	**Sediment**	**ICP/MS 04**	**03/02/12**	**03/05/12 14:37**	**120302L01E**

Comment(s): -Results are reported on a dry weight basis.

Parameter	Result	RL	DF	Qual	Parameter	Result	RL	DF	Qual
Aluminum	9310	6.68	1		Lead	0.963	0.134	1	
Antimony	ND	0.668	1		Manganese	246	0.668	1	
Arsenic	2.06	0.134	1		Molybdenum	0.872	0.267	1	
Barium	25.6	0.134	1		Nickel	57.1	0.134	1	
Beryllium	ND	0.668	1		Selenium	0.483	0.134	1	
Cadmium	0.239	0.134	1		Silver	ND	0.134	1	
Chromium	28.5	0.134	1		Thallium	ND	0.134	1	
Cobalt	12.3	0.134	1		Vanadium	61.9	1.34	1	
Copper	24.3	0.134	1		Zinc	23.0	1.34	1	
Iron	18700	6.68	1						

KAHO 2	**12-02-1625-2-A**	**02/23/12 12:36**	**Sediment**	**ICP/MS 04**	**03/02/12**	**03/05/12 14:33**	**120302L01E**

Comment(s): -Results are reported on a dry weight basis.

Parameter	Result	RL	DF	Qual	Parameter	Result	RL	DF	Qual
Aluminum	2250	8.16	1		Lead	1.72	0.163	1	
Antimony	ND	0.816	1		Manganese	77.8	0.816	1	
Arsenic	1.02	0.163	1		Molybdenum	0.454	0.326	1	
Barium	6.21	0.163	1		Nickel	28.0	0.163	1	
Beryllium	ND	0.816	1		Selenium	0.437	0.163	1	
Cadmium	ND	0.163	1		Silver	ND	0.163	1	
Chromium	14.9	0.163	1		Thallium	ND	0.163	1	
Cobalt	4.86	0.163	1		Vanadium	35.8	1.63	1	
Copper	9.56	0.163	1		Zinc	12.5	1.63	1	
Iron	6640	8.16	1						

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

Calscience Environmental Laboratories, Inc.

Analytical Report

Marine Research Consultants, Inc.
1039 Waakaua Pl.
Honolulu, HI 96822-1173

Date Received:	02/28/12
Work Order No:	12-02-1625
Preparation:	EPA 3050B
Method:	EPA 6020
Units:	mg/kg

Project: C KAHO SEDIMENT PESTICIDES

Page 2 of 2

Client Sample Number	Lab Sample Number	Date /Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
KAHO 3	**12-02-1625-3-A**	**02/23/12 13:42**	**Sediment**	**ICP/MS 04**	**03/02/12**	**03/05/12 14:41**	**120302L01E**

Comment(s): -Results are reported on a dry weight basis.

Parameter	Result	RL	DF	Qual	Parameter	Result	RL	DF	Qual
Aluminum	2390	61.7	1		Lead	10.0	1.23	1	
Antimony	ND	6.17	1		Manganese	48.0	6.17	1	
Arsenic	3.43	1.23	1		Molybdenum	33.1	2.47	1	
Barium	4.90	1.23	1		Nickel	20.0	1.23	1	
Beryllium	ND	6.17	1		Selenium	5.80	1.23	1	
Cadmium	ND	1.23	1		Silver	ND	1.23	1	
Chromium	90.5	1.23	1		Thallium	ND	1.23	1	
Cobalt	2.50	1.23	1		Vanadium	1410	12.3	1	
Copper	137	1.23	1		Zinc	143	12.3	1	
Iron	4470	61.7	1						

Method Blank	**096-10-002-2,193**	**N/A**	**Solid**	**ICP/MS 04**	**03/02/12**	**03/06/12 16:40**	**120302L01E**

Parameter	Result	RL	DF	Qual	Parameter	Result	RL	DF	Qual
Aluminum	ND	5.00	1		Lead	ND	0.100	1	
Antimony	ND	0.500	1		Manganese	ND	0.500	1	
Arsenic	ND	0.100	1		Molybdenum	ND	0.200	1	
Barium	ND	0.100	1		Nickel	ND	0.100	1	
Beryllium	ND	0.500	1		Selenium	ND	0.100	1	
Cadmium	ND	0.100	1		Silver	ND	0.100	1	
Chromium	ND	0.100	1		Thallium	ND	0.100	1	
Cobalt	ND	0.100	1		Vanadium	ND	1.00	1	
Copper	ND	0.100	1		Zinc	ND	1.00	1	
Iron	ND	5.00	1						

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

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Calscience Environmental Laboratories, Inc.

Analytical Report

Marine Research Consultants, Inc.
1039 Waakaua Pl.
Honolulu, HI 96822-1173

Date Received:	02/28/12
Work Order No:	12-02-1625
Preparation:	EPA 7471A Total
Method:	EPA 7471A

Project: C KAHO SEDIMENT PESTICIDES

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
KAHO 1	12-02-1625-1-A	02/23/12 10:22	Sediment	Mercury	03/07/12	03/07/12 17:55	120307L01E

-Results are reported on a dry weight basis.

Parameter	Result	RL	DF	Qual	Units
Mercury	ND	0.0268	1		mg/kg

KAHO 2	12-02-1625-2-A	02/23/12 12:36	Sediment	Mercury	03/07/12	03/07/12 17:57	120307L01E

-Results are reported on a dry weight basis.

Parameter	Result	RL	DF	Qual	Units
Mercury	ND	0.0327	1		mg/kg

KAHO 3	12-02-1625-3-A	02/23/12 13:42	Sediment	Mercury	03/07/12	03/07/12 18:04	120307L01E

-Results are reported on a dry weight basis.

Parameter	Result	RL	DF	Qual	Units
Mercury	ND	0.247	1		mg/kg

Method Blank	099-12-452-275	N/A	Solid	Mercury	03/07/12	03/07/12 11:02	120307L01E

Parameter	Result	RL	DF	Qual	Units
Mercury	ND	0.0200	1		mg/kg

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

Calscience Environmental Laboratories, Inc.

Quality Control - Spike/Spike Duplicate

Marine Research Consultants, Inc.
1039 Waakaua Pl.
Honolulu, HI 96822-1173

Date Received:	02/28/12
Work Order No:	12-02-1625
Preparation:	EPA 3050B
Method:	EPA 6020

Project C KAHO SEDIMENT PESTICIDES

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	MS/MSD Batch Number
KAHO 2	Sediment	ICP/MS 04	03/02/12	03/05/12	120302S01

Parameter	SPIKE ADDED	MS %REC	MSD %REC	%REC CL	RPD	RPD CL	Qualifiers
Aluminum	25.00	4X	4X	80-120	4X	0-20	Q
Antimony	25.00	66	57	80-120	15	0-20	3
Arsenic	25.00	109	108	80-120	1	0-20	
Barium	25.00	123	113	80-120	7	0-20	3
Beryllium	25.00	111	110	80-120	1	0-20	
Cadmium	25.00	99	96	80-120	2	0-20	
Chromium	25.00	109	119	80-120	6	0-20	
Cobalt	25.00	108	106	80-120	1	0-20	
Copper	25.00	103	107	80-120	3	0-20	
Iron	25.00	4X	4X	80-120	4X	0-20	Q
Lead	25.00	113	112	80-120	0	0-20	
Manganese	25.00	191	176	80-120	4	0-20	3
Molybdenum	25.00	115	113	80-120	2	0-20	
Nickel	25.00	123	128	80-120	3	0-20	3
Selenium	25.00	127	112	80-120	12	0-20	3
Silver	12.50	97	95	80-120	2	0-20	
Thallium	25.00	99	103	80-120	4	0-20	
Vanadium	25.00	124	148	80-120	11	0-20	3
Zinc	25.00	98	94	80-120	3	0-20	

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - PDS / PDSD

Marine Research Consultants, Inc.	Date Received	02/28/12
1039 Waakaua Pl.	Work Order No:	12-02-1625
Honolulu, HI 96822-1173	Preparation:	EPA 3050B
	Method:	EPA 6020

Project: C KAHO SEDIMENT PESTICIDES

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	PDS / PDSD Batch Number
KAHO 2	**Sediment**	**ICP/MS 04**	**03/02/12**	**03/05/12**	**120302S01**

Analysis Comment: * - Analyzed 3/6/2012 5:16:07 PM

Parameter	SPIKE ADDED	PDS %REC	PDSD %REC	%REC CL	RPD	RPD CL	Qualifiers
Aluminum	25.00	4X	4X	75-125	4X	0-20	Q
Antimony	25.00	92	94	75-125	2	0-20	
Arsenic	25.00	104	105	75-125	1	0-20	
Barium	25.00	100	103	75-125	3	0-20	
Beryllium	25.00	108	110	75-125	3	0-20	
Cadmium	25.00	92	94	75-125	2	0-20	
Chromium	25.00	98	99	75-125	1	0-20	
Cobalt	25.00	98	98	75-125	1	0-20	
Copper	25.00	95	97	75-125	2	0-20	
Iron	25.00	4X	4X	75-125	4X	0-20	Q
Lead	25.00	103	104	75-125	1	0-20	
Manganese	25.00	103	96	75-125	2	0-20	
Molybdenum	25.00	109	110	75-125	1	0-20	
Nickel	25.00	97	98	75-125	0	0-20	
Selenium	25.00	125	108	75-125	15	0-20	
Silver	12.50	81	81	75-125	0	0-20	
Thallium	25.00	94	95	75-125	2	0-20	
Vanadium	25.00	109	103	75-125	3	0-20	
Zinc	25.00	85	86	75-125	1	0-20	

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - Duplicate

Marine Research Consultants, Inc.	Date Received:	02/28/12
1039 Waakaua Pl.	Work Order No:	12-02-1625
Honolulu, HI 96822-1173	Preparation:	N/A
	Method:	SM 2540 B

Project: C KAHO SEDIMENT PESTICIDES

Quality Control Sample ID	Matrix	Instrument	Date Prepared:	Date Analyzed:	Duplicate Batch Number
12-03-0909-1	**Sediment**	**N/A**	**03/14/12**	**03/14/12**	**C0314TSD2**

Parameter	Sample Conc	DUP Conc	RPD	RPD CL	Qualifiers
Solids, Total	39.9	40.7	2	0-10	

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - Spike/Spike Duplicate

Marine Research Consultants, Inc.
1039 Waakaua Pl.
Honolulu, HI 96822-1173

Date Received: 02/28/12
Work Order No: 12-02-1625
Preparation: EPA 7471A Total
Method: EPA 7471A

Project C KAHO SEDIMENT PESTICIDES

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	MS/MSD Batch Number
12-03-0330-1	Solid	Mercury	03/07/12	03/07/12	120307S01

Parameter	SPIKE ADDED	MS %REC	MSD %REC	%REC CL	RPD	RPD CL	Qualifiers
Mercury	0.8350	105	104	71-137	1	0-14	

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - Spike/Spike Duplicate

Marine Research Consultants, Inc.
1039 Waakaua Pl.
Honolulu, HI 96822-1173

Date Received: 02/28/12
Work Order No: 12-02-1625
Preparation: EPA 8151A
Method: EPA 8151A

Project C KAHO SEDIMENT PESTICIDES

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	MS/MSD Batch Number
KAHO 2	Sediment	GC 40	03/07/12	03/09/12	120307S02

Parameter	SPIKE ADDED	MS %REC	MSD %REC	%REC CL	RPD	RPD CL	Qualifiers
2,4-D	0.4000	45	66	30-130	38	0-30	4
2,4,5-T	0.04000	42	65	30-130	42	0-30	4
2,4-DB	0.4000	34	37	30-130	8	0-30	

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - Spike/Spike Duplicate

Marine Research Consultants, Inc.	Date Received:	02/28/12
1039 Waakaua Pl.	Work Order No:	12-02-1625
Honolulu, HI 96822-1173	Preparation:	EPA 3545
	Method:	EPA 8081A

Project C KAHO SEDIMENT PESTICIDES

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	MS/MSD Batch Number
12-02-1512-2	Sediment	GC 51	03/01/12	03/06/12	120301S05

Parameter	SPIKE ADDED	MS %REC	MSD %REC	%REC CL	RPD	RPD CL	Qualifiers
Aldrin	5.000	83	73	50-135	12	0-25	
Alpha-BHC	5.000	95	76	50-135	22	0-25	
Beta-BHC	5.000	103	90	50-135	13	0-25	
Delta-BHC	5.000	95	82	50-135	14	0-25	
Gamma-BHC	5.000	89	76	50-135	16	0-25	
Dieldrin	5.000	89	79	50-135	12	0-25	
4,4'-DDD	5.000	107	93	50-135	14	0-25	
4,4'-DDE	5.000	116	103	50-135	12	0-25	
4,4'-DDT	5.000	85	70	50-135	19	0-25	
Endosulfan I	5.000	86	76	50-135	13	0-25	
Endosulfan II	5.000	87	75	50-135	14	0-25	
Endosulfan Sulfate	5.000	89	78	50-135	14	0-25	
Endrin	5.000	102	88	50-135	14	0-25	
Endrin Aldehyde	5.000	70	57	50-135	21	0-25	
Endrin Ketone	5.000	94	76	50-135	20	0-25	
Heptachlor	5.000	82	70	50-135	16	0-25	
Heptachlor Epoxide	5.000	86	74	50-135	14	0-25	
Methoxychlor	5.000	75	62	50-135	19	0-25	
Alpha Chlordane	5.000	96	85	50-135	12	0-25	
Gamma Chlordane	5.000	90	78	50-135	15	0-25	

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - Spike/Spike Duplicate

Marine Research Consultants, Inc.	Date Received:	02/28/12
1039 Waakaua Pl.	Work Order No:	12-02-1625
Honolulu, HI 96822-1173	Preparation:	EPA 3545
	Method:	EPA 8141B

Project C KAHO SEDIMENT PESTICIDES

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	MS/MSD Batch Number
12-02-1607-9	Solid	GC 35	02/29/12	03/06/12	120229S12

Parameter	SPIKE ADDED	MS %REC	MSD %REC	%REC CL	RPD	RPD CL	Qualifiers
Azinphos Methyl	4.000	83	80	30-130	4	0-30	
Bolstar	4.000	89	85	30-130	4	0-30	
Chlorpyrifos	4.000	77	75	30-130	3	0-30	
Coumaphos	4.000	88	84	30-130	5	0-30	
Diazinon	4.000	84	79	30-130	6	0-30	
Disulfoton	4.000	86	80	30-130	7	0-30	
Ethoprop	4.000	88	84	30-130	5	0-30	
Fensulfothion	4.000	88	85	30-130	4	0-30	
Fenthion	4.000	82	79	30-130	3	0-30	
Merphos	4.000	85	82	30-130	4	0-30	
Methyl Parathion	4.000	79	76	30-130	3	0-30	
Phorate	4.000	91	85	30-130	6	0-30	
Ronnel	4.000	76	74	30-130	3	0-30	
Stirophos	4.000	72	68	30-130	5	0-30	
Tokuthion	4.000	80	78	30-130	4	0-30	
Trichloronate	4.000	78	76	30-130	3	0-30	

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - Spike/Spike Duplicate

Marine Research Consultants, Inc.	Date Received:	02/28/12
1039 Waakaua Pl.	Work Order No:	12-02-1625
Honolulu, HI 96822-1173	Preparation:	EPA 3545
	Method:	EPA 8270C SIM

Project C KAHO SEDIMENT PESTICIDES

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	MS/MSD Batch Number
12-02-1512-2	Sediment	GC/MS MM	03/01/12	03/06/12	120301S08

Parameter	SPIKE ADDED	MS %REC	MSD %REC	%REC CL	RPD	RPD CL	Qualifiers
2,4,6-Trichlorophenol	1.000	65	64	40-160	2	0-20	
2,4-Dichlorophenol	1.000	69	69	40-160	0	0-20	
2-Methylphenol	1.000	57	56	40-160	1	0-20	
2-Nitrophenol	1.000	61	61	40-160	0	0-20	
4-Chloro-3-Methylphenol	1.000	65	66	40-160	2	0-20	
Acenaphthene	1.000	60	58	40-106	3	0-20	
Benzo (a) Pyrene	1.000	61	60	17-163	2	0-20	
Chrysene	1.000	58	57	17-168	3	0-20	
Di-n-Butyl Phthalate	1.000	60	59	40-160	2	0-20	
Dimethyl Phthalate	1.000	60	59	40-160	2	0-20	
Fluoranthene	1.000	62	60	26-137	3	0-20	
Fluorene	1.000	63	62	59-121	2	0-20	
Naphthalene	1.000	59	58	21-133	2	0-20	
Phenanthrene	1.000	61	59	54-120	3	0-20	
Phenol	1.000	55	54	40-160	1	0-20	
Pyrene	1.000	61	60	6-156	2	0-46	

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - LCS/LCS Duplicate

Marine Research Consultants, Inc.	Date Received:	N/A
1039 Waakaua Pl.	Work Order No:	12-02-1625
Honolulu, HI 96822-1173	Preparation:	EPA 3050B
	Method:	EPA 6020

Project: C KAHO SEDIMENT PESTICIDES

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	LCS/LCSD Batch Number
096-10-002-2,193	Solid	ICP/MS 04	03/02/12	03/06/12	120302L01E

Parameter	SPIKE ADDED	LCS %REC	LCSD %REC	%REC CL	ME CL	RPD	RPD CL	Qualifiers
Aluminum	25.00	119	107	80-120	73-127	11	0-20	
Antimony	25.00	95	94	80-120	73-127	1	0-20	
Arsenic	25.00	96	94	80-120	73-127	2	0-20	
Barium	25.00	103	102	80-120	73-127	1	0-20	
Beryllium	25.00	101	100	80-120	73-127	1	0-20	
Cadmium	25.00	104	104	80-120	73-127	1	0-20	
Chromium	25.00	99	95	80-120	73-127	5	0-20	
Cobalt	25.00	101	99	80-120	73-127	2	0-20	
Copper	25.00	101	99	80-120	73-127	2	0-20	
Iron	25.00	87	105	80-120	73-127	19	0-20	
Lead	25.00	85	85	80-120	73-127	1	0-20	
Manganese	25.00	98	97	80-120	73-127	1	0-20	
Molybdenum	25.00	95	94	80-120	73-127	1	0-20	
Nickel	25.00	99	98	80-120	73-127	1	0-20	
Selenium	25.00	93	93	80-120	73-127	0	0-20	
Silver	12.50	75	73	80-120	73-127	2	0-20	ME
Thallium	25.00	92	92	80-120	73-127	0	0-20	
Vanadium	25.00	97	96	80-120	73-127	2	0-20	
Zinc	25.00	102	120	80-120	73-127	17	0-20	

Total number of LCS compounds : 19
Total number of ME compounds : 1
Total number of ME compounds allowed : 1
LCS ME CL validation result : Pass

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - LCS/LCS Duplicate

Marine Research Consultants, Inc.
1039 Waakaua Pl.
Honolulu, HI 96822-1173

Date Received: N/A
Work Order No: 12-02-1625
Preparation: EPA 7471A Total
Method: EPA 7471A

Project: C KAHO SEDIMENT PESTICIDES

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	LCS/LCSD Batch Number
099-12-452-275	Solid	Mercury	03/07/12	03/07/12	120307L01E

Parameter	SPIKE ADDED	LCS %REC	LCSD %REC	%REC CL	RPD	RPD CL	Qualifiers
Mercury	0.8350	100	100	82-124	0	0-16	

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - LCS/LCS Duplicate

Marine Research Consultants, Inc.
1039 Waakaua Pl.
Honolulu, HI 96822-1173

Date Received: N/A
Work Order No: 12-02-1625
Preparation: EPA 8151A
Method: EPA 8151A

Project: C KAHO SEDIMENT PESTICIDES

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	LCS/LCSD Batch Number
095-01-033-992	Solid	GC 40	03/07/12	03/09/12	120307L02

Parameter	SPIKE ADDED	LCS %REC	LCSD %REC	%REC CL	RPD	RPD CL	Qualifiers
2,4-D	0.4000	81	63	30-130	25	0-30	
2,4,5-T	0.04000	81	71	30-130	12	0-30	
2,4-DB	0.4000	37	31	30-130	17	0-30	

RPD - Relative Percent Difference , CL - Control Limit

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Calscience Environmental Laboratories, Inc.

Quality Control - LCS/LCS Duplicate

Marine Research Consultants, Inc.
1039 Waakaua Pl.
Honolulu, HI 96822-1173

Date Received: N/A
Work Order No: 12-02-1625
Preparation: EPA 3545
Method: EPA 8081A

Project: C KAHO SEDIMENT PESTICIDES

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	LCS/LCSD Batch Number
099-12-858-129	Solid	GC 51	03/01/12	03/06/12	120301L05

Parameter	SPIKE ADDED	LCS %REC	LCSD %REC	%REC CL	ME CL	RPD	RPD CL	Qualifiers
Aldrin	5.000	91	89	50-135	36-149	2	0-25	
Alpha-BHC	5.000	93	87	50-135	36-149	7	0-25	
Beta-BHC	5.000	93	94	50-135	36-149	0	0-25	
Delta-BHC	5.000	94	84	50-135	36-149	11	0-25	
Gamma-BHC	5.000	96	90	50-135	36-149	7	0-25	
Dieldrin	5.000	93	91	50-135	36-149	3	0-25	
4,4'-DDD	5.000	95	93	50-135	36-149	2	0-25	
4,4'-DDE	5.000	95	93	50-135	36-149	2	0-25	
4,4'-DDT	5.000	88	83	50-135	36-149	6	0-25	
Endosulfan I	5.000	91	89	50-135	36-149	2	0-25	
Endosulfan II	5.000	90	88	50-135	36-149	2	0-25	
Endosulfan Sulfate	5.000	89	86	50-135	36-149	4	0-25	
Endrin	5.000	96	87	50-135	36-149	10	0-25	
Endrin Aldehyde	5.000	88	88	50-135	36-149	0	0-25	
Endrin Ketone	5.000	94	93	50-135	36-149	1	0-25	
Heptachlor	5.000	93	85	50-135	36-149	9	0-25	
Heptachlor Epoxide	5.000	89	87	50-135	36-149	2	0-25	
Methoxychlor	5.000	87	83	50-135	36-149	5	0-25	
Alpha Chlordane	5.000	92	90	50-135	36-149	3	0-25	
Gamma Chlordane	5.000	93	91	50-135	36-149	3	0-25	

Total number of LCS compounds : 20
Total number of ME compounds : 0
Total number of ME compounds allowed : 1
LCS ME CL validation result : Pass

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - LCS/LCS Duplicate

Marine Research Consultants, Inc.
1039 Waakaua Pl.
Honolulu, HI 96822-1173

Date Received: N/A
Work Order No: 12-02-1625
Preparation: EPA 3545
Method: EPA 8141B

Project: C KAHO SEDIMENT PESTICIDES

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	LCS/LCSD Batch Number
099-12-465-110	Solid	GC 35	02/29/12	03/02/12	120229L12

Parameter	SPIKE ADDED	LCS %REC	LCSD %REC	%REC CL	ME CL	RPD	RPD CL	Qualifiers
Azinphos Methyl	4.000	68	74	30-130	13-147	8	0-30	
Bolstar	4.000	75	78	30-130	13-147	4	0-30	
Chlorpyrifos	4.000	67	69	30-130	13-147	3	0-30	
Coumaphos	4.000	72	77	30-130	13-147	7	0-30	
Diazinon	4.000	71	72	30-130	13-147	2	0-30	
Disulfoton	4.000	72	73	30-130	13-147	1	0-30	
Ethoprop	4.000	75	76	30-130	13-147	2	0-30	
Fensulfothion	4.000	73	77	30-130	13-147	6	0-30	
Fenthion	4.000	70	72	30-130	13-147	3	0-30	
Merphos	4.000	72	75	30-130	13-147	4	0-30	
Methyl Parathion	4.000	68	70	30-130	13-147	3	0-30	
Phorate	4.000	77	79	30-130	13-147	2	0-30	
Ronnel	4.000	66	68	30-130	13-147	3	0-30	
Stirophos	4.000	60	63	30-130	13-147	5	0-30	
Tokuthion	4.000	68	72	30-130	13-147	5	0-30	
Trichloronate	4.000	68	71	30-130	13-147	4	0-30	

Total number of LCS compounds : 16
Total number of ME compounds : 0
Total number of ME compounds allowed : 1
LCS ME CL validation result : Pass

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - LCS/LCS Duplicate

Marine Research Consultants, Inc.	Date Received:	N/A
1039 Waakaua Pl.	Work Order No:	12-02-1625
Honolulu, HI 96822-1173	Preparation:	EPA 3545
	Method:	EPA 8270C SIM

Project: C KAHO SEDIMENT PESTICIDES

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	LCS/LCSD Batch Number
099-12-413-362	Solid	GC/MS MM	03/01/12	03/06/12	120301L08

Parameter	SPIKE ADDED	LCS %REC	LCSD %REC	%REC CL	ME CL	RPD	RPD CL	Qualifiers
2,4,6-Trichlorophenol	1.000	60	58	40-160	20-180	3	0-20	
2,4-Dichlorophenol	1.000	65	64	40-160	20-180	1	0-20	
2-Methylphenol	1.000	52	53	40-160	20-180	2	0-20	
2-Nitrophenol	1.000	53	51	40-160	20-180	3	0-20	
4-Chloro-3-Methylphenol	1.000	63	62	40-160	20-180	1	0-20	
Acenaphthene	1.000	58	57	48-108	38-118	3	0-11	
Benzo (a) Pyrene	1.000	61	58	17-163	0-187	5	0-20	
Chrysene	1.000	56	54	17-168	0-193	5	0-20	
Di-n-Butyl Phthalate	1.000	63	60	40-160	20-180	4	0-20	
Dimethyl Phthalate	1.000	62	60	40-160	20-180	4	0-20	
Fluoranthene	1.000	61	59	26-137	8-156	4	0-20	
Fluorene	1.000	58	58	59-121	49-131	1	0-20	ME
Naphthalene	1.000	62	61	21-133	2-152	1	0-20	
Phenanthrene	1.000	59	57	54-120	43-131	3	0-20	
Phenol	1.000	53	53	40-160	20-180	1	0-20	
Pyrene	1.000	53	51	28-106	15-119	4	0-16	

Total number of LCS compounds : 16
Total number of ME compounds : 1
Total number of ME compounds allowed : 1
LCS ME CL validation result : Pass

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Glossary of Terms and Qualifiers

Work Order Number: 12-02-1625

Qualifier	Definition
*	See applicable analysis comment.
<	Less than the indicated value.
>	Greater than the indicated value.
1	Surrogate compound recovery was out of control due to a required sample dilution. Therefore, the sample data was reported without further clarification.
2	Surrogate compound recovery was out of control due to matrix interference. The associated method blank surrogate spike compound was in control and, therefore, the sample data was reported without further clarification.
3	Recovery of the Matrix Spike (MS) or Matrix Spike Duplicate (MSD) compound was out of control due to matrix interference. The associated LCS and/or LCSD was in control and, therefore, the sample data was reported without further clarification.
4	The MS/MSD RPD was out of control due to matrix interference. The LCS/LCSD RPD was in control and, therefore, the sample data was reported without further clarification.
5	The PDS/PDSD or PES/PESD associated with this batch of samples was out of control due to a matrix interference effect. The associated batch LCS/LCSD was in control and, hence, the associated sample data was reported without further clarification.
6	Surrogate recovery below the acceptance limit.
7	Surrogate recovery above the acceptance limit.
B	Analyte was present in the associated method blank.
BU	Sample analyzed after holding time expired.
E	Concentration exceeds the calibration range.
ET	Sample was extracted past end of recommended max. holding time.
HD	The chromatographic pattern was inconsistent with the profile of the reference fuel standard.
HDH	The sample chromatographic pattern for TPH matches the chromatographic pattern of the specified standard but heavier hydrocarbons were also present (or detected).
HDL	The sample chromatographic pattern for TPH matches the chromatographic pattern of the specified standard but lighter hydrocarbons were also present (or detected).
J	Analyte was detected at a concentration below the reporting limit and above the laboratory method detection limit. Reported value is estimated.
ME	LCS/LCSD Recovery Percentage is within Marginal Exceedance (ME) Control Limit range.
ND	Parameter not detected at the indicated reporting limit.
Q	Spike recovery and RPD control limits do not apply resulting from the parameter concentration in the sample exceeding the spike concentration by a factor of four or greater.
SG	The sample extract was subjected to Silica Gel treatment prior to analysis.
X	% Recovery and/or RPD out-of-range.
Z	Analyte presence was not confirmed by second column or GC/MS analysis.

Solid - Unless otherwise indicated, solid sample data is reported on a wet weight basis, not corrected for % moisture. All QC results are reported on a wet weight basis.
MPN - Most Probable Number

FedEx. USA Airbill Express

8431 3189 3749

Recipient's

1 From: STEVEN DOLLAR, MARINE RESEARCH CONSULTANTS, 1039 WAAKAUA PL, HONOLULU HI 96822, Phone 808 988-3002

2 Your Internal Billing Reference

3 To: CALSCIENCES ENVIRONMENTAL LABS, 7440 LINCOLN WAY, GARDEN GROVE CA 92841-1427, Phone 714 895-5494

4a Express Package Service: FedEx Standard Overnight

4b Express Freight Service

5 Packaging: FedEx Envelope*

6 Special Handling

7 Payment: Sender

8 Release Signature

Total Weight

Total Charges

0259360555

1447

CHAIN OF CUSTODY

MARINE RESEARCH CONSULTANTS
1039 WAAKAUA PL. HON. HI 96822

SUBMITTED TO:

Calsciences Environmental Labs
7440 Lincoln Way
Garden Grove CA 92841-1427
714 895-5494

12-02-1625

PROJECT: C KAHO SEDIMENT PESTICIDES

	SAMPLE ID	DATE	TIME	SAMPLE TYPE	# OF CONTAINERS	REQUESTED ANALYSES FOR ALL SAMPLES	PRESERVE
1	KAHO 1	2/23/12	10:22	12 OZ	1	8081, 8141, 8151, 8270 (PAH)	chill
				GRAB		METALS	
2	KAHO 2	2/23/2012	12:36	"	1		"
3	KAHO 3	2/23/2012	13:42	"	1		"

SAMPLED BY: Steven Dollar 2/23/12	RELINQUISHED BY: Steven Dollar 2/27/12	RECEIVED BY:
PRINT / DATE	PRINT / DATE	PRINT / DATE
	11:00	3. PATEL 2/28/12
SIGNATURE / TIME	SIGNATURE / TIME	SIGNATURE / TIME 1000

PLEASE RETURN SIGNED CHAIN OF CUSTODY FORM IN ENCLOSED ENVELOPE.
SAMPLE RESULTS DUE BY:

Calscience Environmental Laboratories, Inc.

WORK ORDER #: 12-02-1625

SAMPLE RECEIPT FORM Cooler 1 of 1

CLIENT: Marine Research DATE: 02/28/12

TEMPERATURE: Thermometer ID: SC3 (Criteria: 0.0 °C – 6.0 °C, not frozen)

Temperature 5.8 °C - 0.3 °C (CF) = 5.5 °C ☐ Blank ☑ Sample

☐ Sample(s) outside temperature criteria (PM/APM contacted by: _____).

☐ Sample(s) outside temperature criteria but received on ice/chilled on same day of sampling.

☐ **Received at ambient temperature, placed on ice for transport by Courier.**

Ambient Temperature: ☐ Air ☐ Filter Initial: JP

CUSTODY SEALS INTACT:

☐ Cooler ☐_____ ☐ No (Not Intact) ☑ Not Present ☐ N/A Initial: JP

☐ Sample ☐_____ ☐ No (Not Intact) ☑ Not Present Initial: NS

SAMPLE CONDITION:	Yes	No	N/A
Chain-Of-Custody (COC) document(s) received with samples	☑	☐	☐
COC document(s) received complete	☑	☐	☐
☐ Collection date/time, matrix, and/or # of containers logged in based on sample labels.			
☐ No analysis requested. ☐ Not relinquished. ☐ No date/time relinquished.			
Sampler's name indicated on COC	☑	☐	☐
Sample container label(s) consistent with COC	☑	☐	☐
Sample container(s) intact and good condition	☑	☐	☐
Proper containers and sufficient volume for analyses requested	☑	☐	☐
Analyses received within holding time	☑	☐	☐
pH / Res. Chlorine / Diss. Sulfide / Diss. Oxygen received within 24 hours	☐	☐	☑
Proper preservation noted on COC or sample container	☐	☐	☑
☐ Unpreserved vials received for Volatiles analysis			
Volatile analysis container(s) free of headspace	☐	☐	☑
Tedlar bag(s) free of condensation	☐	☐	☑

CONTAINER TYPE:

Solid: ☐4ozCGJ ☐8ozCGJ ☐16ozCGJ ☐Sleeve (_____) ☐EnCores® ☐TerraCores® ☑500CGJ

Water: ☐VOA ☐VOAh ☐VOAna$_2$ ☐125AGB ☐125AGBh ☐125AGBp ☐1AGB ☐1AGBna$_2$ ☐1AGBs ☐500AGB ☐500AGJ ☐500AGJs ☐250AGB ☐250CGB ☐250CGBs ☐1PB ☐1PBna ☐500PB ☐250PB ☐250PBn ☐125PB ☐125PBznna ☐100PJ ☐100PJna$_2$ ☐_____ ☐_____ ☐_____

Air: ☐Tedlar® ☐Summa® **Other:** ☐_____ **Trip Blank Lot#:**_____ **Labeled/Checked by:** NS

Container: C: Clear A: Amber P: Plastic G: Glass J: Jar B: Bottle Z: Ziploc/Resealable Bag E: Envelope **Reviewed by:** JP

Preservative: h: HCL n: HNO_3 na$_2$: $Na_2S_2O_3$ na: NaOH p: H_3PO_4 s: H_2SO_4 u: Ultra-pure znna: $ZnAc_2$+NaOH f: Filtered **Scanned by:** JP

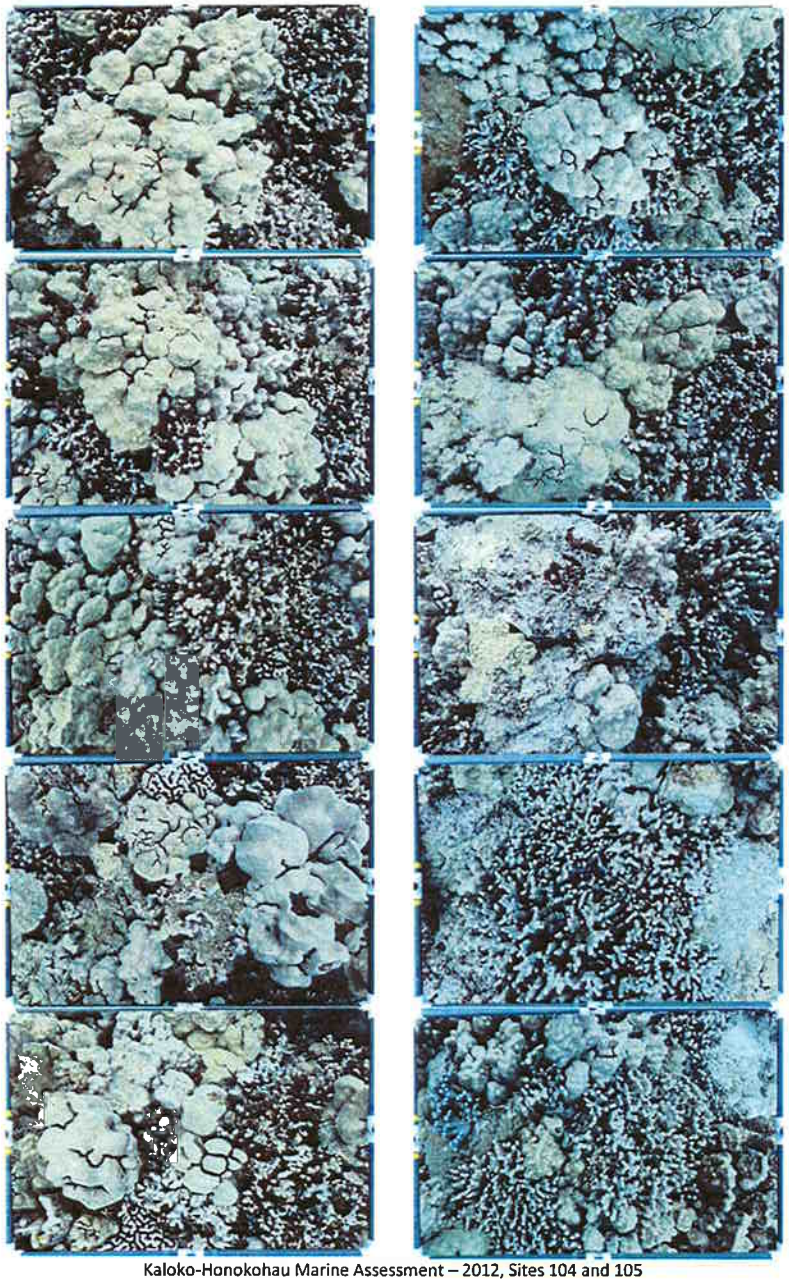
ROP T100 090 (12/06/11)

APPENDIX B.

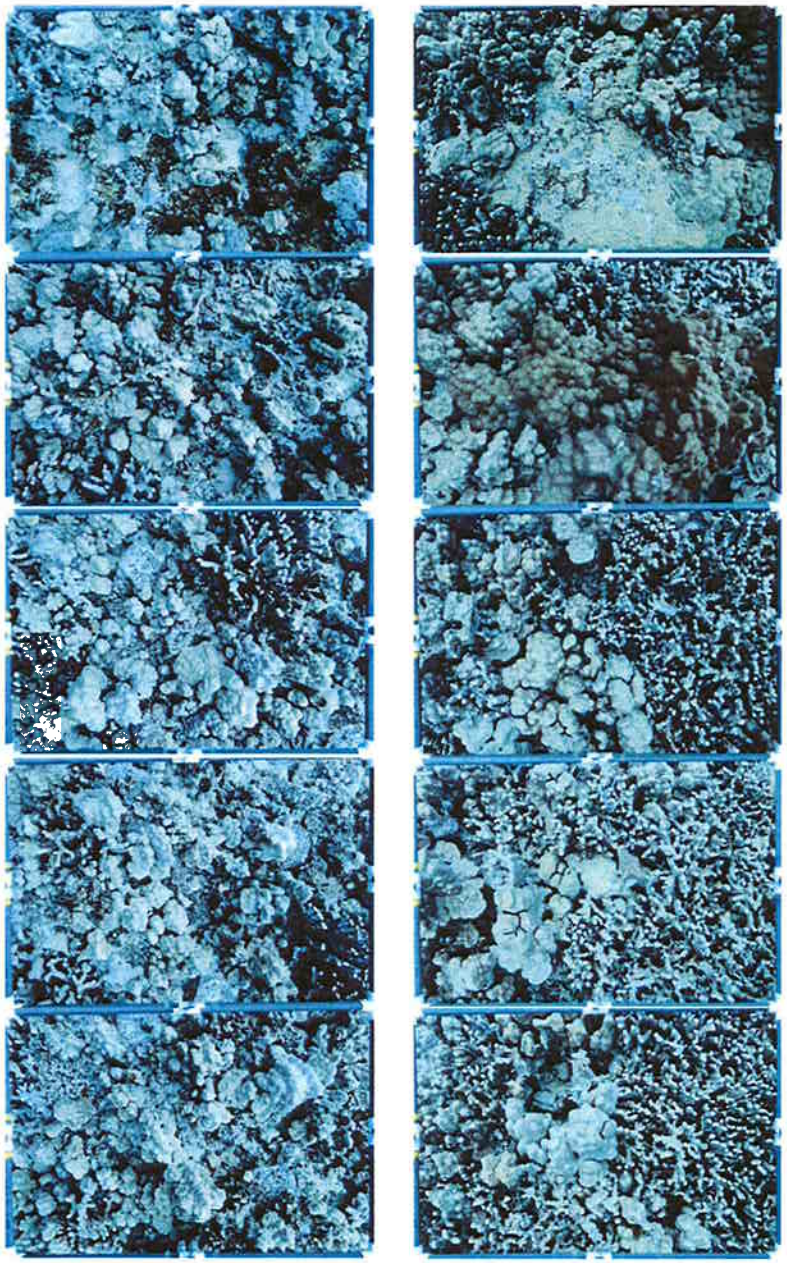
Calibration-Validation Photographs

Kaloko-Honokohau

March 2012



Kaloko-Honokohau Marine Assessment – 2012, Sites 104 and 105



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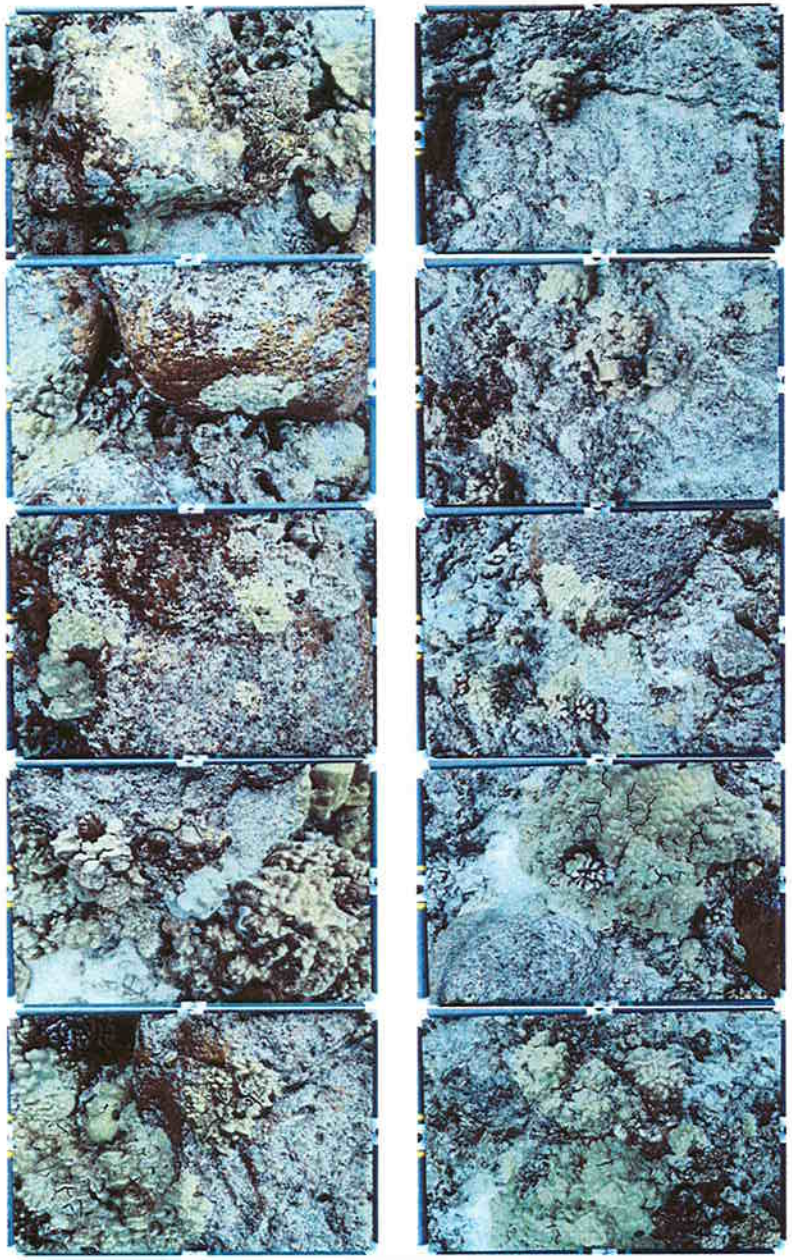
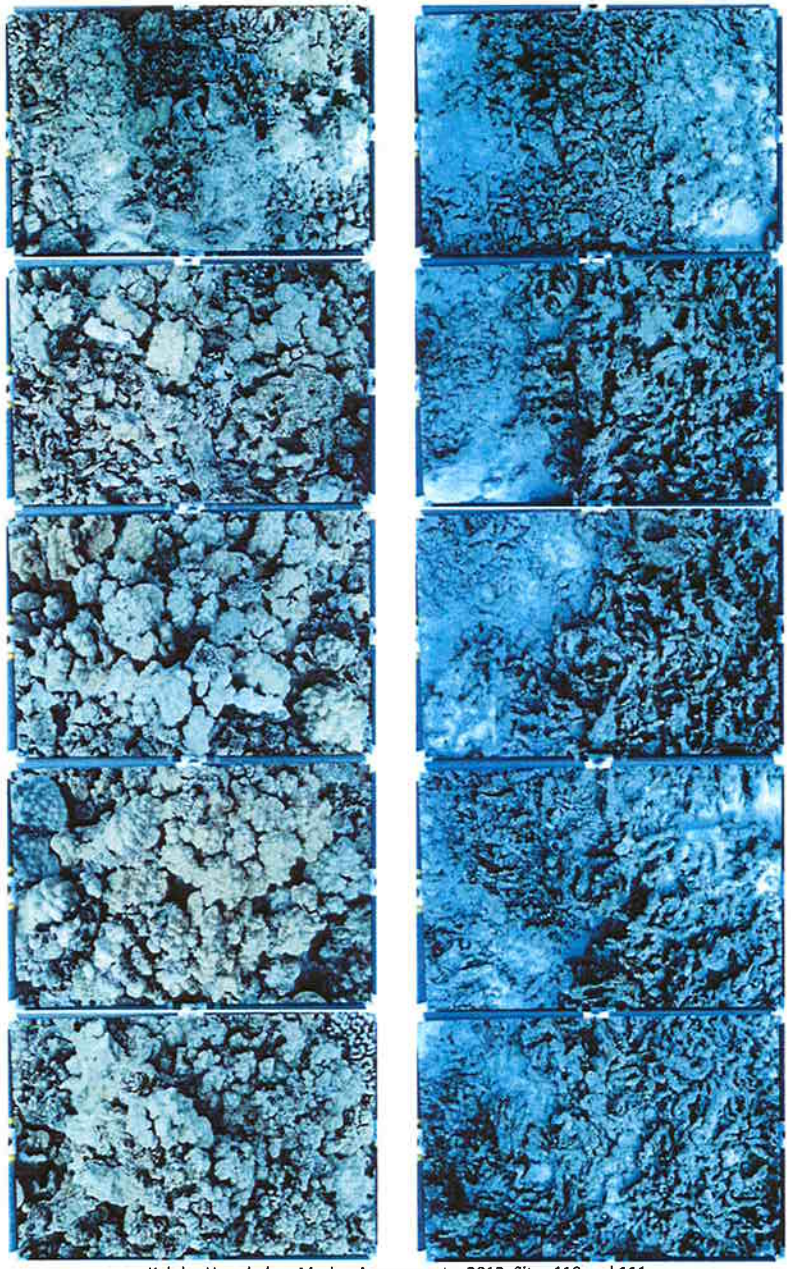
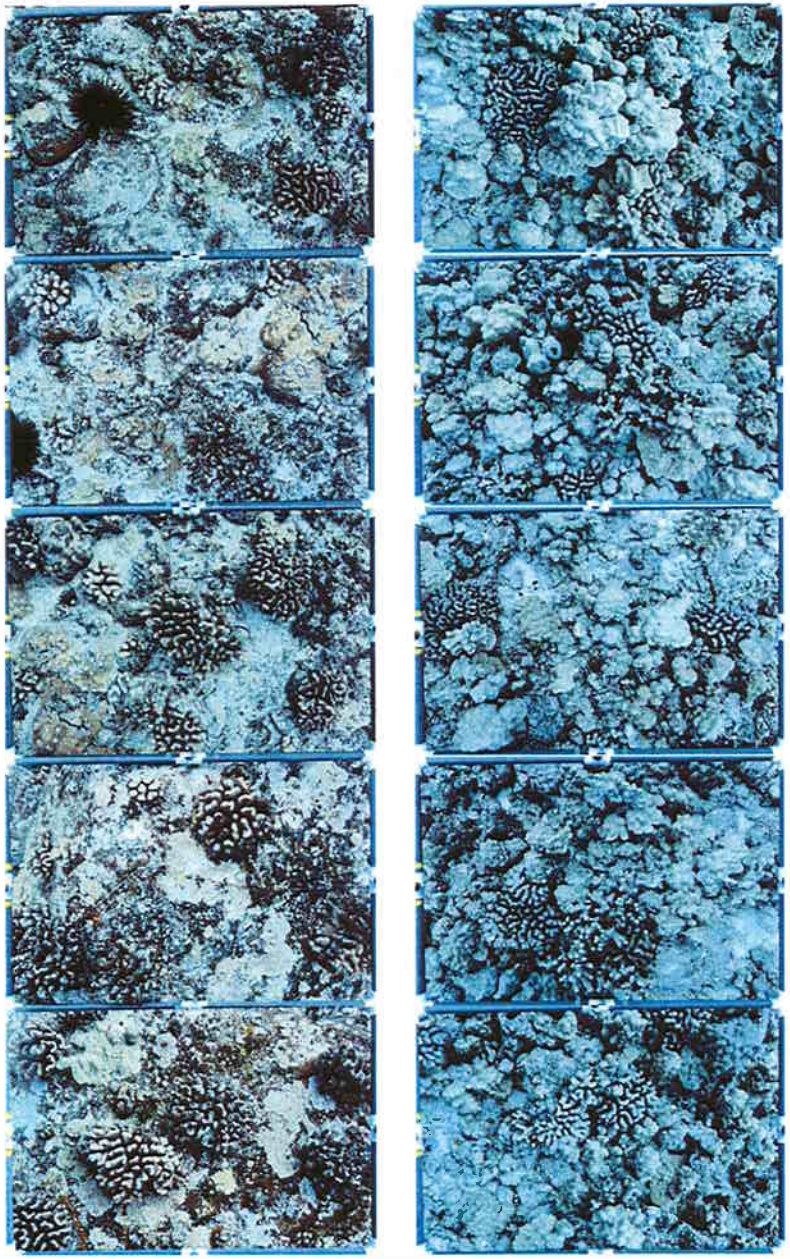


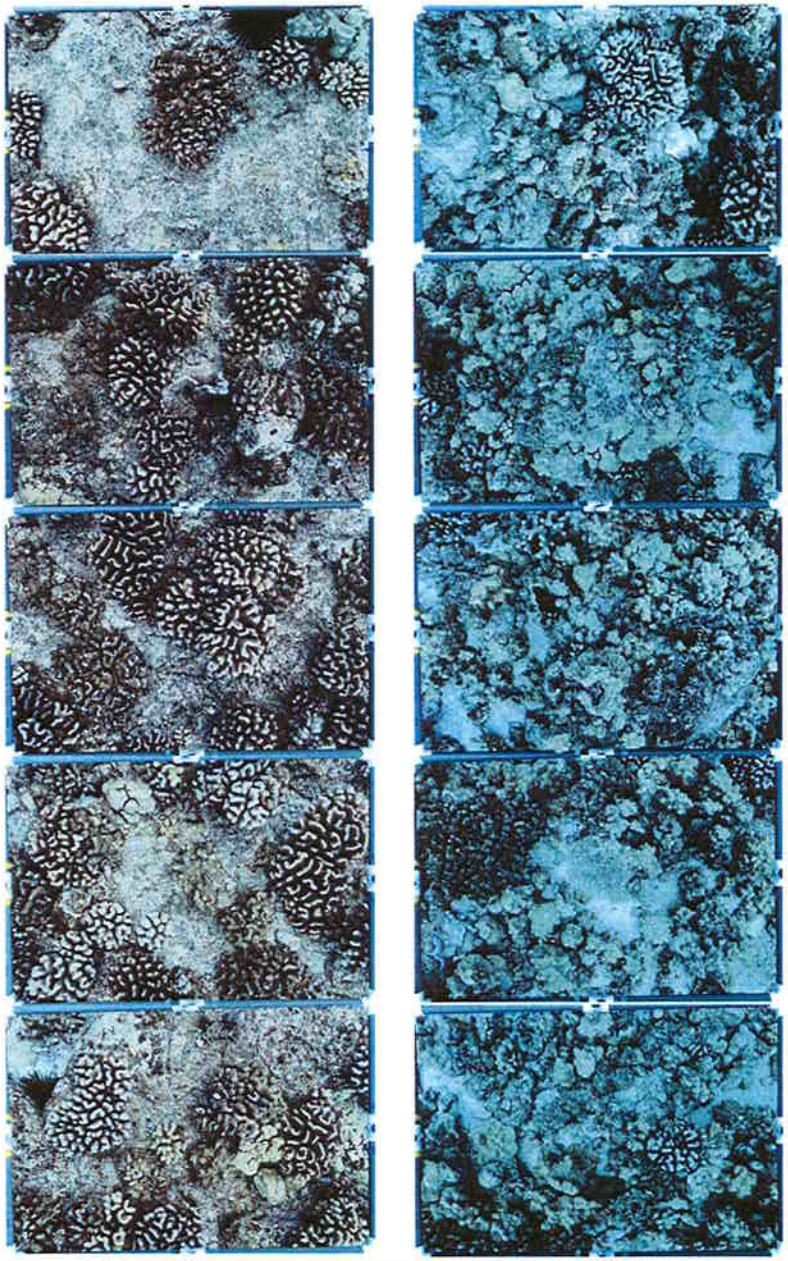
Kaloko-Honokohau Marine Assessment – 2012, Sites 108 and 109



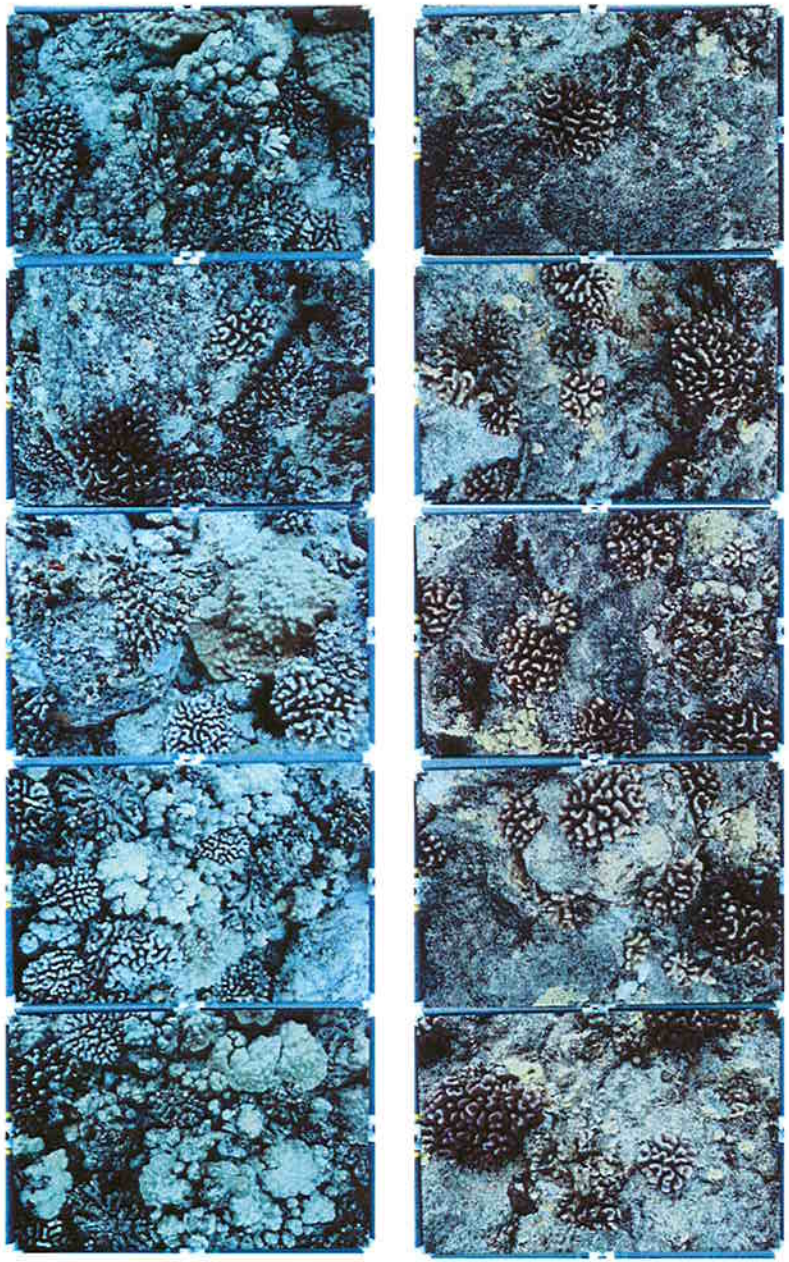
Kaloko-Honokohau Marine Assessment – 2012, Sites 110 and 111



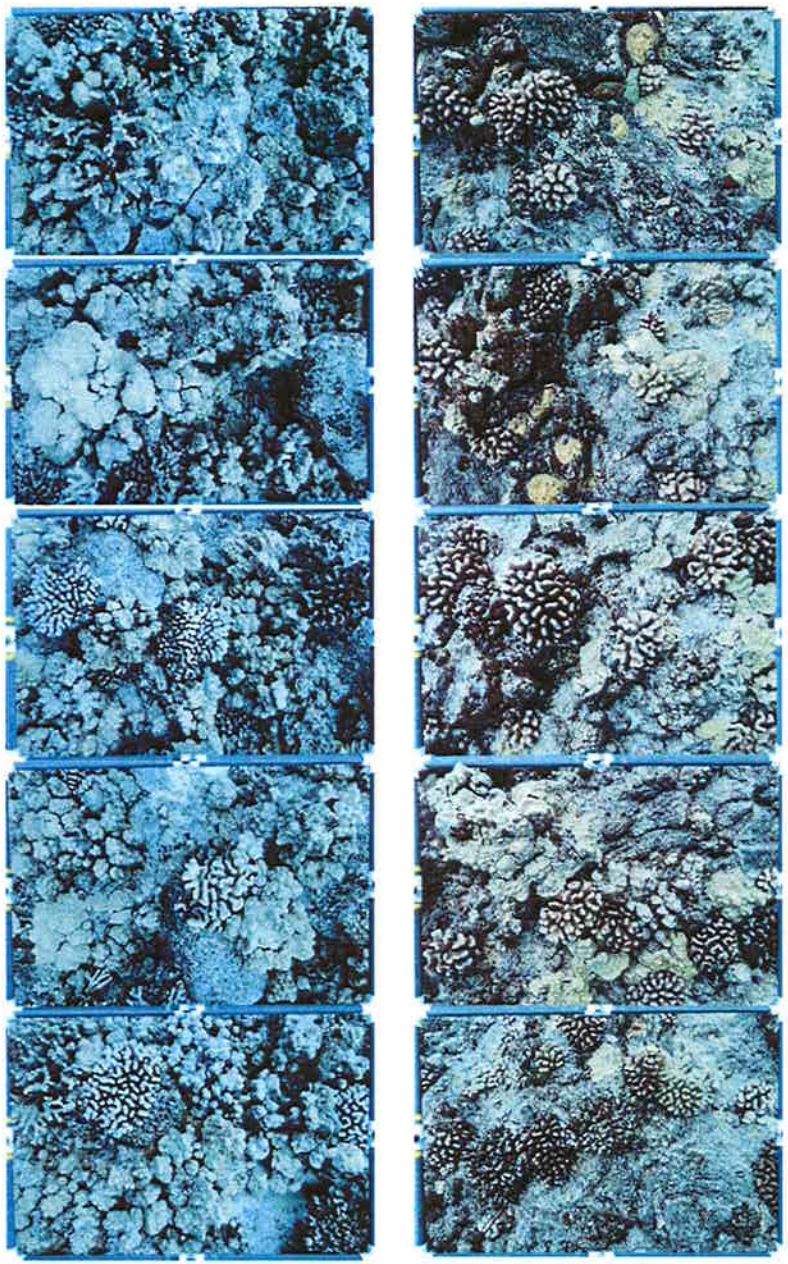
Kaloko-Honokohau Marine Assessment – 2012, Sites 112 and 113



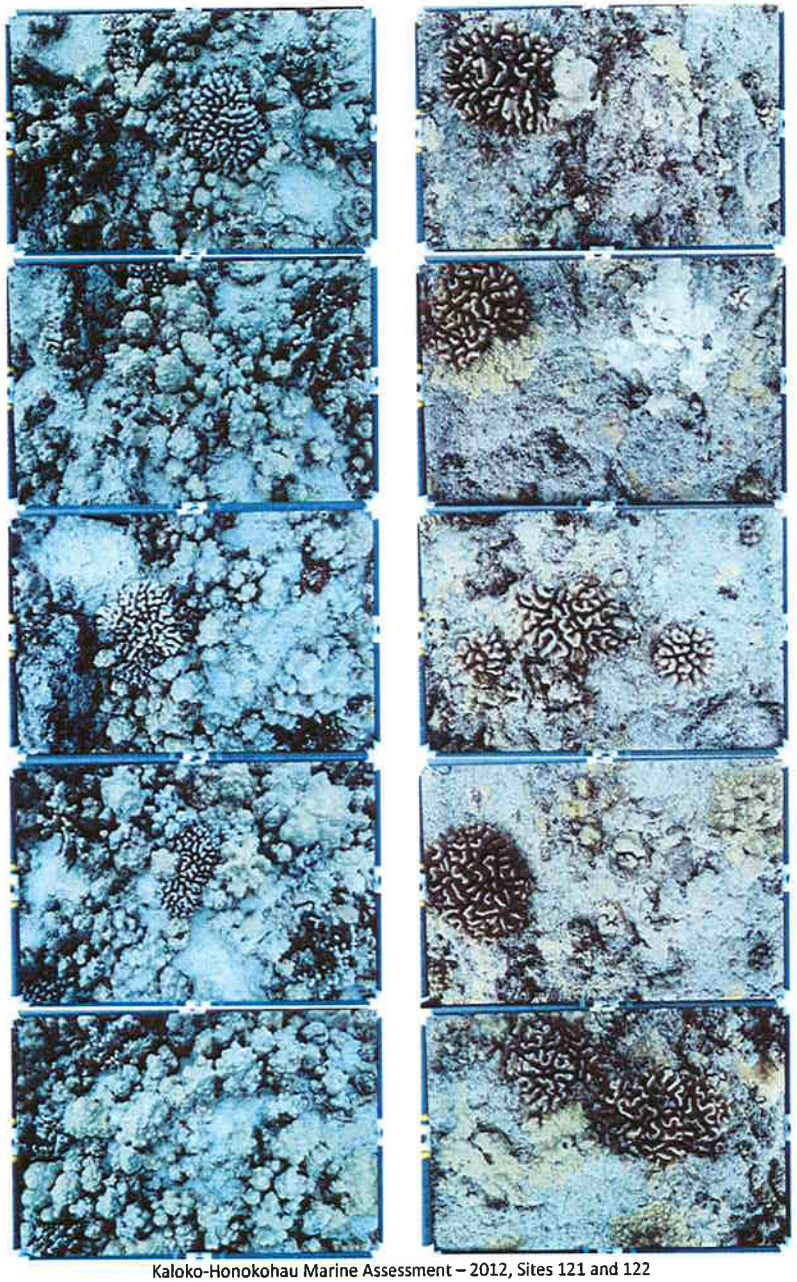
Kaloko-Honokohau Marine Assessment – 2012, Sites 114 and 115



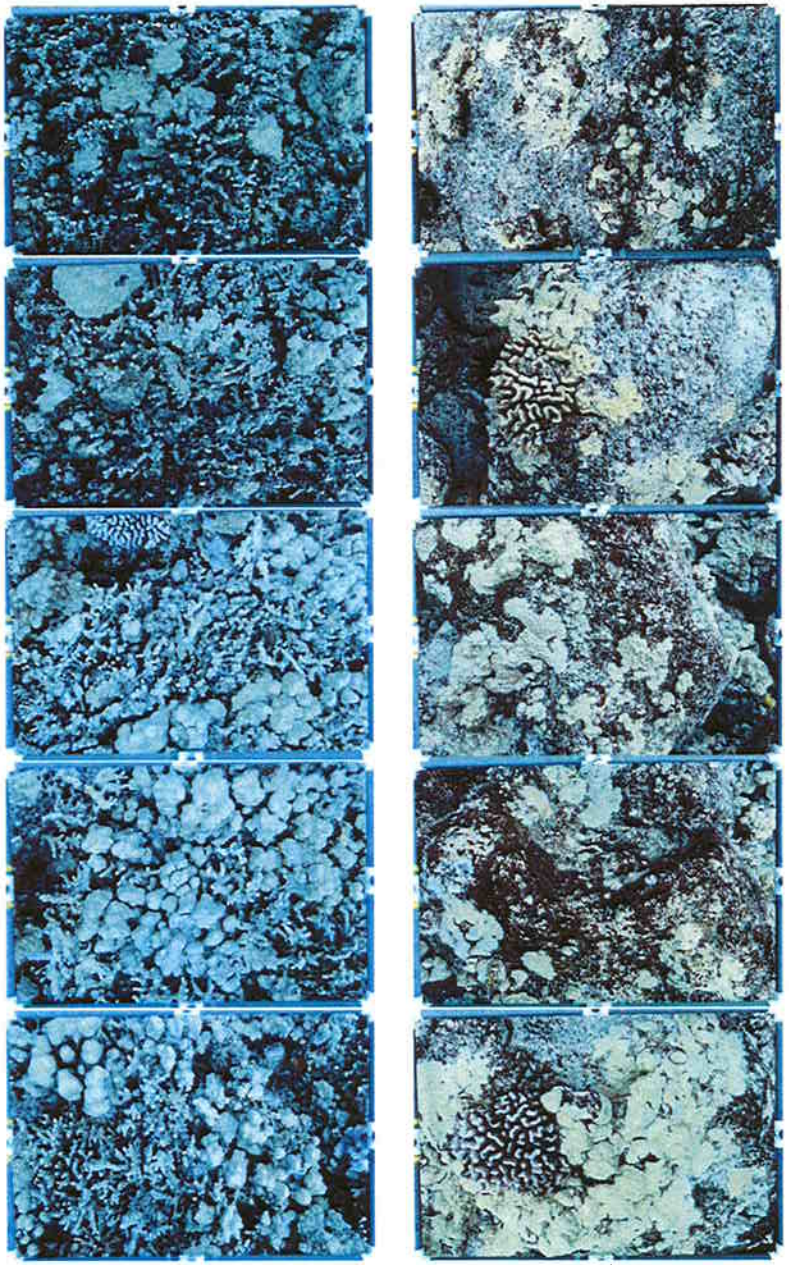
Kaloko-Honokohau Marine Assessment – 2012, Sites 117 and 118



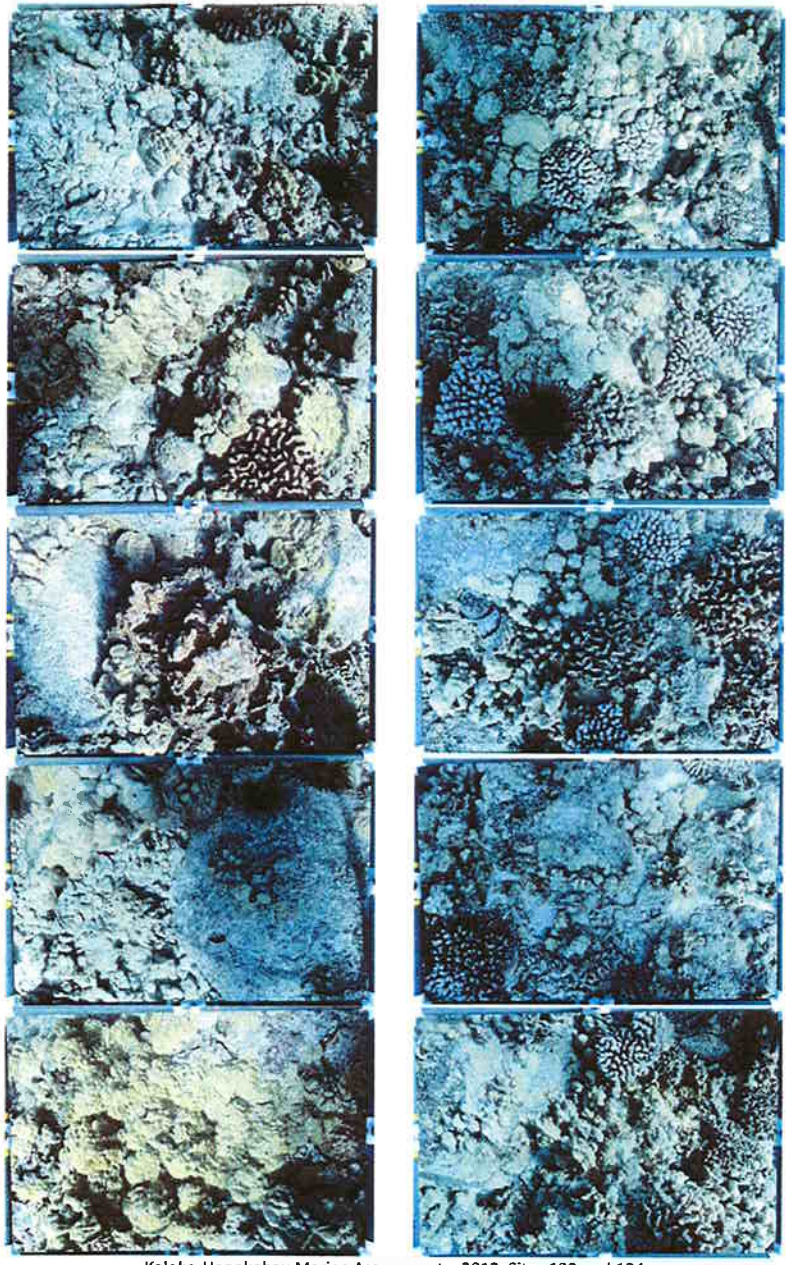
Kaloko-Honokohau Marine Assessment – 2012, Sites 119 and 120



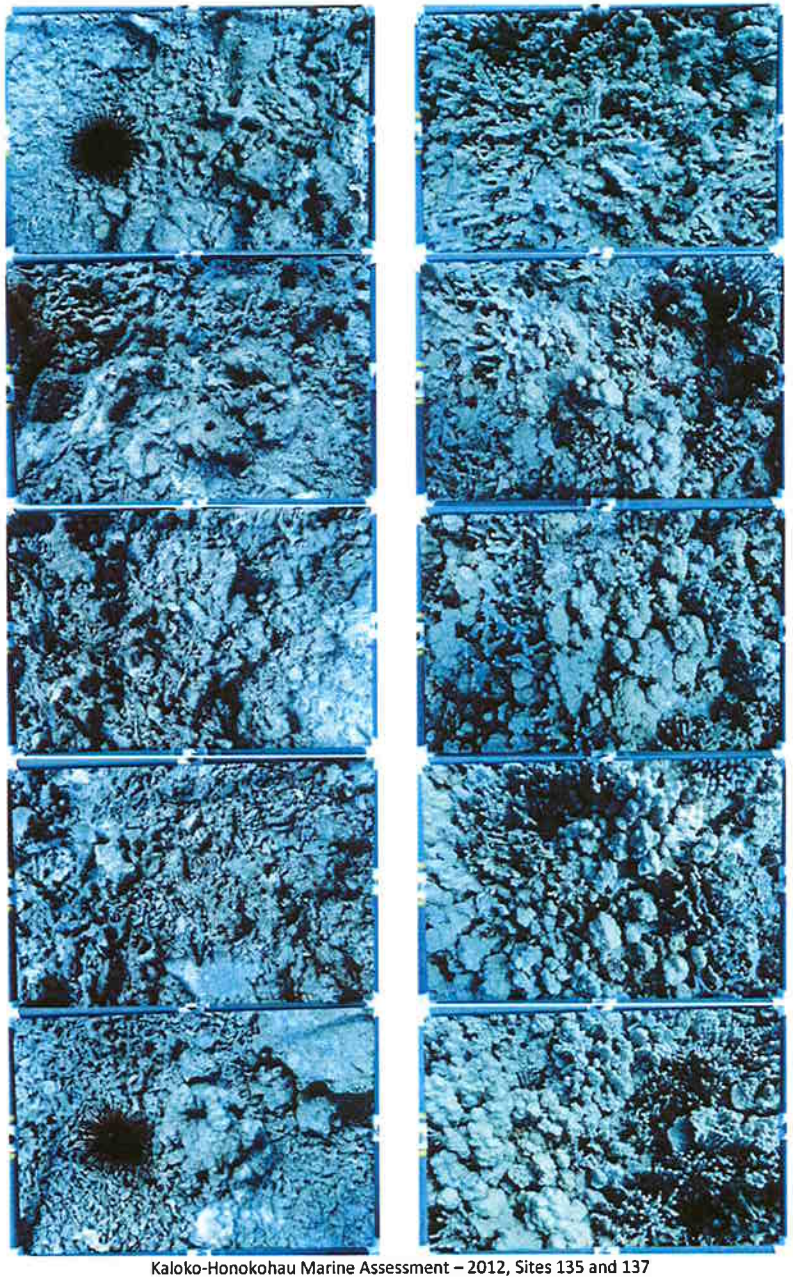
Kaloko-Honokohau Marine Assessment – 2012, Sites 121 and 122



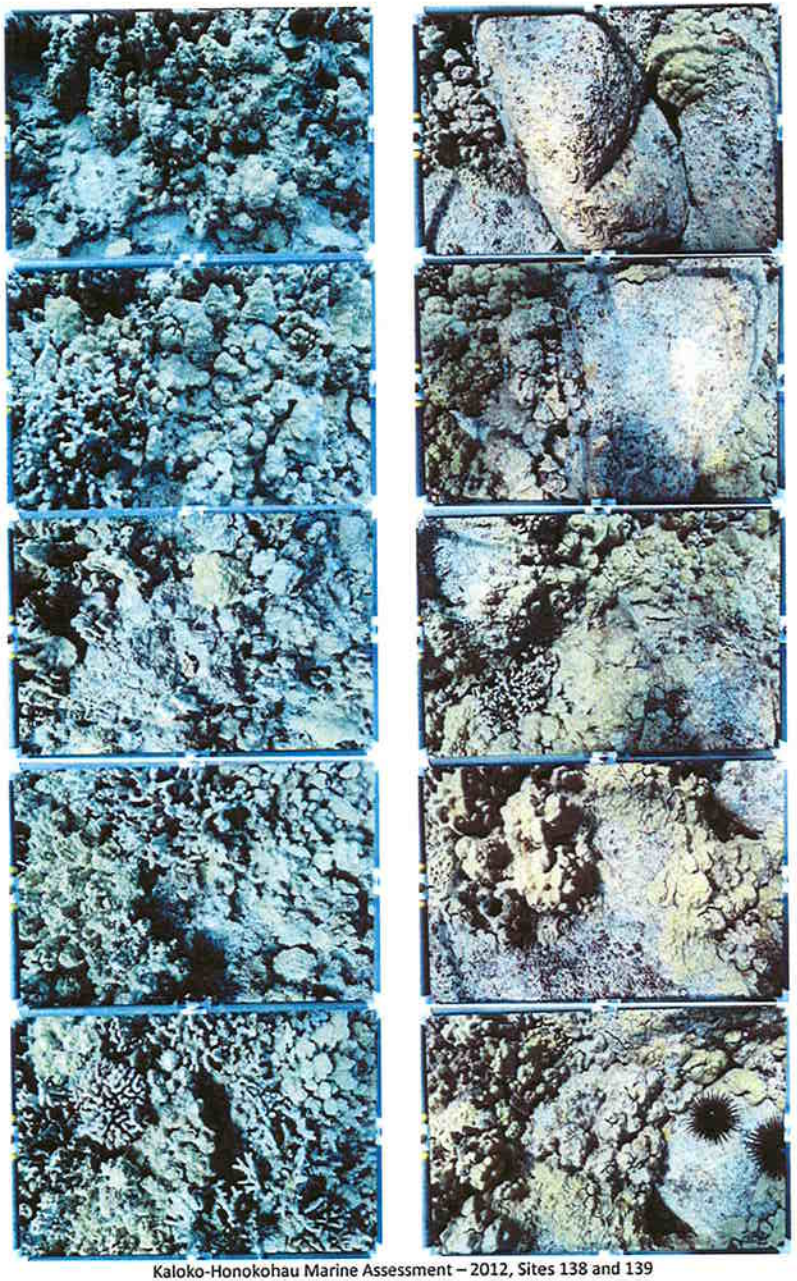
Kaloko-Honokohau Marine Assessment – 2012, Sites 125 and 126



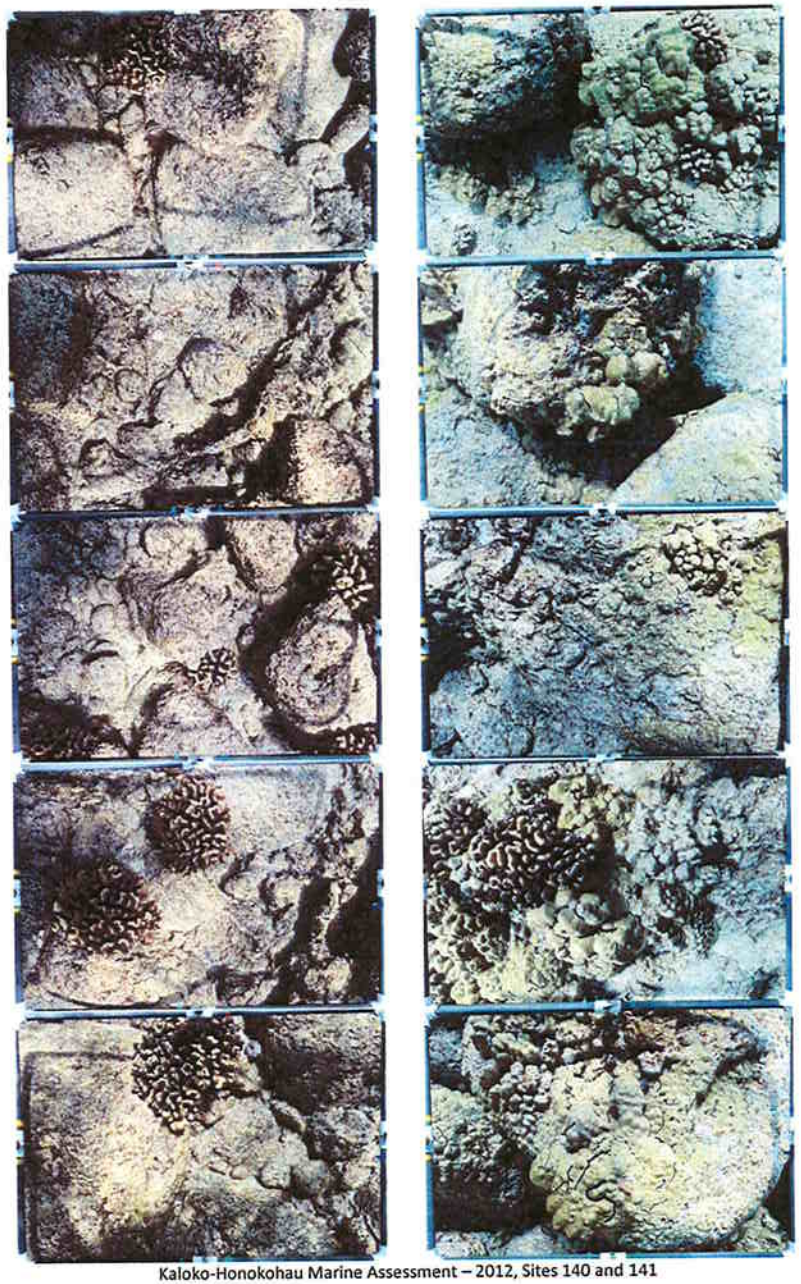
Kaloko-Honokohau Marine Assessment – 2012, Sites 133 and 134



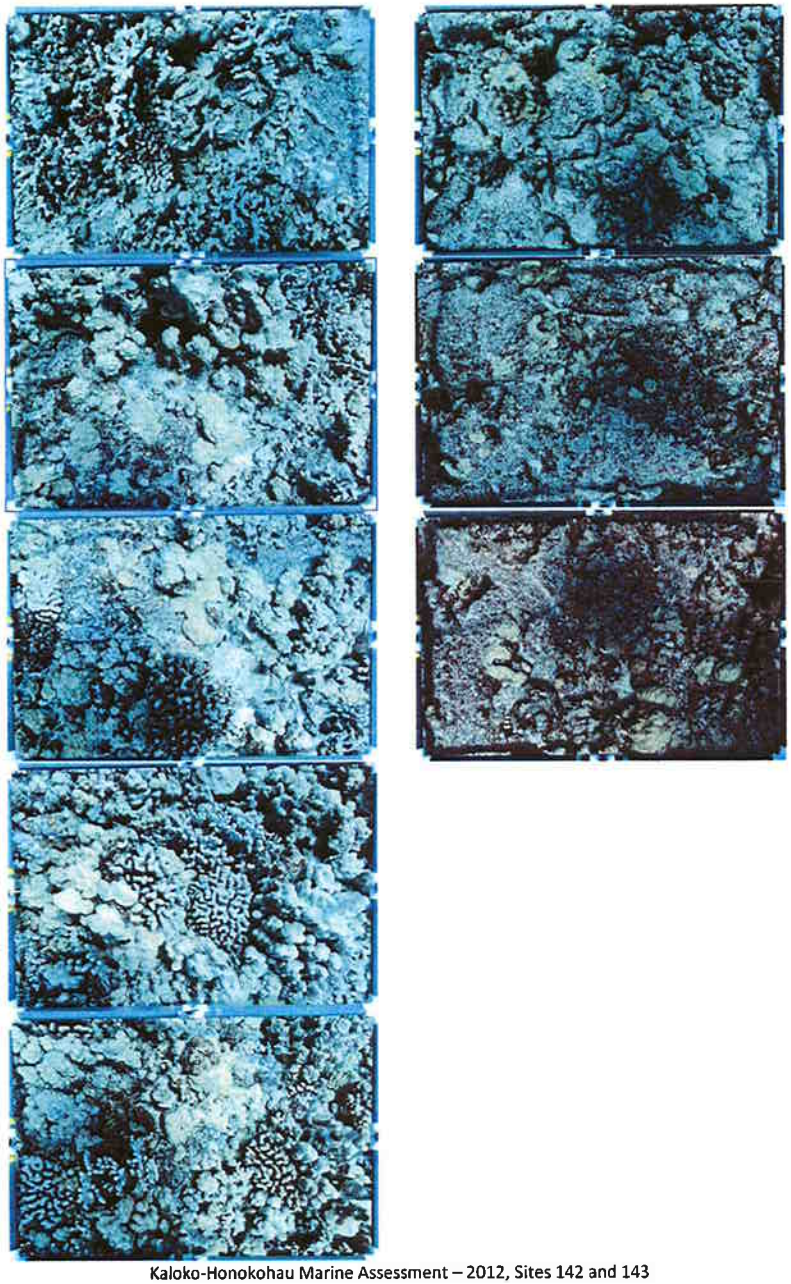
Kaloko-Honokohau Marine Assessment – 2012, Sites 135 and 137



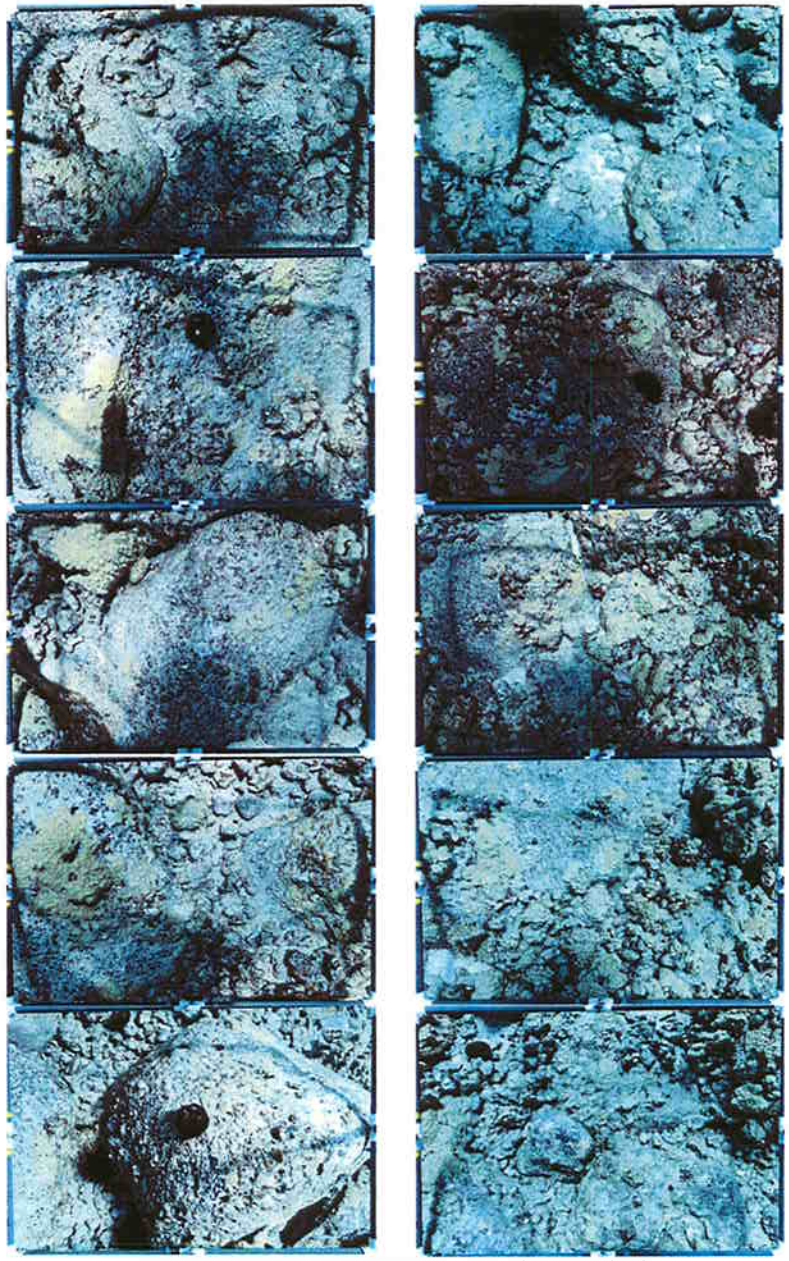
Kaloko-Honokohau Marine Assessment – 2012, Sites 138 and 139



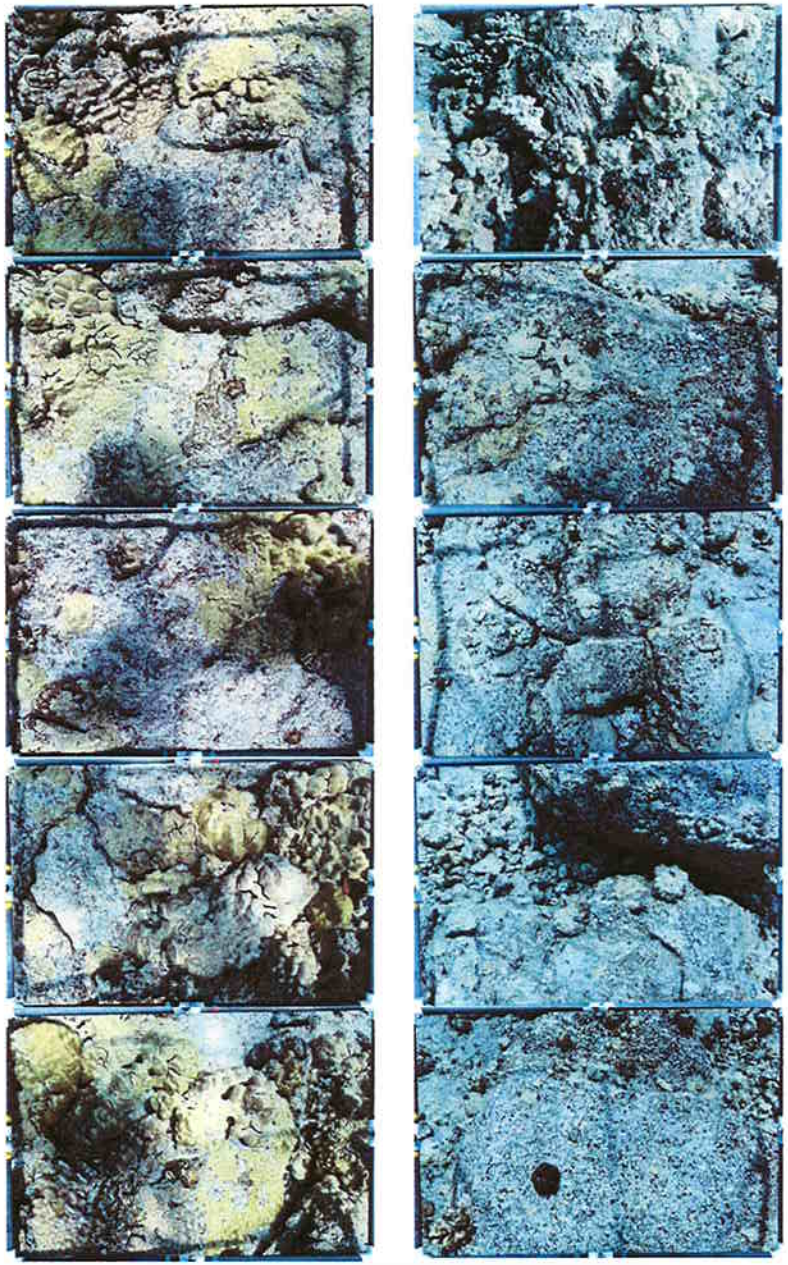
Kaloko-Honokohau Marine Assessment – 2012, Sites 140 and 141



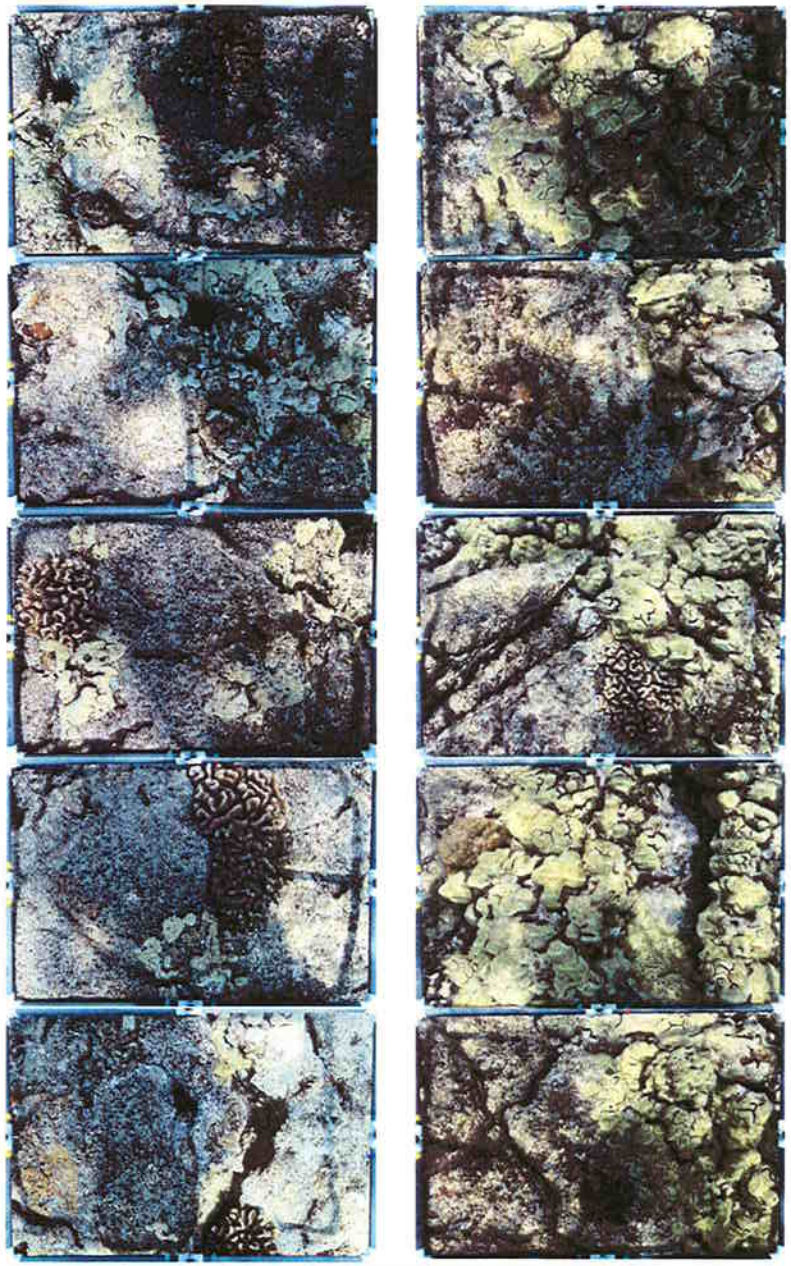
Kaloko-Honokohau Marine Assessment – 2012, Sites 142 and 143



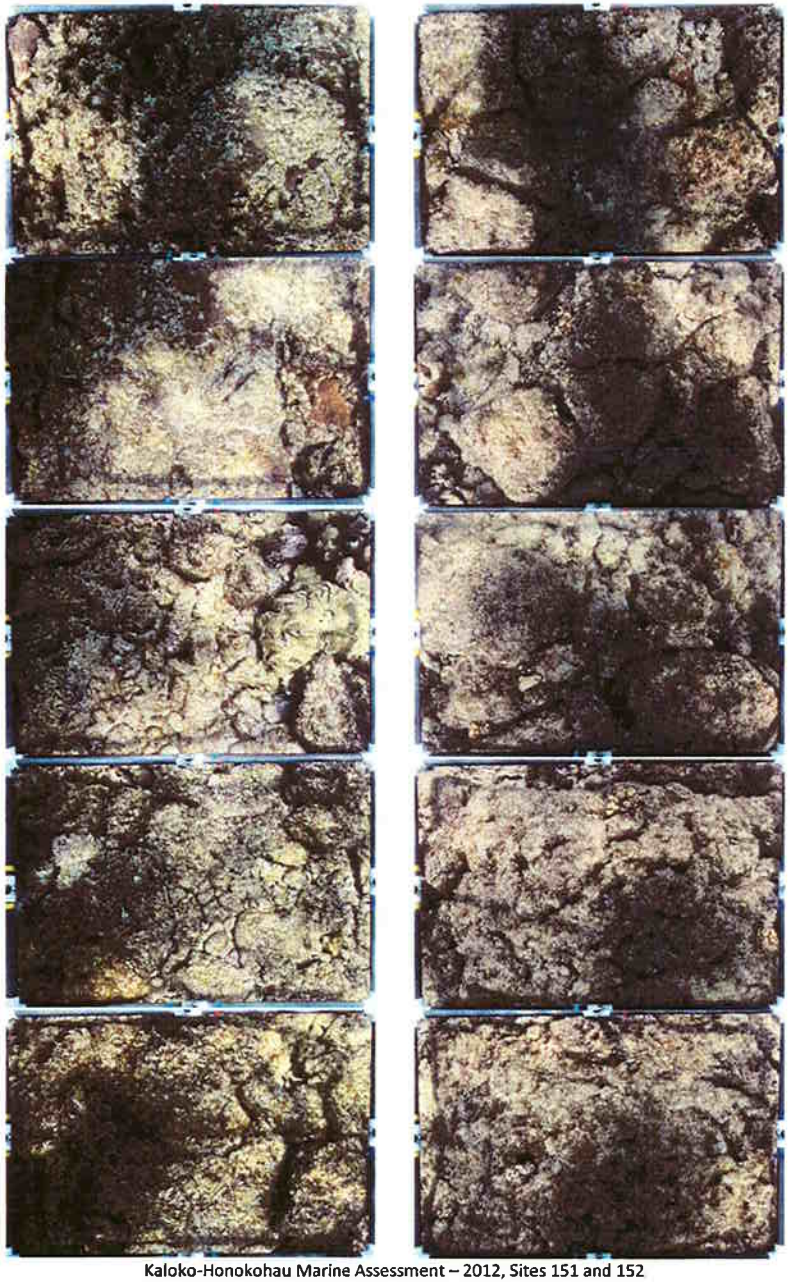
Kaloko-Honokohau Marine Assessment – 2012, Sites 144 and 146



Kaloko-Honokohau Marine Assessment – 2012, Sites 147 and 148



Kaloko-Honokohau Marine Assessment – 2012, Sites 149 and 150



Kaloko-Honokohau Marine Assessment – 2012, Sites 151 and 152

Kaloko-Honokohau Marine Assessment – 2012, Site 154

Appendix E

Botanical Survey of Kaloko Properties
Isle Botanica
December 2006

Botanical Survey

of

Kaloko Properties

North Kona
Island of Hawai'i

by

Art Whistler, Ph.D.
Isle Botanica
Honolulu, Hawai'i

Report prepared for

Wilson Okamoto Corporation
Honolulu, Hawai'i

December 2006

INTRODUCTION

The current project site encompasses about 1296 acres located in North Kona on the island of Hawai'i. It is situated north of Kona town, and mauka of Ka'ahumanu Highway and the "Kaloko Light Industrial Subdivision," which includes Costco. It is bordered on the west side by the highway, and extends mauka (eastward) to eventually straddle both sides of Hina Lani Road (Fig. 1). The area comprises lava flows of various ages that are covered mostly with a highly disturbed scrub and grass vegetation. However, a relatively undisturbed dryland forest, one of the most biologically diverse yet most heavily damaged ecosystems in the State, covers one area comprising most of the southeastern portion of the property.

BACKGROUND

The USFWS has long recognized the importance of the dryland forest on the site for its unique assemblage of native plants, and has indicated their desire to a preserve a portion of the property for its botanical value. They noted that the dryland forest located on the site is one of the last dryland forests still relatively free of introduced, alien grasses and cattle. The area has remained in such good condition because the substrate is a young lava flow that has acted as a deterrent to cattle, fire, and the spread of alien grasses (USFWS pers. comm. 2006). This patch of forest contains, or has contained, several federally listed endangered plant species: *'aiea* (*Nothocestrum breviflorum*), *ma'oloa* (*Neraudia ovata*), *Cyperus faurieri*, and *hala pepe* (*Pleomele hawaiiensis*). These species are also listed by the State as endangered species (DLNR 1998).

At least two botanical surveys in or adjacent to the area have been conducted. The first was carried out in conjunction with a proposed transmission line that would have crossed the property (CH2M Hill 1993). The second survey was done for the Kaloko town center (site of the present business district that includes Costco), which is adjacent to the current study site (Char and Associates 1995). The CH2M Hill botanical survey crossed the present study area, but also extended in either direction several miles, so the two areas are not exactly comparable. It listed the presence of 101 plant species in that corridor. Three of the species recorded are federally listed endangered species. Five individuals of the sedge *Cyperus fauriei* (known at that time as *Mariscus fauriei*) were noted growing on a single boulder at about 115 m elevation on the 'a'a flow. Two trees of *Nothocestrum breviflorum* were noted growing on the 'a'a flow at 110 m elevation. Two mature individuals of *Neraudia ovata* were noted growing on the 'a'a lava flow at 115 m elevation. The checklist for the Char and Associates botanical survey on the property adjacent to the present study site listed a total of 47 species present, but none of these are federally listed.

In 2003, the USFWS sent a team over for a reconnaissance of the site (USFWS 2003a & b). They noted finding one live specimen of *Neraudia ovata* in the study area, and reported making "a sweep of the area looking for the other four known plants but found none of them. We suspect they may be dead." They also noted the presence of good-sized individuals of *Bidens micrantha* spp. *ctenophylla* (*ko'oko'olau*) in low numbers and one dying *Pleomele hawaiiensis* (*hala pepe*) as well as several other native plant species.

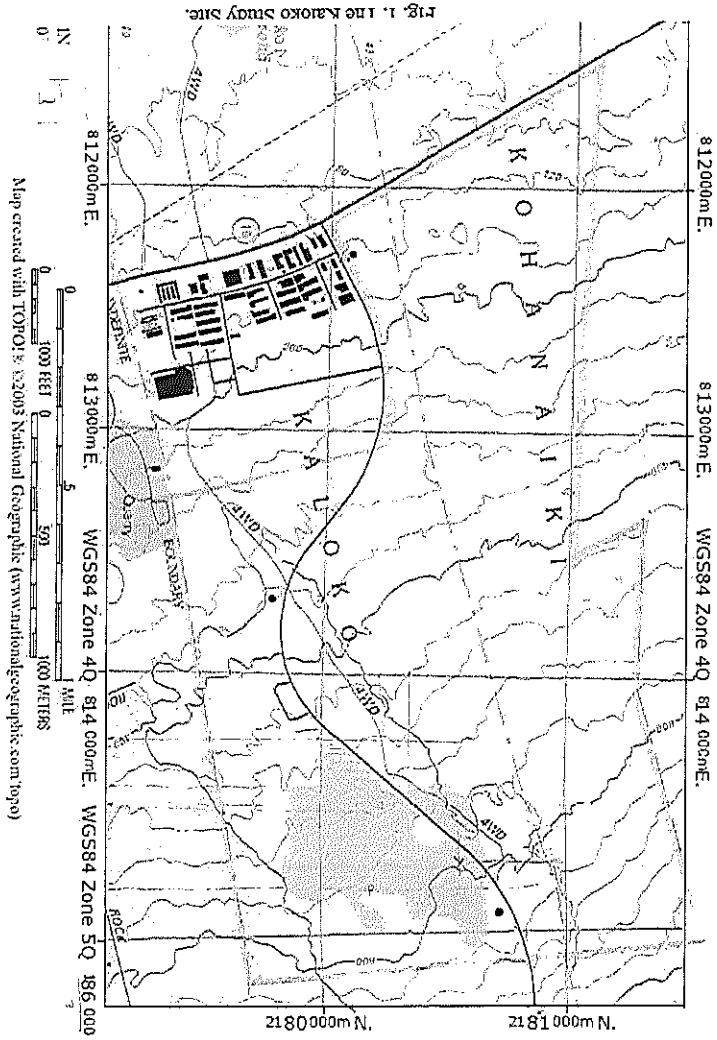


Fig. 1. The Kaloko Study Site.

METHODOLOGY

Before the fieldwork was carried out, a review of the literature was undertaken by the Principal Investigator (PI). The current status of the endangered species previously reported from the site was checked using the official database of threatened and endangered species (USFWS 2005). This list is identical to the State of Hawai'i list of threatened and endangered plant species. In addition, information about threatened and endangered plant species found in the area was extracted from the Hawai'i Natural Heritage Program database (Anon. 2005) of Federally listed plant species (Fig. 2).

After the review of the existing literature, a botanical field survey at the Kaloko site was conducted by a two-person botanical team consisting of the PI (Art Whistler) and a Field Assistant (Beate Neher), from 1 to 6 September 2006. All plant species encountered during the survey were recorded, along with an indication of their frequency. Particular care was taken in the area of dryland forest and other 'a'a areas, since this is where most of the native species and all of the endangered species have been reported. New lists were made for each vegetation type and/or day, and these were combined into a comprehensive checklist of all plants found at the study site (see Appendix). Notes were also taken on vegetation types present at the site, indicating the dominance and frequency of the plant species present. This was later analyzed and written up to form the vegetation section below.

Most of the species encountered during the fieldwork were familiar to the field team. Only one plant observed during the survey defied attempts at identification in the field. It was taken back to Honolulu to the Bishop Museum to compare with specimens there, and was eventually identified with the help of the Bishop Museum Herbarium staff.

THE VEGETATION

Four types of vegetation can be recognized on the Kaloko property: (1) Managed Land Vegetation; (2) Leucaena Scrub, which can be divided into a lowland subtype with extensive amounts of *Pennisetum setaceum* between the trees, and an upland subtype with *Kalanchoē pinnatum* and *Panicum maximum* dominating the ground cover; (3) Christmas-Berry Scrub that occurs on recent 'a'a flows, and which can be divided into two subtypes, one with only scattered Christmas berry trees and a few native species, the other with a similar, denser, scrub forest; and (4) Dryland Forest.

(1) Managed Land Vegetation

This comprises the areas of the parcel that are under periodic or frequent management, such as the edges of roads. It also includes the large quarry on the south side of the dryland forest. This is a relatively minor component of the overall vegetation on the property, and is entirely dominated by alien weedy species, such as the grasses *Digitaria ciliaris* (large crabgrass) and *Rhynchelytrum repens* (Natal redtop), and the dicot herbs *Tridax procumbens* (coat buttons), *Chamaesyce hirta* (garden spurge), *Chamaesyce hyssopifolia*, *Desmodium tortuosum* (Florida beggarweed), *Macroptilium lathyroides* (cow pea), *Boerhavia coccinea*, *Waltheria indica* (*'uhaloa*, a native species), and *Sida rhombifolia* (Cuba jute).

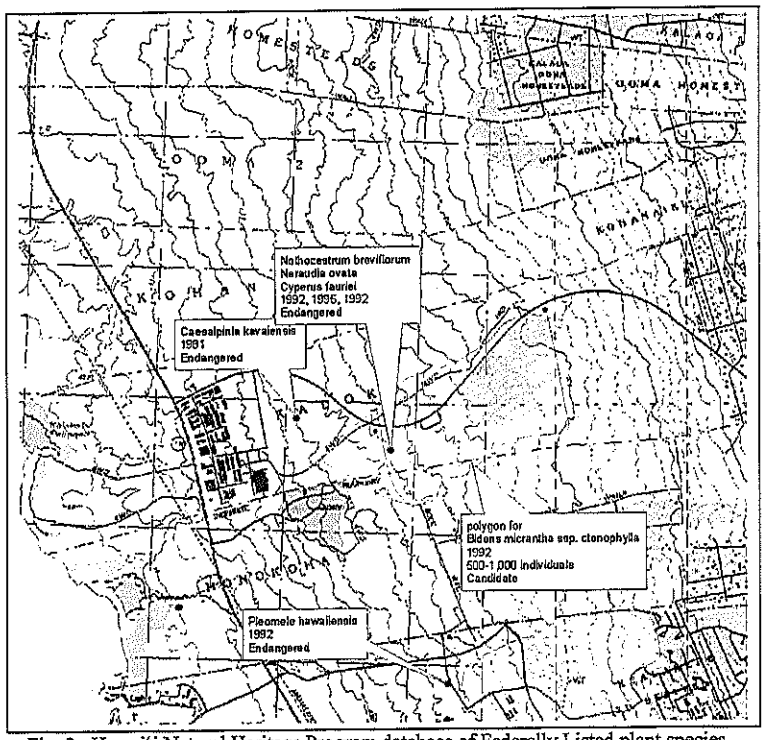


Fig. 3. Hawai'i Natural Heritage Program database of Federally Listed plant species.

(2) *Leucaena* Scrub

This is the type of vegetation found on areas of older lavas dominated by the alien scrubby tree *Leucaena leucocephala* (*koa haole*). It is not a homogeneous type of vegetation, since with increasing elevation along the north side of the road, its density and the species associated with it change. On the lower portions (Fig. 3), *koa haole* is mostly 1–2 m in height, scattered in an open-to-dense matrix of *Pennnisetum setaceum* (fountain grass). Several other trees and shrubs are found here, but in low numbers. This includes the alien tree species *Prosopis pallida* (*kiawe*) and *Schinus terebinthifolius* (Christmas berry), the alien shrub *Acacia farnesiana* (klu), the Polynesian introduction *Morinda citrifolia* (*noni*), and the native shrubs *Dodonaea viscosa* (*'a'ali'i*), *Psydrax odorata* (*'alahe'e*), and *Sida fallax* (*'ilima*). Also present are plants such as the shrubs *Indigofera suffruticosa* (indigo) and *Waltheria indica* (*'uhaloa*), the herbs *Chamaecrista nictitans* (*lau-ki*), *Talinum triangulare* (talinum), and *Portulaca pilosa* (*'ihi*), and

the grasses *Rhynchelytrum repens* (Natal redtop) and *Heteropogon contortus* (*pili*). This might be better described as a mosaic vegetation, with patches of *koa haole* alternating with areas entirely dominated by the fountain grass, but this grass is also found in the partial shade of the *koa haole*, especially when its canopy is thin. It might equally validly be labeled as a fountain grass grassland with associated *koa haole* trees.

At the upper (eastern or mauka) end of the property, the *koa haole* is also dominant, but is denser and taller (2–4 m in height). Instead of forming a mosaic with fountain grass beneath, it forms a dense monodominant scrub forest (Fig. 4). Other tree species are interspersed with it, particularly the native trees or shrubs *Psydrax odorata* (*'alahe'e*), *Diospyros sandwicensis* (*lama*), and *Sophora chrysophylla* (*mamane*), and the alien trees *Schinus terebinthifolius* (Christmas berry) and *Grevillea robusta* (silk oak). The latter two are large and scattered, but appear to be invasive and spreading. The ground cover in this upper area is dominated by *Kalanchoë pinnatum* (air plant) and *Panicum maximum* (Guinea grass), with some *Pennisetum setaceum* (fountain grass) in patches (Fig. 5). The native herb *Peperomia leptostachya* (*'ala'ala-wai-nui*) is occasional on rocks. In disturbed areas across the road from this, next to the upper water tank, the *Leucaena* scrub has an understory of fountain grass (Fig. 6). This differs from the lowland type of *Leucaena* scrub in that the trees are taller and more densely arranged.

Leucaena scrub is classified as disturbed, since fires periodically sweep through the area and goats are known to be present. These two factors account for the dominance of alien species, which are better adapted to these disruptive conditions than are the native species. According to the flora of Hawai'i (Wagner et al. 1999), fountain grass " is rapidly expanding its range in the Kona district of Hawaii." Introduced into the Kona District "in the early 1900s as an ornamental, [it] has aggressively spread and now dominates abandoned pastures, young lava flows, and burn areas. Fountain grass poses one of the most serious contemporary conservation problems because it is disrupting the more sparsely vegetated lowland native dry forests and shrublands, which contain several endangered and many candidate endangered plant species."

(3) Christmas-Berry Scrub

This is the type of vegetation on more recent lava flows, ones that are distinctly 'a'a lava. An irregular tongue of this runs down the slope near the northern boundary of the study site. In the lower portion of the study site, this vegetation is very sparse on the inhospitable surface, but scattered trees of the alien *Schinus terebinthifolius* (Christmas berry) comprise the most common species (Fig. 7). Also found here are scattered individuals of the native trees or shrubs *Capparis sandwichiana* (*pua pilo*), *Psydrax odoratum* (*'alahe'e*), *Metrosideros polymorpha* (*'ohi'a lehua*), *Myoporum sandwicense* (*naio*), as well as the introduced trees *Leucaena leucocephala* (*koa haole*) and *Morinda citrifolia* (*noni*).

The ground cover is also very sparse, with scattered clumps of *Pennisetum setaceum* (fountain grass) found mostly in pockets of soil or pahoehoe, and perhaps being the most common species found here. There were also a few patches of *Ipomoea indica* (*kowali-'awa*) and *Cocculus trilobus* (*huehue*), and even smaller amounts of the alien species *Nephrolepis multiflora* (hairy swordfern), *Lantana camara* (lantana), and *Pluchea carolinensis* (pluchea). Because the vegetation is so sparse, it hardly qualifies as vegetation at all, just scattered trees with equally scattered clumps of herbaceous species.

At higher elevations in this habitat on the same flow, where increasing rainfall and/or cloud cover makes the habitat more hospitable to trees, the vegetation comprises a low closed forest

(Fig. 8) dominated by Christmas berry, with lesser amounts of the native trees *Psydrax odorata* (*'alahe'e*), *Sophora chrysophylla* (*mamane*), and *Diospyros sandwicensis* (*lama*). Tall individuals of *Grevillea robusta* (silk oak) are scattered in the area. The native shrub *Dodonaea viscosa* (*'a'ali'i*) is sometimes common in clearings on the lava. No individuals of *Metrosideros polymorpha* (*'ohi'a lehua*), *Reynoldsia sandwicense* (*'ohe*), *Pleomele hawaiiensis* (*hala pepe*), or *Myoporum sandwicensis* (*naio*) were found in this scrub forest. Because of the dense shade, very little ground cover is present, but that which is present comprises mostly *Panicum maximum* (Guinea grass) and *Kalanchoë pinnatum* (air plant). However, some fountain grass is found in clumps on the lava flow there.

Like the *Leucaena* scrub, this vegetation is classified as disturbed, since fires periodically sweep through the area, and goats are known to be in the area. It somewhat matches the description of the "Lowland Dry Shrublands" described in Wagner et al. (1999), which is described as occurring in leeward situations on most of the main islands, at 100 to 600 m elevation, and being open and not exceeding 3 m in height.

(4) Dryland Forest

This is the open to closed native forest (Figs. 9 and 10) occurring on the relatively recent lava flow comprising most of the central portion of the southern half of the study area. Because of the rugged 'a'a lava, the vegetation is difficult for feral grazing animals to visit. Over much of the area the trees are separated from each other, and this, combined with the virtual absence of fountain grass, has caused the area to be spared from grazing and wildfires. Consequently, the forest is relatively intact, and was home until recently, at least, to four endangered species: *Nothocestrum breviflorum*, *Neraudia ovata*, *Cyperus fauriei*, and *Pleomele hawaiiensis*.

The most common trees are probably the native species *Diospyros sandwicensis* (*lama*), *Psydrax odoratum* (*'alahe'e*), *Capparis sandwichiana* (*pua pilo*; often more of a shrub than a tree), and *Sophora chrysophylla* (*mamane*). Also occasional are the native trees *Metrosideros polymorpha* (*'ohi'a lehua*), *Reynoldsia sandwicensis* (*'ohe*), *Myoporum sandwicensis* (*naio*), and *Dodonaea viscosa* (*'a'ali'i*), as well as scattered individuals of the endangered tree-like monocot *Pleomele hawaiiensis* (*hala pepe*). The only alien tree species noted in this open forest were *Jacaranda mimosifolia* (jacaranda), the Polynesian introduction *Morinda citrifolia* (*noni*), *Schinus terebinthifolius* (Christmas berry), and *Leucaena leucocephala* (*koa haole*). The latter two species, especially Christmas berry, sometimes form clumps and in some places dominate the edges of the dryland forest. The southern boundary of this forest has recently been bulldozed in quarry activities, and fountain grass is spreading in this newly created disturbed habitat (Fig. 11).

The ground cover in the dryland forest is very sparse, due to the inhospitable growing conditions. The most common species in this category are *Lantana camara* (lantana), the native vines *Cocculus trilobus* (*huehue*) and *Ipomoea indica* (*kowali-'awa*), *Pennisetum setaceum* (fountain grass), *Nephrolepis multiflorum* (hairy swordfern), and an escaped ornamental vine *Lophospermum erubescens* (larger roving sailor).

Overall, this vegetation comprises a good quality dryland forest, based upon the flora and the dominance of native species. The native flora is virtually the same as that found in the list of the native flora on the whole site shown in Table 1 (below), with the possible exception of *Heteropogon contortus* (*pili*), which was found elsewhere on the study site but not in the dryland forest.

THE FLORA

A total of 93 plant species (see Appendix) was recorded in the study area, but this does not include a few cultivated species planted along the roadsides. Twenty-five of the species encountered are native and eleven of these native species are endemic. Indigenous plants are species that are native to a region or place, but are also found elsewhere. Endemic plants are species restricted to a single region or area, i.e., in the case of Hawai'i, they are found only in Hawai'i. In biodiversity terms, the endemic status is the more important of the two categories, since if a species belonging to it is endangered or threatened in Hawai'i, it would likewise be classified globally. Indigenous species, however, can be classified as threatened or endangered in Hawai'i, but may be common elsewhere in the Pacific. Over 90% of the native plants in Hawai'i are endemic, one of the highest rates in the world.

The majority of the 93 species encountered during the survey are naturalized "alien" plants that were accidentally or intentionally introduced to Hawai'i, but which have now become established in the islands and can spread on their own. The checklist of Char and Associates (1995) included several other species found on the adjacent property that were not found during the present survey: *Bidens cynapiifolia* (beggar's tick), *Cucumis dipsaceus* (wild cucumber), *Tephrosia purpurea* (*'auhuhu*), *Abutilon incanum* (hoary abutilon), *Boerhavia repens* (*alena*), and *Solanum americanum* (*popolo*). All of these except *Tephrosia purpurea* are herbaceous species that die back during the dry season, and consequently would likely turn up in the current study area during a survey in the rainy season. Three of them are native (or questionably so), but none are endemic.

Only one of the native species found during the present survey, *Pleomele hawaiiensis*, is a federally listed endangered species. Hawai'i Natural Heritage Program database map (Fig. 2) shows a record of *Caesalpinia kavaiensis* (*uhiuhi*) as occurring between the current study site and the industrial area, but the date on this record is 1981 and the tree has probably died by now, since it has not been recorded there since that time. (Also, it is located outside of the present study site.) A list of native species found at the study site is shown in Table 1. The other three endangered plant species, *Cyperus fauriei*, *Nothocestrum breviflorum*, and *Neraudia ovata*, previously reported from the dryland forest were not encountered during the present survey, and may have disappeared from the site.

DISCUSSION

Only one of the species encountered during the survey is Federally Listed as Threatened or endangered, *Pleomele hawaiiensis* (Fig. 12). According to the USFWS, "six to eight populations are currently known: one to three in the Puu Waawaa region of Hualalai on State-leased and private land, two in the Kaloko/Kaloao area on private land, two in the Kapua/Kahuku area on private land, and one on Holei Pali within Hawaii Volcanoes National Park. These populations total 250–300 individuals, of which over 75 are found at Kaloko. Kaloko represents one of only

Table 1. Native species found at the study site

Argemone glauca (Papaveraceae)	pua kala	Endemic
Bidens micrantha		

subsp. *ctenophylla* (Asteraceae)	ko'oko'olau	Endemic
Capparis sandwichiana (Capparaceae)	pua pilo	Endemic
Chamaesyce celastroides (Euphorbiaceae)	'atoto	Endemic
Cocculus trilobus (Menispermaceae)	huehue	Indigenous
Diospyros sandwicensis (Ebenaceae)	lama	Endemic
Dodonaea viscosa (Sapindaceae)	'a'ali'i	Indigenous
Doryopteris decipiens (Adiantiaceae)	kumuniu	Endemic
Heteropogon contortus (Poaceae)	pili grass	Indigenous?
Ipomoea indica (Convolvulaceae)	koali-'awa	Indigenous
Lipochaeta subcordata (Asteraceae)	---------	Endemic
Metrosideros polymorpha (Myrtaceae)	'ohi'a lehua	Endemic
Myoporum sandwicense (Myoporaceae)	naio	Indigenous
Osteomeles anthyllidifolia (Rosaceae)	'ulei	Indigenous
Peperomia leptostachya (Piperaceae)	'ala'ala-wai-nui	Indigenous
Plectranthus parviflorus (Lamiaceae)	spurflower	Indigenous
Pleomele hawaiiensis (Agavaceae)	halapepe	Endemic
Psilotum nudum (Psilotaceae)	moa	Indigenous
Psydrax odoratum (Rubiaceae)	alahe'e	Indigenous
Reynoldsia sandwicensis (Araliaceae)	'ohe	Endemic
Scaevola sericea (Goodeniaceae)	naupaka	Indigenous
Senna gaudichaudii (Fabaceae)	kolomona	Indigenous
Sida fallax (Malvaceae)	'ilima	Indigenous
Sophora chrysophylla (Fabaceae)	mamane	Endemic
Waltheria indica (Sterculiaceae)	'uhaloa	Indigenous

two known populations that are successfully regenerating" (USFWS 2006, pers. comm.). During the present survey, only about 24 plants were observed, but since counting individuals was not part of the project, this should not be judged to be indicative of a decline in the number of individuals currently there. The species is not included on the Hawai'i Natural Heritage Program Database map (Fig. 2).

Several other endangered species have been reported from the dryland forest area, but were not found during the present survey. According to the USFWS, the endangered *Nothocestrum brevifolium* is "historically known from 15 locations extending from the southern Kohala Mountains, south along the leeward side of the Big Island, to the South Point area. Currently, six populations are known. Two of the 53 known individuals of this species occur in Kaloko (USFWS pers. comm. 2006)." The Hawai'i Natural Heritage Program Database (Fig. 2) noted a location of the plant in the dryland forest and dates this record to 1992. Rex Palmer observed the plant growing in the dryland forest only three years ago (pers. comm. 2006). The Division of Forestry and Wildlife (DOFAW) representative Lyman Perry (pers. comm. 2006) noted his belief that "...*Nothocestrum* [has] not been observed in this area for quite some time...The nearest *Nothocestrum* locations that I know of are in Kaupulehu (above the road at the 28 mile marker in the NTBG 6 acre enclosure)." A site visit by USFWS personnel in 2003 looking at endangered species did not report finding it either (USFWS 2003 a&b).

A third endangered species, *Neraudia ovata*, has been reported from the dryland forest. Palmer (pers. comm. 2006) noted its presence there in 2003 growing under trees near to where homeless people are known to camp. The presence of a single flowering and fruiting plant was reported there in 2003 (USFWS 200 3a&b). Lyman Perry (pers. comm. 2006) noted "...*Neraudia* [has] not been observed in this area for quite some time...The nearest known location of *Neraudia* was the lava flow behind COSTCO on Hina Lani Street but those plants died in the last couple of years." The Hawai'i Natural Heritage Program Database (Fig. 2) shows its occurrence in the area in 1995.

A fourth endangered species has been reported from the dryland forest, the endemic *Cyperus fauriei* (formerly known as *Mariscus fauriei*). According to the USFWS, "only four populations are currently known: 20–30 plants on State owned land on Molokai, 22 plants in two populations on State owned land on the southern end of the island of Hawaii, and five plants in Kaloko, on private land" (USFWS pers. comm. 2006). This information about its presence at Kaloko is probably based on the record from the survey described in CH2M Hill (1993). The Hawai'i Natural Heritage Program Database (Fig. 2) shows its presence there in 1992, apparently also based on the CH2M Hill report.

The Hawai'i Natural Heritage Program Database map (Fig. 2) also shows a record of the federally listed endangered tree *Caesalpinia kavaiensis* (*uhiuhi*) as occurring in the area just west of the study site and east of the industrial area, but it apparently has not been seen for years and was not noted in the USFWS 2003 site visit report (USFWS 2003a&b).

CONCLUSIONS AND RECOMMENDATIONS

Based upon the survey, there are three main kinds of vegetation at the site: (1) disturbed scrub dominated by *Leucaena leucocephala* (*koa haole*) in combination with *Pennisetum setaceum* (fountain grass) in the lower part of the study site, and with *Kalanchoë pinnatum* (air plant) and *Panicum maximum* (Guinea grass) in the upper part; (2) disturbed scrub dominated by *Schinus terebinthifolius* (Christmas berry); and (3) relatively undisturbed dryland forest. The two kinds of disturbed vegetation occupy most of the site. The USFWS, based on notes from 1996, reported their belief that the dryland forest was approximately 200 acres (80 hectares) in area (USFWS pers. comm. 2006). By this reckoning, the disturbed vegetation comprises about 1100 acres (1296 minus 200) of the site. No Federally listed endangered or threatened plant species were recorded in this disturbed area.

The dryland forest is a different story. It constitutes valuable and irreplaceable habitat for Hawai'i's unique biota, and consequently has major cultural and biological significance. It is one of the last few remaining, relatively undisturbed patches of this dryland forest habitat in Hawai'i. Twenty-five native species were recorded from this site, eleven of them endemic to Hawai'i (i.e., found nowhere else in the world). Four of these (three found during previous surveys only, and one during the present and previous surveys) are federally listed endangered species. Some of these species are very rare since they are restricted to only a few localities. This combination of rare vegetation, rare native species, and federally listed endangered species make this remnant dryland very important to the biodiversity of Hawai'i. The USFWS is bound by law to protect these species and consequently they will need to protect this area of dryland forest where they occur. However, the USFWS has previously noted that they would not hinder any development plans for the areas of disturbed vegetation at the site if the dryland forest were to be set aside and given protection status (USFWS. pers. comm. 2006). Consequently, the

owners will have to negotiate with the USFWS and DOFAW on just how much land needs to be set aside for this protection. They may also have to overcome local opposition to the project, so they should make it clear that they are also interested in preserving these unique and rare species, within the confines of development for the major portion of the parcel.

It is also recommended that of some of the rare and endemic species occurring on the site or in the general area should be considered for any landscaping that will be done, such as around utility buildings and public structures. This would be a win-win situation. Some of the species make attractive ornamentals, and are already adapted to the dryland conditions at the site. Thus they require little maintenance and watering. Using rare or culturally significant species would also help to alleviate any local or governmental concerns that the project would be detrimental to the survival of these rare species. Some of these species are already being propagated by local gardeners and gardens, such as the nearby Amy Greenwell Garden. These may be available for purchase, or these individuals or gardens could be hired to do the local plant landscaping. Some species recommended for this are as follows:

Aleurites moluccana (*kukui*)—This species is a Polynesian introduction to Hawai'i rather than a native species, but it has important cultural significant since it seeds were traditionally used for night time illumination (hence its English name candlenut. Currently the seeds are used to produce massage oil and the fruits are fashioned into attractive, jet-black seed leis. It gray-green leaves and large stature make it a popular ornamental tree in Hawai'i.

Bidens micrantha subsp. *ctenophylla* (*ko'oko'olau*)—An endemic shrub that was formerly a candidate, federally listed endemic species. It is restricted mostly to this part of the island of Hawai'i and has small, attractive, yellow, sunflower-like flowers (Fig. 13)

Capparis sandwichiana (*pua pilo*, *pua pilo*)—An endemic shrub or small tree with large, attractive white, fragrant flowers. It relatively rare in Hawai'i, but does well on lowland lava flows.

Erythrina sandwicensis (*wiliwili*)—A spreading endemic tree with showy seasonal red flowers, found in the area, but not recorded from the study site. It is a popular, long-lived, native ornamental tree in Hawai'i that is related to the ornamental coral tree (*Erythrina variegata*).

Metrosideros polymorpha (*'ohi'a lehua*)—This is the indigenous, medium-sized tree covering much of the island, and has attractive red, powderpuff-like flowers. Some varieties also have attractive gray-green leaves. It is uncommon at the site, probably because the area does not get enough rainfall to allow it to flourish, but it dominates the intact forests upslope.

Myoporum sandwicense (*naio*)—An indigenous small tree or shrub with small, fragrant white flowers. Its English name is false sandalwood, indicative of its fragrant wood once used like sandalwood. The plant is easily grown from cuttings.

Osteomeles anthyllidifolia (*'ulei*)—A sprawling indigenous shrub that makes a nice shrubby ground cover. It has attractive but small, white, rose-like flowers (it is a member of the rose family).

Pleomele hawaiiensis (*halapepe*)—A federally listed endangered endemic species. This yucca-like plant is similar to the money tree (*Dracaena marginata*) that is a popular ornamental plant in Hawai'i.

Psydrax odoratum (*alahe'e*)—A small indigenous tree or shrub fairly common at the site, to which it is well adapted. It has attractive dark green leaves, thick canopy, and baseball-sized clusters of fragrant, attractive white flowers.

Reynoldsia sandwicensis (*'ohe*)—A large, fast growing endemic tree with an open canopy.

Senna gaudichaudii (*kolomona*)—Small indigenous tree with pale yellow flowers. It is similar to the scrambled eggs tree (*Senna surattensis*) that is a popular ornamental tree in Hawai'i, and which is also naturalized at the site.

Sida fallax (*'ilima*)—An indigenous shrub common at the site. It is a popular ornamental in Hawai'i, where the orange mallow-like flowers are fashioned into exquisite leis.

Sophora chrysophylla (*mamane*)—An endemic small tree or shrub common on the Big Island, especially at higher elevations. It has attractive yellow, sweetpea-like flowers and an unusual, bead-necklace-like pod.

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TABLE 1. PLANT SPECIES CHECKLIST FOR THE KALOKO PROPERTY

The following is a checklist of the vascular plants inventoried during the field studies on the Kaloko planned development area. The plants are divided into three groups, Ferns (including fern allies), Monocots, and Dicots. Within these groups, the species are presented taxonomically by family, with each family and each species in the family in alphabetical order. The taxonomy and nomenclature of the ferns follow Palmer 2003 and the flowering plants (Monocots and Dicots) follow Wagner *et al.* (1999). In most cases, common English and/or Hawaiian names listed here have been taken from St. John (1973) or Porter (1972). Native plants are shown in **bold.**

For each species, the following information is provided:

1. Scientific name with author citation.
2. Common English and/or Hawaiian name, when known.
3. Biogeographic status. The following symbols are used.
   E = endemic (found only in Hawai'i).
   I = indigenous (native to Hawai'i as well as other geographic areas).
   P = Polynesian introduction (introduced to Hawai'i by Polynesians before the advent of the Europeans).
   X = Introduced or alien (not native, introduced to Hawai'i, either accidentally or intentionally, after the advent of the Europeans).
4. Relative frequency (abundant, locally abundant, common, locally common, occasional, uncommon, rare).

Species	Common Names	Status	Abundance
FERNS AND FERN ALLIES			
ADIANTACEAE (Maiden's-hair Family)			
Doryopteris decipiens (Hook.) J. Sm.	kumuniu	E	
NEPHROLEPIDACEAE (Sword Fern Family)			
Nephrolepis multiflora (Roxb.) Jarret ex Morton	hairy swordfern	X	
PSILOTACEAE (Psilotum Family)			
Psilotum nudum L.	moa	I	
POLYPODIACEAE (Common Fern Family)			
Phymatosorus grossus (Langsd. & Fisch.) Brownlie	laua'e	X	
MONOCOTS			
AGAVACEAE (Agave Family)			
Pleomele hawaiiensis Degener and I. Degener	halapepe	E	

Species	Common Names	Status
COMMELINACEAE (Spiderwort Family)		
Commelina benghalensis L.	hairy honohono	X
DIOSCOREACEAE (Yam Family)		
Dioscorea bulbifera L.	bitter yam, hoi	P
POACEAE (Grass Family)		
Cenchrus echinatus L.	sandbur	X
Chloris barbata (L.) Sw.	swollen fingergrass	X
Dactyloctenium aegyptium (L.) Willd.	beach wiregrass	X
Digitaria ciliaris (Retz.) Koeler	large crabgrass	X
Eragrostis tenella (L.) P. Beauv. ex Roem. & Schult.	love grass	X
Heteropogon contortus (L.) P. Beauv. ex Roem. & Schult.	pili grass	I
Melinus minutiflora P. Beauv.	molasses grass	X
Panicum maximum Jacq.	Guinea grass	X
Pennisetum setaceum (Forssk.) Chiov.	fountain grass	X
Rhynchelytrum repens (Willd.) C.E. Hubb.	Natal redtop	X
DICOTS		
AMARANTHACEAE (Amaranth Family)		
Amaranthus viridis L.	slender amaranth	X
ANACARDIACEAE (Mango Family)		
Schinus terebinthifolius Raddi	Christmas berry	X
APOCYNACEAE (Periwinkle Family)		
Catharanthus roseus (L.) G. Don	Madagascar periwinkle	X
ARALIACEAE (Panax Family)		
Reynoldsia sandwicensis A. Gray	'ohe	E
ASTERACEAE (Sunflower Family)		
Ageratum conyzoides L.	ageratum	X
Bidens micrantha Gaud. subsp. *ctenophylla* (Sherff) Nagatga & Ganders	--------	E
Emilia fosbergii Nicolson	red pualele, emilia	X
Emilia sonchifolia (L.) DC.	pualele, emilia	X
Lipochaeta subcordata A. Gray	--------	E
Pluchea carolinensis (Jacq.) G. Don	pluchea	X
Senecio madagascariensis Poir.	fireweed	X
Tridax procumbens L.	coat buttons	X
BIGNONIACEAE (Bignonia Family)		
Jacaranda mimosifolia D. Don	jacaranda	X
Spathodea campanulata P. Beauv.	African tulip tree	X
BUDDLEIACEAE (Butterfly-bush Family)		
Buddleia asiatica Lour.	dogtail, heulo'ilio	X

Species	Common Names	Status
CACTACEAE (Cactus Family)		
Hylocereus undatus (Haw.) Britten & Rose	night-blooming cereus	X
Opuntia ficus-indica (L.) Mill.	prickly pear, panini	X
CAPPARACEAE (Caper Family)		
Capparis sandwichiana DC	pua pilo	E
CLUSIACEAE (Mangosteen Family)		
Clusia rosea Jacq.	autograph tree	X
CONVOLVULACEAE (Morning-Glory Family)		
Ipomoea indica (J. Burm.) Merr.	koali-'awa	I
Ipomoea obscura (L.) Ker-Gawl.	bindweed	X
CRASSULACEAE (Stonecrop Family)		
Kalanchoë pinnata (Lam.) Pers.	air plant	X
CUCURBITACEAE (Gourd Family)		
Coccinea grandis (L.) Voigt	ivy gourd	X
Momordica charantia L.	wild bittermelon	X
EBENACEAE (Ebony Family)		
Diospyros sandwicensis (A. DC.) Fosb.	lama	E
EUPHORBIACEAE (Spurge Family)		
Aleurites moluccana (L.) Willd.	candlenut, kukui	P
Chamaesyce celastroides (Boiss.) Croziat and Degener	'atoto	E
Chamaesyce hirta (L.) Millsp.	garden spurge	X
Chamaesyce hyssopifolia (L.) Small	--------	X
Macaranga tanarius (L.) Muell. Arg.	--------	X
Ricinus communis L.	castor bean	X
FABACEAE (Pea Family)		
Acacia farnesiana (L.) Willd.	klu	X
Chamaecrista nictitans (L.) Moench	partridge pea, lau-ki	X
Crotalaria pallida Aiton	smooth rattlepod	X
Desmodium incanum DC.	Spanish clover	X
Desmodium tortuosum (Sw.) DC.	Florida beggarweed	X
Indigofera suffruticosa Mill.	indigo, 'iniko	X
Leucaena leucocephala (Lam.) de Wit	koa haole	X
Macroptilium lathyroides (L.) Urb.	cow pea	X
Pithecellobium dulce (Roxb.) Benth.	'opiuma, Manila tamarind	X
Prosopis pallida (Humb. & Bonpl.ex Willd.) Kunth	kiawe, mesquite	X
Senna occidentalis (L.) Link	coffee senna	X
Senna gaudichaudii (Hook. & Arn.) H. Irwin & Barneby	kolomona	I

Species	Common Names	Status
FABACEAE (cont'd.)		
Senna surattensis (N.L. Burm.) H. Irwin & Barneby	kolomona	X
Sophora chrysophylla (Salisb.) Seem.	mamane	E
GOODENIACEAE (Goodenia Family)		
Scaevola sericea Vahl	naupaka	I
LAMIACEAE (Mint Family)		
Hyptis pectinata (L.) Poir.	comb hyptis	X
Plectranthus parviflorus Willd.	spurflower	I
MALVACEAE (Mallow Family)		
Abutilon grandifolium (Willd.) Sweet	hairy abutilon	X
Malvastrum coromandelianum (L.) Garcke	false mallow	X
Sida fallax Walp.	'ilima	I
Sida rhombifolia	Cuba jute	X
MENISPERMACEAE (Moonseed Family)		
Cocculus trilobus (Thunb.) DC.	huehue	I
MYOPORACEAE (False-sandalwood Family)		
Myoporum sandwicense A. Gray	naio, false sandalwood	I
MYRTACEAE (Myrtle Family)		
Metrosideros polymorpha Gaud.	'ohi'a lehua	E
Psidium guajava L.	guava	X
NYCTAGINACEAE (Four-o'-Clock Family)		
Boerhavia coccinea Mill.	--------	X
PAPAVERACEAE (Poppy Family)		
Argemone glauca (Nutt. ex Prain) Pope	pua kala	E
PASSIFLORACEAE (Passionflower Family)		
Passiflora edulis Sims	passionfruit, liliko'i	X
Passiflora foetida L.	love-in-a-mist	X
PHYTOLACCACEAE (Pokeweed Family)		
Rivina humilis L.	rouge plant	X
PIPERACAEAE (Pepper Family)		
Peperomia leptostachya Hooker & Arnott	'ala'ala-wai-nui	I
PORTULACACEAE (Purslane Family)		
Portulaca oleracea L.	common purslane	X
Portulaca pilosa L.	'ihi	X
Talinum triangulare (Jacq.) Willd.	talinum	X
PROTACEAE (Protea Family)		
Grevillea robusta A. Cunn. ex R. Br.	silk oak	X
ROSACEAE (Rose Family)		
Osteomeles anthyllidifolia (Sm.) Lindl.	'ulei	I

Species	Common Names	Status
RUBIACEAE (Coffee Family)		

Morinda citrifolia L.	Indian mulberry, noni	P
Psydrax odoratum (Forst. f.) A. C. Sm. & S. Darwin	alahe'e	I
SAPINDACEAE (Soapberry Family)		
Dodonaea viscosa Jacq.	'a'ali'i	I
SCROPHULARIACEAE (Snap-dragon Family)		
Lophospermum erubescens D. Don	larger roving sailor	X
SOLANACEAE (Nightshade Family)		
Lycopersicon pimpinellifolium (Jusl.) Mill.	currant tomato	X
STERCULIACEAE (Cacao Family)		
Waltheria indica L.	'uhaloa	I
VERBENACEAE (Verbena Family)		
Lantana camara L.	lantana	X
Stachytarpheta australis Moldenke	owi	X
Stachytarpheta cayennensis (Rich.) Vahl	blue rat's-tail	X

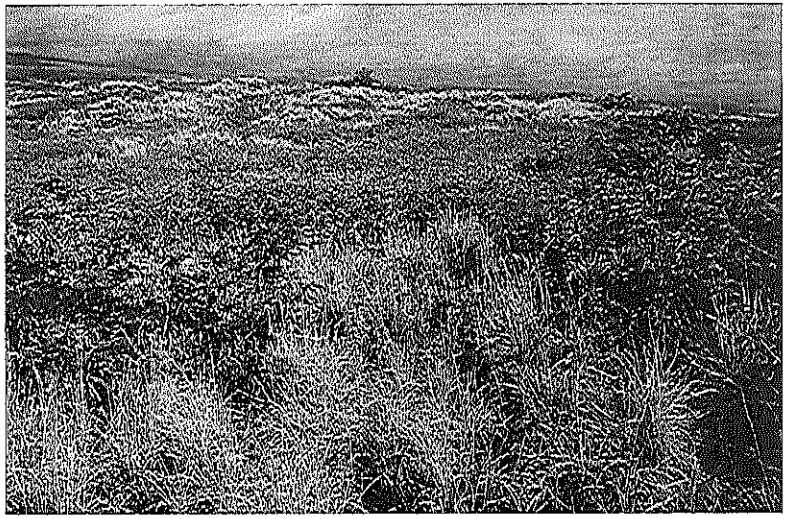

Fig. 3. *Leucaena* scrub at lower end of study site.

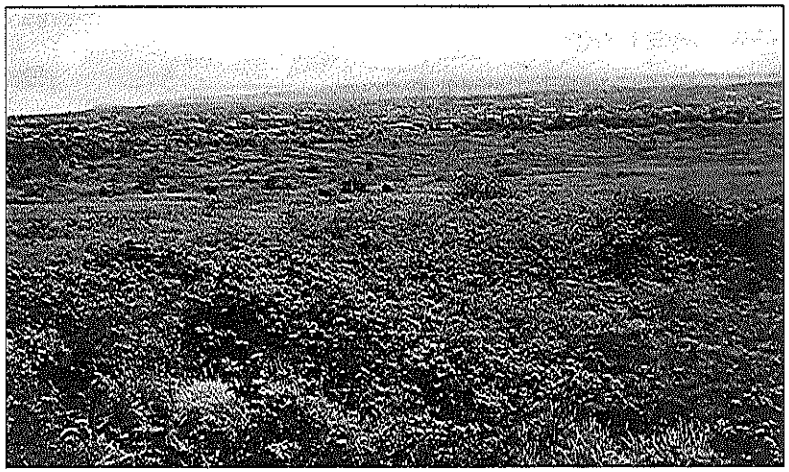

Fig. 4. *Leucaena* scrub on the north-central part of the study site.

Fig. 5. *Kalanchoë pinnata* dominating underneath a *Leucaena* canopy at north-central part of the site.

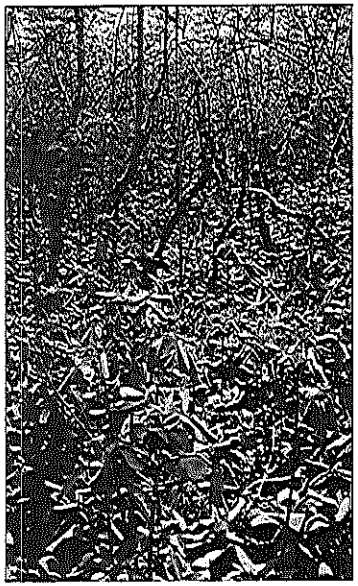

Fig. 6. Fountain grass growing under *Leucaena* trees.

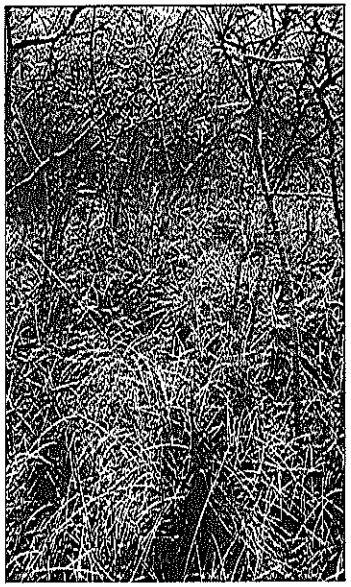

Fig. 7. Sparse Christmas-berry scrub at northeast corner of the study site.

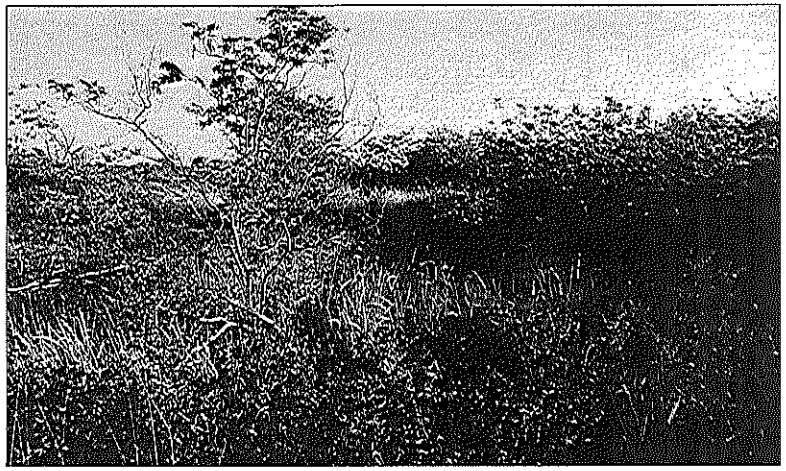

Fig. 8. Upper lava flow dominated by Christmas berry.

Fig. 9. Open lava in the dryland forest

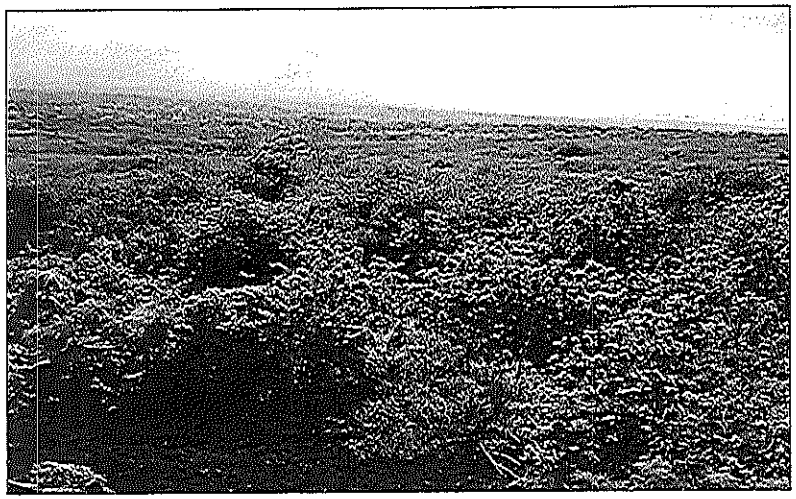

Fig. 10. Dense dryland forest.

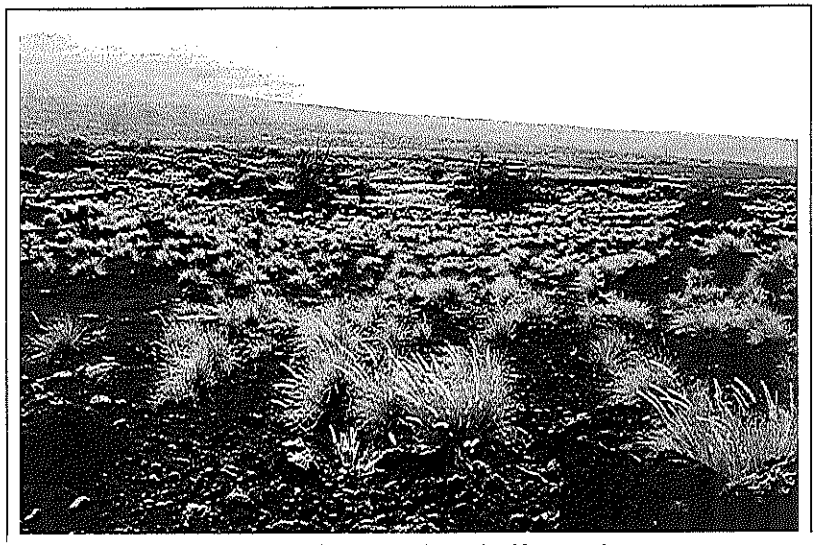

Fig. 11. Fountain grass coming up in old quarry site.

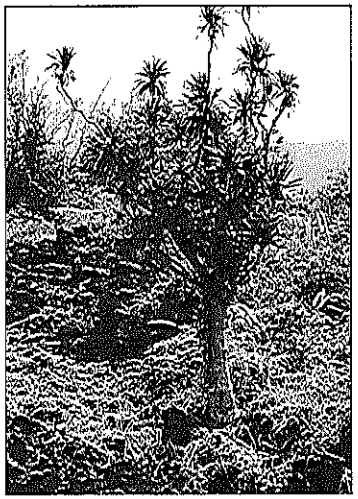

Fig. 12. *Pleomele hawaiiensis.*

Fig. 13. *Bidens micrantha* subsp. *ctenophylla.*

Appendix F

Survey of Avian and Terrestrial Mammalian Species
Rana Productions, Ltd.
September 2006

A Survey of Avian and Terrestrial Mammalian Species on TMK (3) 7-3-09:17, 25, 26, and 28, at Kaloko, and Kohanaiki, North Kona District, Island of Hawai'i.

DRAFT

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Introduction

This report summarizes the findings of avian and mammalian surveys conducted on an approximately 1,151-acre parcel of land identified as TMK (3) 7-3-09:17, 25, 26, and 28. The property is located in the Kaloko, and Kohanaiki *Ahupua'as*, in the North Kona District, Hawai'i (Figure 1).

The primary purpose of the surveys was to determine if there were any avian or mammalian species currently listed as endangered, threatened, or proposed for listing under either the federal or the State of Hawai'i's endangered species programs on, or within in the immediate vicinity of the site. Federal and State of Hawai'i listed species status follows species identified in the following referenced documents (Division of Land and Natural Resources (DLNR) 1998, Federal Register 2005, U. S. Fish & Wildlife Service (USFWS) 2005, 2006). Fieldwork was conducted between September 7 and 11, 2006.

Avian phylogenetic order and nomenclature follows *The American Ornithologists' Union Check-list of North American Birds 7th Edition* (American Ornithologists' Union 1998), and the 42nd through the 47th supplements to *Check-list of North American Birds* (American Ornithologists' Union 2000; Banks et al. 2002, 2003, 2004, 2005, 2006). Mammal scientific names follow *Mammals in Hawaii* (Tomich 1986). Higher native and naturalized plant names follow *Manual of the Flowering Plants of Hawai'i* (Wagner et al. and Wagner and Herbst, 1990, 1999). Place names follow *Place Names of Hawaii* (Pukui et al. 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 14.

General Site Description

The approximately 1,151-acre parcel of land is located in Kaloko, in the North Kona District. The site is transected by the existing Hina Lani Street, and is located immediately upslope (*mauka*) of the Kaloko Light Industrial Park. The site is bound to the northeast, east and south by undeveloped land. The northwest boundary of the site is along Queen Ka'ahumanu Highway, the southwest corner is bound by the Kaloko Light Industrial Park, and the northwest by the Kohanaiki Industrial Park (Figure 1). The site gently slopes from east to west from a maximum elevation of ~ 740-feet above mean sea level (ASL) at the northeastern boundary, down to ~ 60-feet ASL at the northwestern boundary, located along Queen Ka'ahumanu Highway (USGS 1996). The project area consists to three distinct lava flows, the oldest is an 'a'ā flow disgorged from Mount Hualālai between 5,000 and 10,000 years ago, most of this flow has been covered by a mix of weathered broken pāhoehoe, and 'a'ā flows deposited some 3,000 to 5,000 years ago, much of this flow has since been covered by newer flows laid down between 1,500

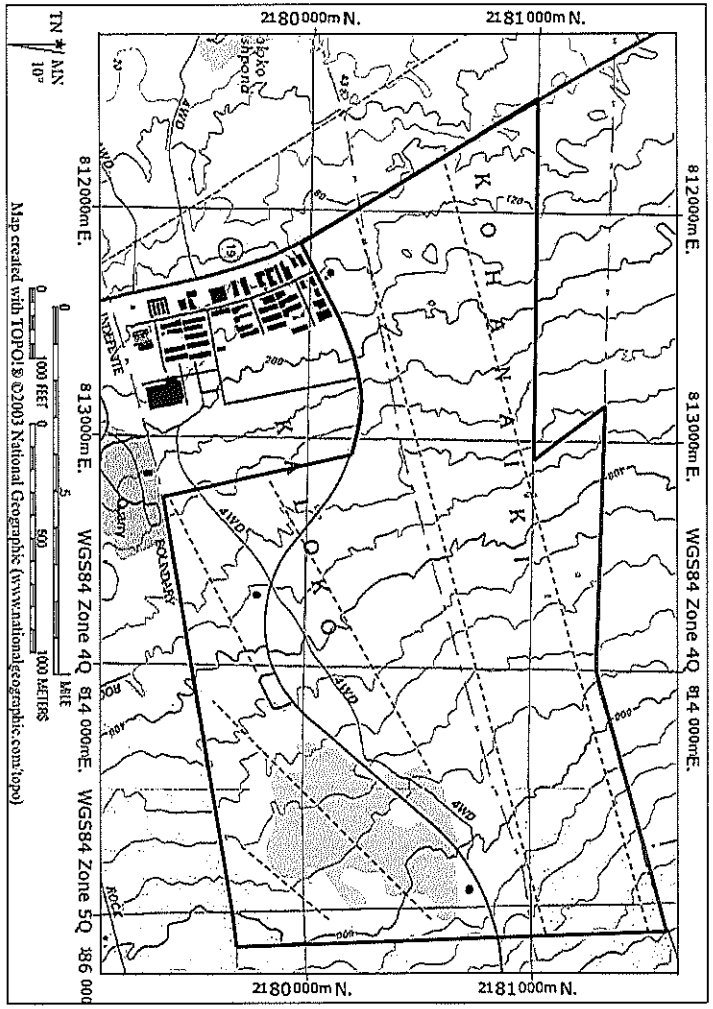
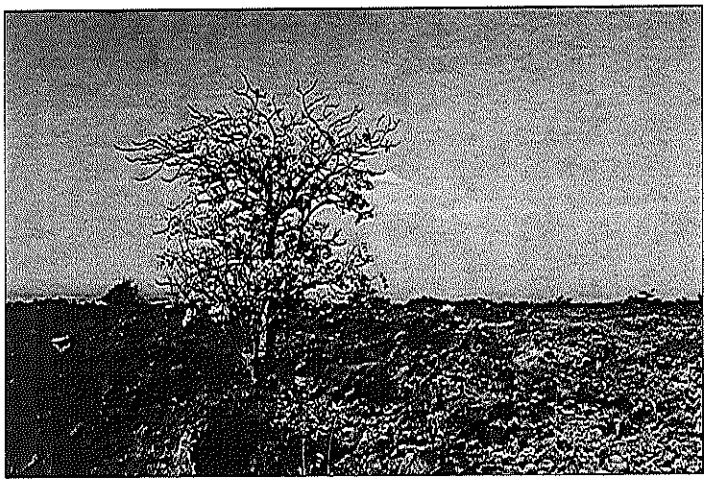


Figure 1 – Kaloko Properties Study Site
Red Line Represents Approximate Boundaries of the Site – Blue Dotted Lines Indicate Avian Transects

and 3,000 years ago (Wolfe and Morris 1996, USGS 1996).

The vegetation present on the oldest 'a'ā flows not covered by newer flows has a high degree of native components remaining, including several rare and endangered species (Figure 2). The bulk of the site, however, is dominated by alien vegetation. This dominant vegetation can be best characterized as a Fountain Grass/ Koa Haole Grassland subtype of a Lowland Dry Grassland Community as described in Gagne and Cuddihy (1990) (Figure 3).

Figure 2
Dryland Forest Vegetation on 'A'ā Flows,
***'ohe makai* (*Reynoldsia sandwicensis*) in the foreground**



Avian Survey Methods

Thirty-two avian count stations were sited at approximately 300-meter intervals along six linear transects running from east-to-west through the project area (Figure 1). One six-minute point count was conducted at each station. Field observations were made using Leitz 10 X 42 binoculars to sight birds and by listening for vocalizations. Counts took place between 06:30 a.m. and 10:30 a.m., the peak of daily bird activity. In an attempt to detect nocturnally flying seabirds over-flying the project area. An additional two hours were spent within the project area on the evenings of September 7th, 8th and 9th on the

mornings of September 8th, 9th, and 10th, 2006. Time not spent counting was used to search the study site for species and habitats that were not detected during count sessions.

Figure 3
Typical Fountain Grass/ Koa Haole Grasslands

Avian Survey Results

A total of 881 individual birds of 20 different species, representing 11 separate families were recorded during station counts. Additionally, one other species, Barn Owl (*Tyto alba*) was recorded as an incidental observation on the evening of September 7, 2006. One of the species recorded, Pacific Golden-Plover (*Pluvialis fulva*) is an indigenous migratory shorebird species that nests in the high Arctic, returning to Hawaii and the Tropical Pacific to spend the fall and winter months each year. The remaining 18 species detected are considered to be alien to the Hawaiian Islands, with one of them, Red Junglefowl (*Gallus gallus*) a domestic species, not currently considered to be established in the wild on the Island of Hawai'i (Table 1).

No avian species currently listed as endangered, threatened, or proposed for listing under either the federal or the State of Hawai'i's endangered species programs were detected during the course of this survey.

Avian diversity and densities were relatively low, though in keeping with the extremely dry habitat present on the site. Three species, House Finch (*Carpodacus mexicanus*), Zebra Dove (*Geopelia striata*), and Japanese White-eye (*Zosterops japonicus*), accounted for 43% of the total number of individual birds recorded. House Finchs were the most frequently recorded species, accounting for slightly more than 17% of the total number of individual birds recorded during station counts. An average of 27 birds were recorded per station count.

Table 1

Avian Species Detected Within the Kaloko Properties Study Site

Common Name	*Scientific Name*	*ST*	*RA*
	GALLIFORMES		
	PHASIANIDAE - Pheasants & Partridges		
	Phasianinae - Pheasants & Allies		
Gray Francolin	*Francolinus pondicerianus*	A	0.84
Black Francolin	*Francolinus francolinus*	A	0.56
Erckel's Francolin	*Francolinus erckelii*	A	0.06
Red Junglefowl	*Gallus gallus*	D	0.06
Kalij Pheasant	*Lophura leucomelanos*	A	0.09
	CHARADRIIFORMES		
	CHARADRIIDAE - Lapwings & Plovers		
	Charadriinae - Plovers		
Pacific Golden-Plover	*Pluvialis fulva*	IM	0.34
	COLUMBIFORMES		
	COLUMBIDAE - Pigeons & Doves		
Spotted Dove	*Streptopelia chinensis*	A	2.22
Zebra Dove	*Geopelia striata*	A	3.66
	STRIGIFORMES		
	TYTONIDAE - Barn Owls		
Barn Owl	*Tyto alba*	A	I-1
	PASSERIFORMES		
	ZOSTEROPIDAE - White-eyes		
Japanese White-eye	*Zosterops japonicus*	A	3.44
	MIMIDAE - Mockingbirds & Thrashers		
Northern Mockingbird	*Mimus polyglottos*	A	0.22
	STURNIDAE - Starlings		
Common Myna	*Acridotheres tristis*	A	2.25
	EMBERIZIDAE - Emberizids		
Saffron Finch	*Sicalis flaveola*	A	1.31

Common Name	*Scientific Name*	*ST*	*RA*
Yellow-billed Cardinal	*Paroaria capitata*	A	0.88
	CARDINALIDAE - Cardinals Saltators & Allies		
Northern Cardinal	*Cardinalis cardinalis*	A	1.56
	FRINGILLIDAE - Fringilline and Carduleline Finches & Allies		
	Carduelinae - Carduline Finches		
House Finch	*Carpodacus mexicanus*	A	4.75
Yellow-fronted Canary	*Serinus mozambicus*	A	1.31
	PASSERIDAE - Old World Sparrows		
House Sparrow	*Passer domesticus*	A	0.66
	ESTRILDIDAE - Estrildid Finches		
	Estrildinae - Estrildine Finches		
African Silverbill	*Lonchura cantans*	A	2.03
Nutmeg Mannikin	*Lonchura punctulata*	A	0.66
Java Sparrow	*Padda oryzivora*	A	1.13

KEY TO TABLE 1

ST Status

A Alien – Introduced to the Hawaiian Islands by humans

D Domestic Species – Not considered to be established in the wild on the Island of Hawai'i

IM Indigenous Migratory Species

RA Relative Abundance – Number of birds detected divided by the number of count stations (32)

I- Incidental – Species detected incidentally, followed by the number of individuals recorded

Mammalian Survey Methods

All observations of mammalian species were of an incidental nature. With the exception of the endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*), or *'ōpe'ape'a* as it is known locally, all terrestrial mammals currently found on the Island of Hawai'i are alien species, and most are ubiquitous. The survey of mammals was limited to visual and auditory detection, coupled with visual observation of scat, tracks, and other animal sign. A running tally was kept of all vertebrate species observed and heard within the study area. Visual and electronic scans, using a Broadband AnaBat II® ultrasonic bat detector, were made for bats during crepuscular periods on the evening of September 7, 8 and 9, 2006.

Mammalian Survey Results

A total of nine mammalian species were detected while on the site. Seven European house mice (*Mus musculus domesticus*) were seen within the study area (Table 1). A total of five small Indian mongooses (*Herpestes a. auropunctatus*) were seen at various locations within the study site, as were two cat (*Felis catus*), one pig (*Sus s. scrofa*) and 35+ goats (*Capra h. hircus*). Additionally, skeletal remains were encountered of small

Indian mongoose, cat, pig, cattle (*Bos Taurus*), goat and sheep (*Ovis aries*). Tracks and sign of dogs (*Canis f. familiaris*), was encountered in several locations within the study area.

Hawai'i's sole endemic terrestrial mammalian species, the endangered Hawaiian hoary bat, was not detected during the survey, though I did record one bat as an incidental observation on the evening of September 15, 2006, while driving up Hina Lani Street. All of the alien mammalian species recorded during this survey are deleterious to avian and floristic components of the remaining native ecosystems present on the Island.

Table 2

Mammalian Species Detected Within the Kaloko Properties Study Site

Common name	*Scientific name*	Status
	CHIROPTERA - BATS	
	VESPERTILIONIDAE - Common Bats	
Hawaiian hoary bat	*Lasiurus cinereus semotus*	EE
	RODENTIA - GNAWERS	
	Muridae - Old World Rats & Mice	
European house mouse	*Mus musculus domesticus*	A
	CARNIVORA- FLESH EATERS	
	Canidae - Wolves, Jackals & Allies	
Domestic dog	*Canis f. familiaris*	A
	Viverridae - Civets & Allies	
Small Indian mongoose	*Herpestes a. auropunctatus*	A
	Felidae- Cats	
House cat	*Felis catus*	A
	ATRIODACTYLA - EVEN-TOED UNGULATES	
	Suicidae - Old World Swine	
Pig	*Sus s. scrofa*	A
	Bovidae- Hollow-horned Ruminants	
Domestic cattle	*Bos taurus*	A
Domestic goat	*Capra h. hircus*	A
Domestic sheep	*Ovis aries*	A

KEY TO TABLE 2

A Alien – Introduced to the Hawaiian Islands by humans

EE Endangered Endemic – Native and unique to the Hawaiian Islands

Discussion

Avian Resources

Avian diversity and densities detected during this survey were in keeping with the results of at least one previous survey conducted on a portion of this site (David 1995), and with several other surveys conducted on lands immediately adjacent to it (David 2000a, 2000c, 2004a, 2004c) and with several other surveys conducted on various parcels of land, with like habitat, in the lowland areas in the North Kona District within the recent past (David 1999, 2000b, 2000d, 2001, 2003, 2004b, 2005b, 2005c, 2006a, 2006b).

All but one of the 21 avian species detected during the course of this survey are considered to be alien to the Hawaiian Islands. The lone native species detected, Pacific Golden-Plover is a common indigenous migratory shorebird species, seen throughout the state between July and late April each year. Avian diversity and densities were low, as is to be expected given the fountain grass dominated xeric habitat present on the site and the surrounding property.

Although not detected during this survey it is possible that small numbers of the endangered endemic Hawaiian Petrel (*Pterodroma sandwichensis*), or *ua'u*, and the threatened Newell's Shearwater (*Puffinus auricularis newelli*), or *'a'o*, over-fly the project area between the months of May and November (Banko 1980a, 1980b, Day et al. 2003a, Harrison 1990).

Hawaiian Petrels were formerly common on the Island of Hawai'i (Wilson and Evans 1890–1899). This pelagic seabird reportedly nested in large numbers on the slopes of Mauna Loa and in the saddle area between Mauna Loa and Mauna Kea (Henshaw 1902), as well as at the mid to high elevations of Mount Hualālai. It has, within recent historic times, been reduced to relict breeding colonies located at high elevations on Mauna Loa and, possibly, Mount Hualālai (Banko 1980a, Banko et al. 2001, Cooper and David 1995, Cooper et al. 1995, Day et al. 2003, Harrison 1990, Hue et al. 2001, Simons and Hodges 1998).

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

The primary cause of mortality in both Hawaiian Petrels and Newell's Shearwaters is thought to be predation by alien mammalian species at the nesting colonies (U.S. Fish & Wildlife Service 1983, Simons and Hodges 1998, Ainley et al. 2001). Collision with man-made structures is considered to be the second most significant cause of mortality of these seabird species in Hawai'i. Nocturnally flying seabirds, especially fledglings on

their way to sea in the summer and fall, can become disoriented by exterior lighting. When disoriented, seabirds often collide with manmade structures, and if they are not killed outright, the dazed or injured birds are easy targets of opportunity for feral mammals (Hadley 1961, Telfer 1979, Sincock 1981, Reed et al. 1985, Telfer et al. 1987, Cooper and Day 1998, Podolsky et al. 1998, Ainley et al. 2001). There is no suitable nesting habitat within or close to the proposed project site for either of these pelagic seabird species.

Mammalian Resources

The findings of the mammalian survey are consistent with the results of at least one previous survey conducted on a portion of this site (David 1995), and with several other surveys conducted on lands immediately adjacent to it (David 2000a, 2000c, 2004a, 2004c) and with several other surveys conducted on various parcels of land, with like habitat, in the lowland areas in the North Kona District within the recent past (David 1999, 2000b, 2000d, 2001, 2003, 2004b, 2005b, 2005c, 2006a, 2006b).

One Hawaiian hoary bats was detected as an incidental observation flying down-slope, (*makai*), from above the eastern boundary of the site towards the ocean. This finding was not unexpected as bats are regularly seen *mauka* of the project site and also below the subject property in the Kaloko-Honokōhau National Historical Park and above the Honolōhau small boat harbor on a seasonal basis (Jacobs 1994, David 2006c). Unlike nocturnally flying seabirds, which often collide with man-made structures, bats are uniquely adapted to avoid collision with most obstacles, man-made or natural. They navigate and locate their prey primarily by using ultrasonic echolocation, which is sensitive enough to allow them to locate and capture small volant insects at night.

Very little research into the life cycle, distribution, or population estimates of this species, has been conducted; and much of what has been studied, were small, disconnected, or anecdotal studies as opposed to coherent controlled experiments. Fundamental research into this species distribution and life cycle has just begun (Bonaccorso et al. 2005).

Although only European house mice were detected during the course of this survey it is probable that the other three established *muridae* known from the Island of Hawai'i, roof rat (*Rattus r. rattus*), Norway rat (*Rattus norvegicus*), and possibly Polynesian rat (*Rattus exulans hawaiiensi*) use resources within the subject property at least occasionally. Especially since the site is bound to the north and south by light industrial developments that likely harbor these commensal species.

Potential Impacts to Protected Species

Hawaiian Hoary Bat

As previously discussed, it is likely that Hawaiian hoary bats over-fly the general project area on a seasonal basis. The planting of trees and ornamental vegetation following

development may increase the presence of prey items for this insectivorous bat, and thus may in fact enhance foraging resources for this species in the area.

Hawaiian Petrel and Newell's Shearwater

The principal potential impact that the development of this site poses to Hawaiian Petrels and Newell's Shearwaters is the increased threat that birds will be downed after becoming disoriented by external lights associated with the new development.

Endangered Waterbirds

Although there is no standing water, streams or other water features on the property, and thus the habitat present does not support waterbirds, two listed waterbird species Hawaiian Coot (*Fulica alai*), and the Hawaiian endemic sub-species of the cosmopolitan Black-necked Stilt (*Himantopus mexicanus knudseni*), are resident breeding species within the Kaloko-Honokōhau National Historical Park, which is located directly across the Queen Ka'ahumanu Highway from the northwestern terminus of the project site. The development of this site does not pose direct threats to these species or their habitat, although, the potential exists that the development could pose secondary threats to the National Park and to it's endangered birds if noxious substances such a petroleum, oils lubricants, sewage and the like were to migrate downslope (*makai*) from the project into the Park.

Conclusions

The modification of the current habitat on the site is not expected to result in significant impacts to any avian or mammalian species currently listed as threatened, endangered or proposed for listing under either the Federal, or State of Hawai'i endangered species programs. Furthermore, the development of the site is not expected to have a significant deleterious impact on native faunal resources found within the North Kona District, with the one possible caveat that if noxious substances such a petroleum, oils lubricants, sewage and the like were to migrate downslope, from the project either during construction, or following build-out, into the Kaloko-Honokōhau National Historical Park, the possibility exists that such an event could result in deleterious impacts to two listed waterbird species, Hawaiian Coot and Black-necked Stilt and/or their habitat.

Recommendations

- To reduce the potential for interactions between nocturnally flying Hawaiian Petrels and Newell's Shearwaters with external lights and man-made structures, it is recommended that any external lighting that may be required in conjunction with development of the project be shielded (Reed et al. 1985, Telfer et al. 1987). This mitigation would serve the dual purpose of minimizing the threat of disorientation and downing of Hawaiian Petrels and Newell's Shearwaters, while at the same time complying with the Hawaii County Code § 14 – 50 *et seq.* which requires the shielding of exterior lights so as to lower the ambient glare caused by unshielded lighting to the astronomical observatories located on Mauna Kea.

- To address potential runoff issues and possible secondary impacts to listed waterbird species and their habitat found within the Kaloko-Honokōhau National Historical Park, it is recommended that once a conceptual Master Plan has been developed that the project, consult with both the USFWS and the National Park Service to ensure that implementation of the Master Plan will not result in deleterious impacts to listed waterbird species and their habitat, which is present within the Park.

Glossary:

'A'ā – Clinker lava formed by slow moving lava flows.
Alien - Introduced to Hawai'i by humans.
Ahupua'a – Traditional Hawaiian land division, usually extending from the uplands to the sea.
Commensal – Animals that share humans' food and lodgings, such as rats and mice.
Crepuscular – Twilight hours.
Diurnal – Daytime
Domesticated – Feral species, not considered established in the wild on the Island of Hawai'i.
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.
Muridae – Rodents, including rats, mice and voles, one of the most diverse families of mammals.
Mauka – Upslope, towards the mountains
Makai – Down-slope, towards the ocean.
Nocturnal – Nighttime, after dark.
Pāhoehoe – Sheet lava formed by relatively fast moving lava flows.
Ruderal – Disturbed, rocky, rubbishy areas, such as old agricultural fields and rock piles
Threatened - Listed and protected under the ESA as a threatened species.
Volant – Flying, capable of flight - as in flying insect.
Xeric – Extremely dry conditions or habitat.

ASL – Above mean sea level.
DLNR – Hawaii State Department of Land & Natural resources.
ESA – Endangered species act of 1973, as amended.
TMK – Tax Map Key.
USFWS – U.S. Fish & Wildlife Service

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Appendix G

Update Flora and Fauna Surveys for the Kaloko Makai Development
Rana Biological Consulting, Inc. and AECOS Consultants
May 17, 2012

Update Flora and Fauna Surveys Conducted for the Kaloko Makai Development, North Kona District, Island of Hawai'i

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Introduction and Background

Stanford Carr – TSA Kaloko Makai LLC is proposing to develop Kaloko Makai as a mixed-use development on approximately 1,139 – acres of currently undeveloped land in Kaloko and Koanaiki, North Kona District, Island of Hawai'i. The properties are identified as TMK: (3) 7-3-09:17, 25, 26, and 28.

This report describes the methods used and the results of a set of updated botanical, avian and mammalian surveys conducted on the subject property. The primary purpose of the surveys was to determine if there have been any significant changes in the habitats and/or avian, mammalian and botanical resources on the property since similar surveys were conducted on the site in 2006. We were also tasked with mapping any trust biological resources encountered on the site and to prepare maps of any such resources for inclusion in this report.

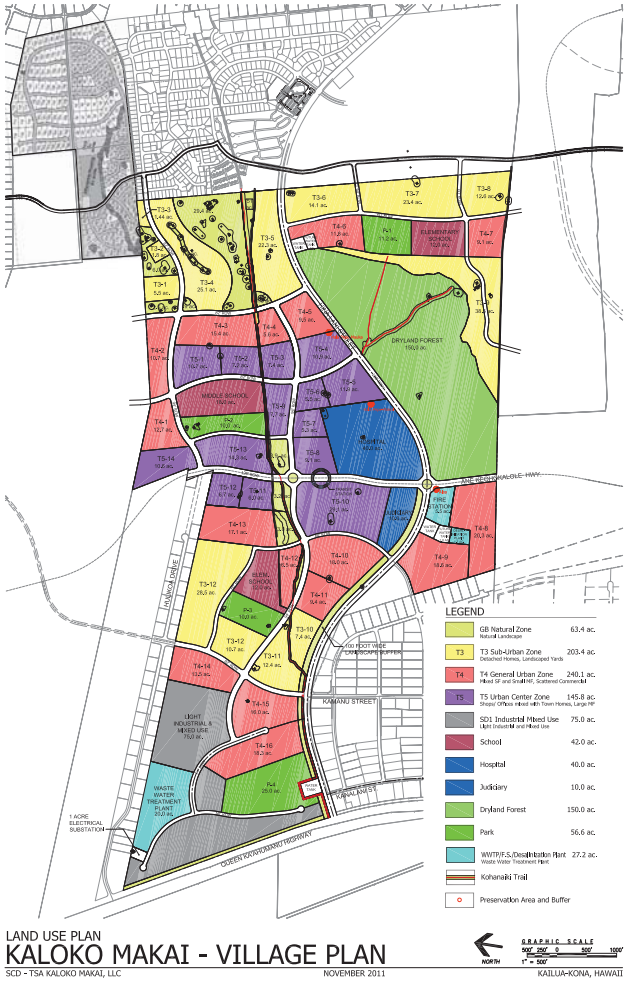
The federal and State of Hawai'i listed species status follows species identified in the following referenced documents, Department of Land and Natural Resources (DLNR) 1998; U. S. Fish & Wildlife Service (USFWS 2005a, 2005b, 2012).

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.

General Project and Site Descriptions

The proposed development will include the construction of up to 5,000 single and multi-family residential units at low and medium densities, centralized commercial and neighborhood retail centers, an array of recreational facilities (e.g. parks, trails and open spaces), urgent care medical facility and hospital, elementary and middle school sites and associated infrastructure (e.g. new roadways, utilities drainage, wastewater and potable and non-potable water distribution systems)(figure 1).

The site is bound to the west by Queen Ka'ahumanu Highway, by the Kaloko Light Industrial Park and undeveloped land to the south, and by the Koahanaiki Industrial Park to the north The existing Hina Lani Street transects the site in an east-to-west direction. Additionally, portions of a former rock quarry occupy the southwest corner (Figure 2). The project site slopes moderately to gently from east-to-west, from a maximum elevation of ~740 feet above sea level (ASL) at the northeastern boundary, down to ~60 feet ASL at the northwestern boundary along Queen Ka'ahumanu Highway (National Geographic, 2010).



LAND USE PLAN
KALOKO MAKAI - VILLAGE PLAN
SCD - TSA KALOKO MAKAI, LLC NOVEMBER 2011 KAILUA-KONA, HAWAII

Figure 1 – Project site

The Project site lies on volcanic flows disgorged from Mount Hualālai. Within the project parcel, the different ages of the lava flows are somewhat evident from the degree of development of the vegetation. Dark red dashed lines in Figure 2 outline the various physiographic features that have significance with respect to the nature of the vegetation. These lines are based on interpretation from a satellite image and were generally confirmed in the field and matched to the geologic map of Sherrod, et al. (2007). The youngest flow-the Kaloko-Honokōhau *ʻaʻā* lava flow (LF1) - dates to between 1,500 and 3,000 years before the present (ybp). In the project area, this *ʻaʻā* flow extends down-slope along the southern side of the site (crossed by Hina Lani Street) from well upslope of the upper property boundary to below Queen Kaʻahumanu Highway. This flow originated from within the northwest rift of Mount Hualālai. The remainder of the property is an older flow dated between 3,000 and 5,000 ybp, but with some distinct *ʻaʻā* flows (LF2) present within this age range. An even older surface (5,000-11,000 ybp) is exposed on the property in the vicinity of Queen Kaʻahumana Highway.

Figure 2 - Project area (outlined in yellow) on both sides of Hina Lani Street. Codes for substratum/vegetation types are as follows:
D – highly disturbed ground;
LF1 – *ʻaʻā* flow less than 3000 years old;
LF2 – *ʻaʻā* flows between 3000 and 5000 years old;
PF – *pāhoehoe* and some *ʻaʻā* with generally open forest or very dense scrub growth;
PS – mostly *pāhoehoe* with scrub vegetation;
Q – old (abandoned) quarry area.

The majority of the site, consisting mostly of old *pāhoehoe* flows, is dominated by alien vegetation: a mixture of grass and shrubs (PS). These shrubs increase in size and density in an upslope direction in response to a gradient of increasing moisture tied to elevation. At around 600 feet (180 meters) above sea level, this shrubland gradually transitions into a more closed forest (PF) in the uppermost parts of the property. The vegetation present on the youngest *ʻaʻā* flow (LF1), although sparse in cover, has a high percentage of native plant species, including several rare species. Disturbed ground (D) is associated with the roadway and an area on the south side near the middle just off Hina Lani Street that was once used as a construction base yard.

Methods

Plant names follow *Manual of the Flowering Plants of Hawaiʻi* (Wagner et al., 1990, 1999) for native and naturalized flowering plants, Palmer (2003) for ferns, and *A Tropical Garden Flora* (Staples and Herbst, 2005) for crop and ornamental plants. Some names have been changed (updated) since these sources were published, and recent accepted names are used here. The avian phylogenetic order and nomenclature used in this report follows the *AOU Check-List of North American Birds* (American Ornithologists' Union, 1998), and the 42nd through the 51st supplements to the Check-List (American Ornithologists' Union, 2000; Banks et al., 2002, 2003, 2004, 2005, 2006, 2007, 2008; Chesser et al., 2009, 2010, 2011). Mammal scientific names follow (Tomich, 1986). Place names follow (Pukui et al., 1974).

Botanical Survey Methods

The botanical survey was undertaken on January 18-20, February 2, and March 28, 2012 and involved wandering transects that traversed all vegetation types in the project area. For these surveys, a property boundary map was loaded into a GPS unit (Trimble, GeoXT or GeoXM) to serve as a guide, both recording the progress track of the botanist and insuring that the survey did not stray outside the project boundaries. Using the recorded track in real time also served as feedback on the adequacy of coverage of the pedestrian survey. A map of the survey tracks (white dotted lines) is presented as Figure 3. A light green route (near the center) is from an earlier survey (Guinther and David, 2010) for a County Courthouse location selection process.

In addition to tracking the course of the survey, positions (locations) of special features were also recorded with the GPS unit. For the most part these were selected rare native plants and specific locations where field notes were taken.

Plant species were identified as they were encountered and notations used to develop a qualitative sense of abundance in various environments encountered. The surveys periods encompassed the wet season and the vegetation was generally in a healthy state. Plants typical of each vegetation type, including annuals, were readily observable and identifiable. For a few species not immediately recognized in the field, photographs were taken and/or material collected for identification at the laboratory. As can be seen on the Figure 3, the

pedestrian survey concentrated on recent lava flows for the reason that these were known (and quickly found) to harbor plant species of interest (i.e., rare native species). Pedestrian surveys tend to be directed by aspects of the terrain that promise the presence of additional species or moving to trees and shrubs viewed from a distance requiring up-close confirmation (and entering position data, if of interest). Thus, in the area of greatest concentration of significant native trees, the survey route is largely directed by wandering from tree to tree as these trees are sighted at distance.

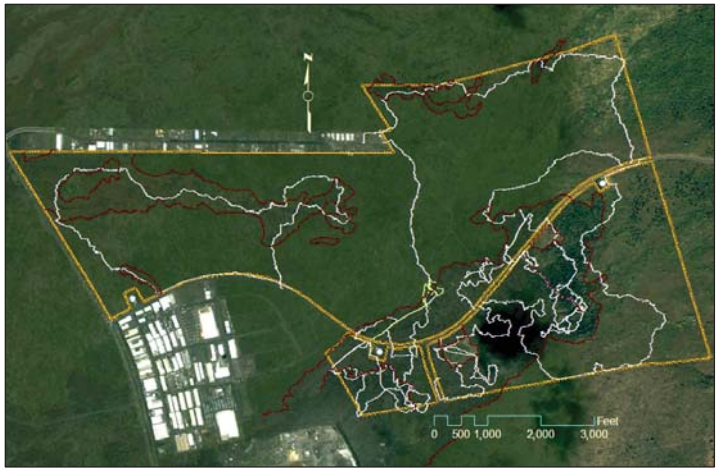


Figure 3 - Map of survey area plotted on an aerial image, showing tracks taken by the botanist over the course of the survey.

Avian Survey Methods

Thirty avian count stations were sited at approximately 300-meter intervals along four linear transects running from east-to-west through the project area. The transects and count stations were sited as close to those used during the course of the 2006 avian survey of the site as possible (David, 2006). A single six-minute avian point count was made at each of the 30 count stations. Field observations were made with the aid of Leica 8 X 42 binoculars and by listening for vocalizations. The counts and subsequent searches of the site, was conducted between 6:30 am and 11:00 am each morning. Time not spent counting

the point count stations was used to search the remainder of the sites for species and habitats not detected during the point counts. Weather conditions were ideal, with no rain, unlimited visibility on the sites and winds of between 1 and 7 kilometers an-hour, during point count periods.

Mammalian Survey Methods

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 Hawaiʻi are alien species, and most are ubiquitous. The survey of mammals was limited to visual and auditory detection, coupled with visual observation of scat, tracks, and other animal sign. A running tally was kept of all terrestrial vertebrate mammalian species detected within the site. The mammalian survey was conducted concurrently with the avian surveys. This mimics the same survey techniques employed during the 2006 survey of the same property (David, 2006).

Results

Botanical Surveys

Flora — A plant checklist (Table 1) was compiled from field observations, with entries arranged alphabetically under plant family names (standard practice). Included in the list are scientific name, common name, and status (whether native or non-native) for each species observed during the 2012 survey. The listing also includes plant species identified on the same property by Whistler (2011), on the same site, but only the parcel between Queen Kaʻahumanu Highway and the 300-foott elevation by Char (1995), and more recently on a very limited part of the property by David and Guinther (2011). Notes <2>, <3>, and <1> respectively in Table 1 identify results from these other surveys. A plant species reported by either Whistler or Char, but not seen in the 2012 survey, lacks an alpha or alphanumeric abundance rating. A plus sign (+) in an abundance column indicates a plant reported by Char (1995) in the indicated environment type[1].

Note that this table is split into two parts: Table 1a presents a list of non-native species (76 species; both naturalized and ornamental) and Table 1b a list of 36 species of "native" plants (including early Polynesian introductions or so-called "canoe plants") and species thought to be either early introductions or indigenous (as ?Ind). Table 1b lists those plants of most interest to resource agencies.

In addition to identifying the plants present within the study site, qualitative estimates of plant abundance were made separately for each environment type, indicated by three

[1] Char recognized two general vegetation types in her survey area: fountain grass grassland and *ʻaʻa* lava flow. These correspond to our PS and LF2, respectively.

columns under abundance labeled "PS", "LF", and "PF", where these correspond to: 1) shrublands on older lava flows, 2) the younger *'a'ā* lava flows (LF1 and LF2), and 3) upper forested areas (on lava of various types and ages) as mapped in Figure 2. Abundance values are coded in the table as explained in the Legend to Table 1 and apply to observations made in 2012. For some species, a two-level system of abundance is used, with a letter-number code indicating a species having a clustered distribution; that is, for example, a species infrequently encountered, but numerous where observed. Thus, an abundance rating of "R" indicates a plant encountered only one to three times during the entire survey of a parcel. An "R2" indicates a plant encountered in just one or two places, but with many individuals present where encountered. An "R3" would be a plant seldom encountered (i.e., rare), but locally abundant in one or more of the locations where it was encountered. Plants tagged as "ruderal" (note <3> in Table 1) are characteristic of disturbed ground typically either recently graded areas (D) or the verges of the roads and highways.

Table 1 – Flora for Kaloko Makai, North Kona, Hawai'i
1a – Non-native (ornamentals and naturalized) plants

Family / Species	Common name	Status	Abundance (by vegetation type) PS	LF	PF	Notes
	FERNS AND FERN ALLIES					
NEPHROLEPIDACEAE						
Nephrolepus multiflora (Roxb.) F.M. Jarrett ex C.V. Morton	sword fern	Nat	--	+ U1	--	< 2, 3>
POLYPODIACEAE						
Phymatosorus grossus (Langsd. & Fisch.) Brownlie	*laua'e*	Nat	--	--	U2	<2>
PTERIDACEAE						
Pityrogramma austroamericana Domin	gold fern	Nat	R	--	--	
	FLOWERING PLANTS DICOTYLEDONS					
AMARANTHACEAE						
Amaranthus viridis L.	slender amaranth	Nat	+	--	--	<2, 3>
Gomphrena globosa L.	globe amaranth	Nat	R	--	--	<4>
ANACARDIACEAE						
Schinus terebinthifolius Raddi	Christmas berry	Nat	+	+ O	AA	<1, 2, 3>
APOCYNACEAE						
Cascabella thevitia (L.) Lippold	be-still tree	Nat	R1	--	--	
Catharanthus roseus (L.) G. Don.	Madagascar periwinkle	Nat	+ R1	--	--	<1, 2, 3>
Plumeria obtusa L.	Singapore plumeria	Orn	R	--	--	<1>
Plumeria rubra L.	graveyard flower	Orn	R	--	--	<1>
ARALIACEAE						
Schefflera actinophylla (Endl.) Harms	octopus tree, umbrella tree	Nat	--	--	R	
ASCLEPIADACEAE						
Stapelia gigantea N. E. Brown	giant toad plant	Nat	R	--	R	
ASTERACEAE						
Ageratum conyzoides L.	ageratum	Nat	--	+	--	<2, 3>
Bidens cynapiifolia Kunth	West Indian beggartick	Nat	+	--	--	<3>
Emilia fosbergii Nicolson	Flora's paintbrush	Nat	--	+ R	--	<2, 3>
Pluchea carolinensis (Jacq.) G. Don	sourbush	Nat	R	+ O	R	<1, 2, 3>
Senecio madagascariensis Poir.	fireweed	Nat	--	R	--	<2>
Tridax procumbans L.	coat buttons	Nat	U	--	--	<1, 2>

Table 1a (continued).

Family	Common name	Status	Abundance (by vegetation type)			Notes
Species			PS	LF	PF	
FABACEAE (continued)						
Senna occidentalis (L.) Link	coffee senna	Nat	+	--	R	<2, 3>
Senna surattensis (N.L. Burm.) H. Irwin & Barneby	*kolomana,* scrambled egg	Nat	R	--	--	<2>
LAMIACEAE						
Hyptis pectinata (L.) Poir.	comb hyptis	Nat	--	--	R	<2, 4>
MALVACEAE						
Abutilon grandifolium (Willd.) Sweet.	hairy abutilon	Nat	--	--	--	<2>
Malvastrum coromandelianum (L.) Garcke	false mallow	Nat	--	--	--	<2>
Sida rhombifolia L.	---	Nat	--	--	--	<2>
MYRTACEAE						
Psidium guajava L.	common guava	Nat	--	--	U	<2>
NYCTAGINACEAE						
Boerhavia coccinea Mill.	---	Nat	--	--	--	<2>
PASSIFLORACEAE						
Passiflora edulis Sims	*liliko'i*, passionfruit	Nat	--	--	R	<2, 5>
Passiflora foetida L.	love-in-a-mist, running pop	Nat	R	--	--	<1, 2>
PHYTOLACCACEAE						
Rivina humilis L.	coral berry	Nat	R	--	R	<1, 2>
PORTULACACEAE						
Portulaca oleracea L.	pig weed	Nat	+ R	--	--	<2, 3>
Portulaca pilosa L.	*'ihi*	Nat	+	--	--	<1, 2, 3>
Talinum trianglare (Jacq.) Willd.	talinum	Nat	--	+ U	A	<1, 2, 3>
PROTEACEAE						
Grevillea robusta A. Cunn. ex R. Br.	silk oak	Nat	+ R	--	C	<1, 2, 3>
SCROPHULARIACEAE						
Lophospermum erubescens D. Don	larger roving sailor	Nat	--	--	--	<2>
SOLANACEAE						
Solanum lycopersicum var. *cerasiforme* (Dunal) Spooner	cherry tomato	Nat	--	--	--	<2>
VERBENACEAE						
Lantana camara L.	lantana	Nat	+ R1	+ O	R	<1, 2, 3>
Stachytarpheta australis Moldenke	---	Nat	--	--	R	<2, 5>
Stachytarpheta cayennensis (Rich.) Vahl	---	Nat	--	--	--	<2>
MONOCOTYLEDONES						
COMMELINACEAE						
Commelina benghalensis L.	hairy *honohono*	Nat	--	--	R	<2>

Table 1a (continued).

Family	Common name	Status	Abundance (by vegetation type)			Notes
Species			PS	LF	PF	
BIGNONIACEAE						
Jacaranda mimosifolia D. Don	jacaranda	Nat	--	R1	--	<2>
Spathodea campanulata P. Beauv.	African tulip tree	Nat	--	--	--	<2>
BUDDLEIACEAE						
Buddleia asiatica Lour.	dogtail	Nat	--	--	--	<2>
CACTACEAE						
Hylocereus undatus (Haw.) Britten & Rose	night-blooming cereus	Nat	--	R	--	<2>
Opuntia ficus-indica (L.) Mill.	prickly pear	Nat	--	+ R	--	<2, 3>
CLUSIACEAE						
Clusia rosea Jacq.	autograph tree	Nat	--	R	R	<2>
CONVOLVULACEAE						
Ipomoea obscura (L.) Ker-Gawl.	---	Nat	--	--	--	<2>
CRASSULACEAE						
Kalanchoë pinnata (Lam.) Pers.	air plant	Nat	+	U	AA	<2, 3>
Kalanchoë tubiflora (Harv.) Raym-Hamet	chandelier plant	Nat	R1	--	--	<1>
CUCURBITACEAE						
Coccinia grandis (L.) Voigt	scarlet-fruited gourd	Nat	R	--	--	<2>
Cucumis dipsaceus Ehrenb. ex. Spach	teasel gourd	Nat	+	--	--	<3>
Momordica charantia L.	wild bitter melon	Nat	--	+	R	<1, 2, 3>
EUPHORBIACEAE						
Euphorbia hirta L.	garden spurge	Nat	+ R	--	R	<1, 2, 3>
Euphorbia hyssopifolia (L.) Sm.	---	Nat	--	--	--	<2>
Macaranga tanarius (L.) Müll. Arg.	---	Nat	--	--	--	<2>
Ricinus communis L.	castor bean	Nat	R	R	--	<2>
FABACEAE						
Acacia farnesiana (L.) Willd.	*klu*	Nat	+ O	R	--	<2, 3>
Chamaecrista nictitans s(L.) Moench	patridge pea, *lauki*	Nat	+ R	R	U	<1, 2, 3, 4>
Crotalaria pallida Aiton	rattlepod	Nat	--	R	--	<1, 2, 4, 5>
Desmodium incanum DC	Spanish clover	Nat	--	--	R	<2>
Desmodium tortuosum (Sw.) DC	Florida beggarweed	Nat	+ U1	--	--	<1, 2, 3, 4>
Indigofera suffruticosa Mill.	indigo	Nat	+ U	--	--	<2, 3, 4>
Leucaena leucocephala (Lam.) deWit	*koa haole*	Nat	+ AA	+ O	AA	<1, 2, 3>
Macroptilium lathyroides (L.) Urb.	cow pea	Nat	--	--	R	<2, 4>
Pithecellobium dulce (Roxb.) Benth.	*'opiuma*	Nat	--	--	--	<2>
Prosopis pallida (Humb. & Bonpl. ex Willd.) Kunth	*kiawe*	Nat	+ R	--	--	<2, 3>

Family	Common name	Status	Abundance (by vegetation type)			Notes
Species			PS	LF	PF	
CONVOLVULACEAE						
Ipomoea indica (J. Burm.) Merr.	*koali'awa*	**Ind**	+	O	--	<1, 2, 3>
EBENACEAE						
Diospyros sandwicensis (A. DC.) Fosb.	*lama*	**End**	--	+	O	<2, 3>
EUPHORBIACEAE						
Aleurites moluccana (L.) Willd.	*kukui*	Pol	--	--	U1	<2>
Euphorbia celastroides Boiss.	*'akoko*	**End**	--	R	--	<2>
FABACEAE						
Caesalpinia kavaiensis H. Mann	*uhiuhi*	**End**	--	R	--	
Erythrina sandwicensis Degener	*wiliwili*	**End**	--	--	--	planted in "D"
Senna gaudichaudii (Hook. & Arn.) H. Irwin & Barneby	*kolomona*	**Ind**	--	O	--	<2>
Sophora chrysophylla (Salisb.) Seem.	*mamane*	**End**	--	O	--	<2>
Tephrosia purpurea (L.) Pers.	*'auhuhu*	**Ind**	+	--	--	<3>
GOODENIACEAE						
Scaevola sericea Vahl.	*naupaka*	**Ind**	--	R	--	<2>
LAMIACEAE						
Plectranthus parviflorus Willd.	*'ala'alawainui wahine*	**Ind**	--	R	--	<2>
MALVACEAE						
Abutilon incanum (Link) Sweet	*hoary abutilon*	**Ind**	+ R	--	--	<1, 3>
Sida fallax Walp	*'ilima*	**Ind**	+ U	U	R	<1, 2, 3>
MENISPERMACEAE						
Cocculus orbiculatus (L.) DC	*huehue*	**Ind**	+ O3	+ A	U	<1, 2, 3>
MYOPORACEAE						
Myoporum sandwicense A. Gray	*niao*	**Ind**	--	+ C	--	<1, 2, 3>
MYRTACEAE						
Metrosideros polymorpha Gaud.	*'ōhi'a*	**End**	--	+ U	--	<1, 2, 3>
NYCTAGINACEAE						
Boerhavia repens L.	*alena*	**Ind**	--	+	--	<3>
PAPAVERACEAE						
Argemone glauca (Nutt. ex Prain) Pope	*pua kala*	**End**	R	R	--	<2, 5>
PIPERACEAE						
Peperomia leptostachya Hook. & Arn.	*'ala'alawainui*	**Ind**	+ R	R	R1	<2, 3>
ROSACEAE						
Osteomeles anthyllidifolia (Sm.) Lindl.	*'ulei*	**Ind**	--	R	--	<2>
RUBIACEAE						
Morinda citrifolia Hillbr.	*noni*	Pol	U	R	U	<1, 2, 3>
Psydrax odoratum (Forst. f.) A.C. Smith & S. Darwin	*alahe'e*	**Ind**	+ O	+ R	A	<1, 2, 3>
SAPINDACEAE						
Dodonaea viscosa Jacq.	*'a'ali'i*	**Ind**	+ U	U	C	<2, 3>

Table 1a (continued).

Family	Common name	Status	Abundance (by vegetation type)			Notes
Species			PS	LF	PF	
COMMELINACEAE (continued)						
Tradescantia spathacea Swartz	oyster plant	Nat	--	--	R1	
POACEAE (GRAMINEAE)						
Cenchrus ciliaris L.	bufflegrass	Nat	R	--	--	<4>
Cenchrus echinatus L.	sandbur	Nat	--	--	--	<2>
Chloris barbata (L.) Sw.	swollen fingergrass	Nat	U2	--	--	<2, 4>
Dactyloctenium aegypticum (L.) Willd.	beach wiregrass	Nat	+	--	--	<2, 3>
Digitaria ciliaris (Retz.) Koeler	large crabgrass	Nat	--	--	--	<2>
Eragrostis tenella (L.) P. Beauv ex Roem. & Schult.	lovegrass	Nat	--	--	--	<2>
Melinus minutifloras P. Beauv.	molasses grass	Nat	R	--	--	<2>
Melinus repens (Willd.) Zizka	Natal redtop	Nat	+ R	+	U	<1, 2, 3, 4>
Panicum maximum Jacq.	Guinea grass	Nat	+		AA	<2, 3>
Pennisetum setaceum (Forssk.) Chiov.	fountain grass	Nat	+ AA	+ O	AA	<1, 2, 3>

Table 1b. Native (and early Polynesian introduced) Plants

		FERNS AND FERN ALLIES				
NEPHROLEPIDACEAE						
Nephrolepus exaltata hawaiiensis Wagner	sword fern	**End**	--	--	U2	
PTERIDACEAE						
Doryopteris decipiens (Hook.) J. Sm.	*kumuniu*	**End**	+ R	--	--	<2, 3>
Doryopteris decora Brack	---	**End**	--	R	--	
PSILOTACEAE						
Psilotum nudum (L.) P. Beauv.	*moa*	**Ind**	--	R	--	<2>
		FLOWERING PLANTS DICOTYLEDONS				
ARALIACEAE						
*Polyscias sandwicensis (*A. Gray) Lowry & G. M. Plunkett	*'ohe makai*	**End**	--	+ O	--	<1, 2, 3>
ASTERACEAE						
Bidens micrantha ctenophylla (Sherff) Nagata & Ganders	---	**End**	--	O	--	<2>
Melanthera populifolia (Sherff) Wagner & Rob	*nehe*	**End**	--	R	--	<2>
CAPPARACEAE						
Capparis sandwichiana DC	*maiapilo*	**End**	+	+ O	R	<1, 2, 3>

Table 1b (continued).

A total of 112 different species of plants were recorded as growing on the surveyed parcels. Of these, 33 species (29.5 percent) are recognized as truly native (indigenous or endemic species), a little more than half (~18 or 54 percent) moderately common[2] indigenous plants (defined as native to both Hawai'i and elsewhere in the Pacific Basin), but with 15 (45 percent) endemic species (plant species uniquely native to the Hawaiian Islands). Three early Polynesian introductions (*kukui* or *Aleurites moluccana*, *noni* or *Morinda cirtifoloia*, and bitter yam or *Discorea bulbifera*) have been recorded in recent surveys. These results are rather atypical for lowland surveys in the Hawaiian Islands in the high percentage of native species recorded. David and Guinther (2011) surveyed ten sites of roughly comparable size for the new Kona Courthouse site selection process. Total species recorded combining all ten sites in the North Kona area was 68. Of these, 17 (25 percent) were native, with 6 (9 percent) endemics. Most botanical surveys in the lowlands of any of the main Hawaiian Islands typically yield less than 12 percent native species including early Polynesian introductions (and less than 1 percent if biomass of native and non-native plants is compared).

The survey by Char (1995) was for only the 224-acre portion of the site below 300-feet elevation (TMK: [3] 7-3-09:017) and therefore extensive comparisons with either Whistler (2006) or the present survey would not be particularly instructive. Whistler, on the other hand, surveyed all five of the project parcels, so a comparison with the present survey undertaken some five years later could be useful. We also have a rare plant inventory map prepared by Hawaii Forest Industry Association (undated) covering much of the LF1 part of the project and this will be reviewed further on in our report. Whistler developed a list of 93 plant species for the project property, all of which are included in our Table 1. He observed 17 species of naturalized plants not seen in 2011 and two species of native or early Polynesian plants (*pili* or *Heteropogon contortus* and *hoi or bitter yam*) not seen in 2012. Thus, 74 species were observed in common between the 2006 and 2012 surveys. A majority (~12) of the naturalized species recorded by Whistler and not seen in 2012 are herbs and could easily be missed if conditions were drier in 2012 than in 2006. Many of the naturalized herbs are mentioned as characterizing his managed land vegetation type (that is, disturbed land). *Pili* grass is mentioned in association with the lowland *Leucaena* scrub and was likely overlooked in this area in 2012. Three of the species are trees (African tulip or *Spathodea campanulata*, *Macaranga tanarius*, and *'opiuma* or *Pithecellobium dulce*), but no indication is given as to where these were observed. The first two would require conditions on the wet side and thus could only occur in the uppermost, forested (PF) area.

Curiously the larger roving sailor (*Lophospermum erubescens*) described as a "common" escaped ornamental vine on the LF1 lava flow by Whistler in 2006, was not observed at all in 2012. *Lophospermum* is described in Wagner, Herbst, and Sohmer (1999) as sparingly naturalized in "dry forest, alien grassland, and shrubland on O'ahu and Hawai'i." Possibly, the implication that this alien species was common (Whistler, 2006, p. 6) is at the root of the discrepancy. This species was recorded by Nishida (1993) from the LF1 area. We expect

[2] Two species, *kokomona* and *'auhuhu* (seen only by Char in 1995), are not very common in the Islands.

Table 1b (continued).

Family	Common name	Status	Abundance (by vegetation type)			Notes
Species			PS	LF	PF	
SOLANACEAE						
Nothocestrum breviflorum A. Gray	*'aiea*	**End**	--	R	--	
Solanum americanum Mill.	*pōpolo*	Ind?	+ R	--	--	<1, 3>
STERCULIACEAE						
Waltheria indica L.	*'uhaloa*	Ind?	+ U3	+ O	--	<1, 2, 3, 4>
	MONOCOTYLEDONS					
AGAVACEAE						
Pleomele hawaiiensis Deg. & Deg.	*halapepe*	**End**	--	U	--	<2>
DIOSCOREACEAE						
Dioscorea bulbifera L.	bitter yam	Pol	--	--	--	<2>
POACEAE						
Heteropogon contortus (L.) P. Beauv. ex Roem. & Schult.	*pili*	**Ind**	+	--	--	<2, 3>

Legend to Table 1

Status = distributional status

E**nd** = endemic; native to Hawai'i and found naturally nowhere else.

I**nd** = indigenous; native to Hawai'i, 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.

Abundance = occurrence ratings for plants on property in March 2008

R - Rare - only one or two plants seen.

U - Uncommon - several to a dozen plants observed.

O - Occasional - found regularly, but not abundant anywhere.

C - Common - considered an important part of the vegetation and observed numerous times.

A - Abundant - found in large numbers; may be locally dominant.

AA - Abundant - very abundant and dominant; defining vegetation type.

Numbers (as in R3) offset occurrence ratings (1 – several plants; 2 – many plants; 3 – abundant in a limited area) in cases where distribution across the survey area may be limited, but individuals seen are more than indicated by the occurrence rating alone.

Notes:

<1> Reported at "Site A" (Kaloko Makai) in David and Guinther (2011).

<2> Recorded by Whistler (2006).

<3> Recorded by Char (1995) on an adjacent property.

<4> Ruderal, on highway verge and other highly disturbed areas.

<5> Plant lacking flowers or fruit at time of survey; identification uncertain.

that there would be year-to-year differences in the presence of many herbaceous species, often dependent upon rainfall amounts.

Of significance in terms of native species not seen by either Whistler (2006) or the present survey are the listed plants: *Neraudia ovata* and *Cyperus fauriei*. Also significant are the rare natives, *uhiuhi* (*Caesalpinia kavaiensis*) and *'aiea* (*Nothocestrum breviflorum*), variously recorded from the area in the past, but not observed by Whistler. We recorded single individuals of each in 2011—and, as evidenced by flagging and fencing, are clearly well-known to be present. Rare natives and their general distribution on the project site are considered further in the Discussion section.

Vegetation — A vegetation map prepared by Nishida (1993) for an approximately 0.5-mile wide swath through the project area between the 300 and 400-feet elevation contours provides an early take by Bishop Museum botanists on vegetation types, at least for the lower elevations. The map distinguishes LF1 above 350 feet elevation as an 'Ōhi'a Lowland Dry Forest. Below about 350 feet, this flow is divided into a southern developed land (the quarry) and a narrow finger of "sparsely vegetated lava flow." The latter designation is also applied to our LF2. The remainder of the land mapped by Nishida is an alien plant dominated, Koa Haole/Fountaingrass association corresponding to our PS.

Whistler (2006) recognized four types of vegetation on the property: (1) managed land vegetation; (2) *Leucaena* or *koa haole* scrub; (3) Christmas berry scrub; and (4) dryland forest. While these are accurate in their descriptions, our take on the vegetation distinguishes (4) as a remnant dry land forest on recent *'a'a* lava (LF1) below about the 600-feet elevation, above which the forest becomes a mixed one (PF) dominated by non-native trees on the same lava flow, which extends well up the slope of Hualālai from the project area. The somewhat older *'a'ā* flows (LF2) also support a sparse vegetation that is a mixture of native and naturalized species, but the diversity of natives is small in comparison with that on LF1 and the reasons for this are not entirely clear. Both lava flows have sparse grass cover (minimizing fire hazards) and rough terrain presumably discouraging to ungulates, such as goats.

The **remanant dryland forest** on LF1 is mostly one supporting *lama* (*Diospyros sandwicensis*), *alahe'e* (*Psydrax odoratum*), Christmas berry, and *'ōhi'a* (*Metrosideros polymorpha*). Present, although to lesser extents; are *'ohe makai* (*Polyscias sandwicensis*) and *hala pepe* (*Pleomele hawaiiensis*). Shrubs (sometimes small trees) that are relatively common are *naio* (*Myoporum sandwicense*), *pua pilo* or *maiapilo* (*Capparis sandwichiana*), *'a'ali'i* (*Dodonaea viscosa*), *mamane* (*Sophora chrysophylla*), and *kolomona* (*Senna gaudichaudii*). Very rare are *uhiuhi* and *'aiea* (mentioned above). In the dry conditions that prevail here, the distinction between shrubs and trees is not easily made. In general, the forest is very open with low shrubs and ground-covering herbs predominate. Non-natives invasive species in this dry forest are *koa haole*, jacaranda (*Jacaranda mimosifolia*), and Christmas berry. The latter species seems to be particularly well suited to the habitat and consequently the most serious pest species here. The ground cover on LF1 is notably dominated by *huehue* (*Cocculus orbiculatus*) and *koali 'awa* (*Ipomoea indica;* Figure 4).

Fountain grass (*Pennisetum setaceaum*), lantana (*Lantana camara*), and sword fern (*Nephrolepis multiflora*) are present in scattered locations, as is *ko'oko'olau* (*Bidens micrantha ctenophylla*).

Figure 4 - Scrubby trees and extensive ground cover of *huehue* on rugged *'a'ā* in more open parts of the LF1 lava flow. Plants recognizable in the photo are *maiapilo*, *koa haole*, sparse fountain grass, and scattered *lama* and Christmas berry.

The land between the lava flows (Whistler's ***Leucaena*** or ***koa haole*** scrub; PS in Figure 2) stands out in contrast to the sparse vegetation on the *'a'a* flows is, of course, older and mostly *pāhoehoe* flows (Figure 5). A combination of better water retention near the surface on *pāhoehoe* and a longer period of time for soil formation provide conditions whereby these areas support moderately dense growths of fountain grass and short *koa haole* as a dry shrubland. Native shrubs, especially *alahe'e* and *a'ali'i*, are widely scattered within this vegetation type. At low elevations on the property, *klu* (*Acacia farnesiana*) appears as an occasional shrub and *kiawe* (*Prosopis pallida*) as a rare tree[3]. Whistler points out that because of the dense fountain grass, this scrub vegetation is subject to damaging fires, which may well have eliminated many of the native species over time.

[3] Possibly a consequence of the long period of drought effecting this part of the Island of Hawai'i, nearly all of the *kiawe* trees observed during our survey of the project properties were deceased.

Figure 5 – *Koa haole* shrubland (PF) showing mostly *koa haole* with very scattered *alahe'e.*

The relationship between vegetation and the nature of the substratum becomes more complex above about 600 feet on the site, and while we designate this area as PF in Figure 2, it is a complex of scrub and forest vegetation types extending across the *mauka* or uppermost part of the property. This area is far more heterogeneous with respect to substratum age and type, and composition of the vegetation, than is the case downslope. The reasons for this are certainly related to rainfall. Rainfall records for Honokōhau Ranch nearby at 1275 feet suggest an annual rainfall of around 1230 mm (48 inches); rainfall at the old Kona Airport at 15 feet above sea level 550 mm (21.6 inches). This moisture gradient is evident in the nature of vegetation from the low end of the project area to the top end, with grasses and short stature shrubs mostly at the low end, and trees of increasing stature becoming evident above about the middle. At around the 550 to 600-foot elevation, the young lava flow is no longer clearly visible in aerial/satellite images; the forest is too dense to readily distinguish this feature from adjacent, much older surfaces. For this reason, we lump this vegetation under PF in Fig. 2. However, inside a forest dominated by Christmas berry (presumably, in part, Whistler's **Christmas Berry Scrub**), silk oak (*Grevillea robusta*), *lama*, *alahe'e*, and *'ōhi'a* trees are present. In the understory, either talinum (*Talinum triangulare*) or air plant (*Kalanchoë pinnata*) can be very abundant. In some places grasses are abundant, in other areas bare lava is present.

The following plant associations demonstrate the heterogeneity of the area designated PF vegetation type along the *mauka* border of the property:

dense *koa haole* forest with an understory of dense Guinea grass (*Panicum maximum*) immediately off the north side of Hina Lani Street; somewhat open Christmas berry/*koa haole* forest with dense air plant understory merging gradually into dry land forest type (LF1), downslope and found east and west of Hina Lani Street; Christmas berry savanna with fountain grass (northeast corner of the property); *koa haole* scrub (cattle grazed land) with Guinea grass and scattered *kukui* (*Aleurites moluccana*) in the southeast corner of the property.

In all but the first and last subtypes above, Christmas berry tends to be the most abundant tree, and natives as described for the Christmas berry scrub are present or, in places, common.

Managed land vegetation corresponds to our vegetation on disturbed ground (ruderal vegetation), represented by the extensive verges along Hina Lani Street, other areas where the *'a'a* flow has been graded (D), and a quarry operation (Q) in the southwest corner of the site. These places support mostly ruderal weeds and several other introduced species not observed elsewhere on the property. An exception to the near exclusively non-native aspect of disturbed areas is the presence of *ko'oko'olau* along the interface between the undisturbed (LF1) and disturbed parts of the quarry. Disturbed ground is readily invaded by fountain grass (Figure 6). *'Uhaloa* (*Waltheria indica*) is a native plant that is common in disturbed places. The now abandoned quarry area represents a part of the Kaloko-Honokahau *'a'a* lava flow that has been extensively graded and material removed. A few "islets" of the original surface remain where either *'ōhi'a* or *maiapilo* plants are growing. The site is extensively invaded by fountain grass (Figure 6).

Figure 6 – Fountain grass invading along the edge of the *'a'a* flow,

Avian Surveys

A total of 967 individual birds of 21 species, representing 12 separate families, were recorded during the station counts. Only one of the species detected during this survey, Pacific Golden-Plover (*Pluvialis fulva*) is a native species. Pacific Golden-Plover is an indigenous migratory shorebird species. One species Chicken (Red Junglefowl) [*Gallus gallus*] is a domesticated species that is not established in the wild on the Island of Hawai'i. The remaining 19 species detected are considered to be alien to the Hawaiian Islands (Table 2).

No avian species currently protected or proposed for protection under either the federal or State of Hawai'i endangered species programs were detected during the course of this survey (DLNR, 1998; USFWS, 2005a, 2005b, 2012).

Avian diversity and densities were in keeping with the habitat present on the site. And were comparable to the results of the survey conducted by David on the site in 2006 (see the discussion section of this report for a more detailed discussion on the comparison between the results of the two surveys). Four species, House Finch (*Carpodacus mexicanus*), Zebra Dove (*Geopelia striata*), Japanese White-eye (*Zosterops japonicus*), and Common Waxbill (*Estrilda astrild*), accounted for slightly less than 44 percent of all birds recorded during the

station counts. House Finch was most frequently recorded species, accounting for 18 percent of the total number of individual birds recorded during station counts. We recorded an average of 30 birds per station count. This is a relatively large number.

Table 2 - Avian Species Detected Within the Kaloko Properties Study Site

Common Name	*Scientific Name*	*ST*	*RA-06*	*RA-12*
	GALLIFORMES			
	PHASIANIDAE - Pheasants & Partridges			
	Phasianinae - Pheasants & Allies			
Gray Francolin	*Francolinus pondicerianus*	A	0.84	0.91
Black Francolin	*Francolinus francolinus*	A	0.56	0.59
Erckel's Francolin	*Francolinus erckelii*	A	0.06	0.13
Red Junglefowl	*Gallus gallus*	D	0.06	0.13
Kalij Pheasant	*Lophura leucomelanos*	A	0.09	-
	CHARADRIIFORMES			
	CHARADRIIDAE - Lapwings & Plovers			
	Charadriinae - Plovers			
Pacific Golden-Plover	*Pluvialis fulva*	IM	0.34	0.34
	COLUMBIFORMES			
	COLUMBIDAE - Pigeons & Doves			
Spotted Dove	*Streptopelia chinensis*	A	2.22	1.16
Zebra Dove	*Geopelia striata*	A	3.66	2.97
	PSITTACIFORMES			
	PSITTACIDAE - Lories Parakeets, Macaws & Parrots			
	Arinae - New World Parakeets, Macaws & Parrots			
Mitred Parakeet	*Aratinga mitrata*	A		0.91
	STRIGIFORMES			
	TYTONIDAE - Barn Owls			
Barn Owl	*Tyto alba*	A	**I-1**	-
	PASSERIFORMES			
	ZOSTEROPIDAE - White-eyes			
Japanese White-eye	*Zosterops japonicus*	A	3.44	3.22
	MIMIDAE - Mockingbirds & Thrashers			
Northern Mockingbird	*Mimus polyglottos*	A	0.22	0.31
	STURNIDAE - Starlings			
Common Myna	*Acridotheres tristis*	A	2.25	2.31
	EMBERIZIDAE - Emberizids			
Saffron Finch	*Sicalis flaveola*	A	1.31	1.00
Yellow-billed Cardinal	*Paroaria capitata*	A	0.88	0.78

Table 2 (continued)

Common Name	*Scientific Name*	*ST*	*RA-06*	*RA-12*
	CARDINALIDAE - Cardinals Saltators & Allies			
Northern Cardinal	*Cardinalis cardinalis*	A	1.56	1.47
	FRINGILLIDAE - Fringilline and Carduleline Finches & Allies			
	Carduelinae - Carduline Finches			
House Finch	*Carpodacus mexicanus*	A	4.75	4.66
Yellow-fronted Canary	*Serinus mozambicus*	A	1.31	2.25
	PASSERIDAE - Old World Sparrows			
House Sparrow	*Passer domesticus*	A	0.66	0.72
	ESTRILDIDAE - Estrildid Finches			
	Estrildinae - Estrildine Finches			
Common Waxbill	*Estrilda astrild*	A	-	2.41
African Silverbill	*Lonchura cantans*	A	2.03	1.78
Nutmeg Mannikin	*Lonchura punctulata*	A	0.66	0.84
Java Sparrow	*Padda oryzivora*	A	1.13	1.34

KEY TO TABLE 2

ST	Status
A	Alien – Introduced to the Hawaiian Islands by humans
D	Domesticated – Species not considered to be established in the wild on the Island of Hawai'i
IM	Indigenous Migratory – native but not unique to the Hawaiian Islands, does not breed in Hawai'i
RA-06	Relative Abundance 2006 – Number of birds detected divided by the number of count stations (32)
RA-12	Relative Abundance 2012 – Number of birds detected divided by the number of count stations (32)
I -	Incidental - A species recorded as an incidental observation while transiting between count station, followed by the number of individuals detected

Mammalian Survey Results

Eight terrestrial mammalian species were detected during the course of this survey. Which species were detected during the course of this and the previous survey conducted in 2006 are presented in table 3. The table also contains information on how the individual species were detected.

Table 3 - Mammalian Species Detected Within the Kaloko Properties Study Site

Common name	*Scientific name*	ST	DT-06	DT-12
	CHIROPTERA - BATS			
	VESPERTILIONIDAE - Common Bats			
Hawaiian hoary bat	*Lasiurus cinereus semotus*	**EE**	A,V	-
	RODENTIA - GNAWERS			
	Muridae - Old World Rats & Mice			
European house mouse	*Mus musculus domesticus*	A	V	V
	CARNIVORA- FLESH EATERS			
	Canidae - Wolves, Jackals & Allies			
Domestic dog	*Canis f. familiaris*	A	T, Si,Sc	T,Sc,Sc, A
	Viverridae - Civets & Allies			
Small Indian mongoose	*Herpestes a. auropunctatus*	A	V	V
	Felidae- Cats			
House cat	*Felis catus*	A	V	V
	ATRIODACTYLA - EVEN-TOED UNGULATES			
	Suicidae - Old World Swine			
Pig	*Sus s. scrofa*	A	V,Sci,Sc	V,Sci,Sc
	Bovidae- Hollow-horned Ruminants			
Domestic cattle	*Bos taurus*	A	Sc,Sk	Sc,Sk
Domestic goat	*Capra h. hircus*	A	V,Sci,Sc,A, Sk	V,Sci,Sc,A, Sk
Domestic sheep	*Ovis aries*	A	Sc,Sk	Sc,Sk

KEY TO TABLE 3

EE	Endangered Endemic – Native and unique to the Hawaiian Islands
A	Alien – Introduced to the Hawaiian Islands by humans
DT-06	Detection Type 2006 survey
DT-12	Detection Type 2012 survey
A	Audio – Species detected aurally
V	Visual – Species detected visually
Sci	Sci – Species detected animal sign
Sc	Sc – Species detected by the presence of scat (fecal material)
Sk	Sk – Species detected by observing skeletal remains

Hawai'i's sole endemic terrestrial mammalian species, the endangered Hawaiian hoary bat, was not detected during this survey. This species was detected during the 2006 survey of the same site (Table 3; David, 2006). All of the alien mammalian species recorded during this survey are deleterious to avian and floristic components of the remaining native ecosystems present on the Island.

Discussion

Botanical Resources

Plants found on the property and considered to be of special interest (rare and/or listed natives) were recorded when encountered using the GPS unit. The five species plotted in Figure 7 (and the coding used) are:

- *'aiea – Nothocestrum breviflorum* (Nb) Endangered
- *hala pepe - Pleomele hawaiiensis* (Ph) Endangered
- *ko'oko'olau – Bidens micrantha ctenophylla* (Bm) "Candidate"[4]
- *'ohe makai – Polycias sandwicensis* (Rs) Not listed
- *uhiuhi – Caesalpinia kavaiensis* – (Ck) Endangered

Not one of these species was found on the property outside of the LF1 vegetation zone (essentially the most youthful *'a'ā* flow) with the exception of *ko'oko'olau* which occurs occasionally around the edges of the LF1 and in the extension of the lava flow upslope into the lower part of the PF. Figure 7 shows only a limited portion of the project (and survey) area because none of the selected species plotted was recorded outside of this map area. Most numerous in the plot are *'ohe makai* trees (93 individuals noted). Next most numerous are 66+ *ko'oko'lau* plants (in one instance, notes record "*numerous juvenile Bidens*"). The number of *hala pepe* recorded is 16. The single *'aiea* and *uhiuhi* are marked with red diamonds in Figure 7.

We can compare our Figure 7 with the Hawaii Forest Industry Association (HFIA, undated) map, which covers most, although not all of the area in Figure 7. This map shows feature positions (locations) of some 38 *hala pepe*, all to the southeast of Hina Lani. Over 100 locations for *ko'oko'olau* are indicated. Attempting to visually match up HFIA positions of *hala pepe* to those shown in Figure 7 suggests only some are clearly the same individual plants. There are *hala pepe* indicated on both maps that lack a corresponding plant on the other map. Since *hala pepe* is a moderately large and slow growing tree-like monocot, it is difficult to explain these discrepancies. We did see a number of dead *hala pepe* and the locations of these were not recorded. Our survey in the LF1 was largely driven by moving from special tree to special tree and low growing *ko'oko'olau* could easily be missed.

Ko'oko'olau (specifically, *B. m.* ssp. *ctenophylla*) is presently a candidate species for listing (USFWS, 2011). The HFIA map shows the plant to widely distributed across the Kaloko-Honokōhau *'a'ā* lava flow above the Ane Keohokalole Highway construction corridor at the 400-ft elevation. Nishida (1993) noted the plant to be *"...common on the Kaloko-Honokohau 'a'a flow above an elevation of ca. 90 meters (300 ft)..."*

[4] Candidate species are species which the USFWS has under consideration for possible listing in the future and for which the Service has sufficient information to support listing. Species noted as Candidates are not legally protected until listed, and not all Candidate species end up being listed under the ESA.

It is clear that the *uhiuhi* on the HFIA map is the same tree we recorded. Nishida (1993) observed no *uhiuhi* in the LF1 area of their survey (below 350-feett elevation), but relates that Ken Nagata collected *uhiuhi* material from this area (at 270 and 320 feet elevations) previous to their 1992 survey. These plants are presumably no longer present.

The HFIA survey area did not include the location of the *'aiea* tree. Nishida (1993) describes two *'aiea* trees from the same area *"...on the Kaloko-Honokohau 'a'a flow at 100 meters (360 feet) in elevation..."* A hand drawn USFWS map (2003) also shows two *'aiea* trees located between the "Pit" and the water tank to the west. Only one of these trees is still present (see Figure 7).

Other species of plants that would be of concern, but were not observed during our survey are two Hawai'i endemics: *Cyperus fauriei* (no common name) and *Neraudia ovata* (*ma'aloa*). Both are listed endangered species previously recorded from the LF1 lava flow (Nishida, 1993; USFWS, 2002a), but not recorded as present by Whistler (2006). The distribution of *Neraudia* is indicated on a hand-drawn map by USFWS as being in 5 locations to the south and west of a feature labeled as "Pit" but clearly the disturbed area used as a base yard for the construction of Hina Lani Street ("D" in Figure 2; "base yard" in Figure 7). Whistler relates that Rex Palmer had seen *Neraudia* in 2003 under trees near to where homeless people were known to camp (area directly SSE of the "base yard"). This area was searched in 2012 (although "near" is an uncertain term) without the species being located. The recorded position of a single *Neraudia* on the HFIA map is some 24 m west from one 2012 track and 26 m east from another. At these distances trees and large shrubs would be easy to "discover" but not necessarily small shrubs if hidden within the jumble of lava rocks or under trees (such as Christmas berry) that were not approached.

A map prepared by USFWS (2002) shows *Mariscus* (=*Cyperus*) *fauriei* coincident with *Neraudia ovata* and *Nothocestrum breviflorum* in this area. The sedge, *C. fauriei* was reported present on LF1 in the project area by Nishida (1993). Five plants were seen on a single boulder at about the 380-ft (115-m) elevation. This would put the location downslope of Ane Keohokalole Highway, presently under construction through the LF1 lava flow at the 400-ft elevation. Also recorded from the same area as *ma'aloa* and *C. fauriei* was the rare (but not listed) sedge, *Fimbristylis hawaiiensis* (Nishida, 1993).

Obviously changes in plant numbers and distribution are always occurring and we do not offer up our effort as a complete inventory of the rare species that were mapped. More important is the obvious distribution, or more correctly, limited distribution of these valuable botanical resources to the LF1 vegetation type as mapped on Figure 2 (and outlined in Figure 7). The LF1 flow itself, below ~600-ft elevation and excluding most of the former quarry area is the important feature that would need to be preserved to the extent possible to conserve these particular species populations.

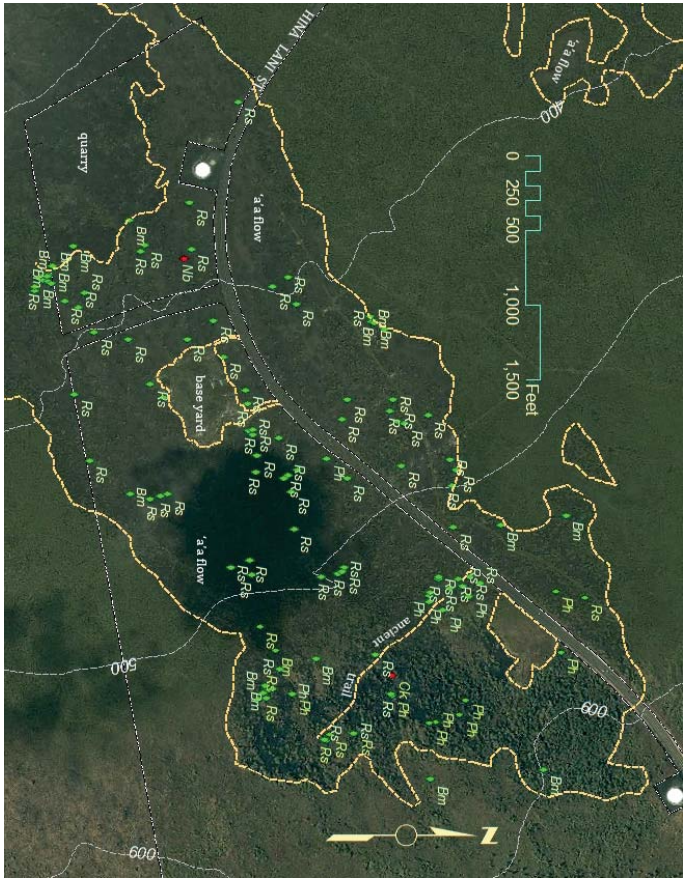


Figure 7 - Plot of selected rare plants in the project area.

(Nb) *'aiea – Nothocestrum breviflorum* - Endangered
(Ph) *halo pepe - Pleomele hawaiiensis* - Endangered
(Ck) *uhiuhi – Caesalpinia kavaiensis* - Endangered
(Bm) *ko'oko'olau – Bidens micrantha ctenophylla* - Candidate
(Rs) *'ohe makai – Polycias sandwicensis* - Not listed

Avian Resources

The findings of the avian survey are consistent with the location of the site, and the habitat present on it. As well as two previous surveys of the same site conducted by David in 1995 and 2006 (David, 1995, 2006), and with two surveys conducted on portions of the land (David, 2007; David and Guinther, 2011) with several surveys on lands immediately adjacent to portions of the site (David, 2000a 2000b, 2004a, 2004b, 2005).

All but one of the 21 avian species detected during the 2012 survey, are alien species (Table 2). The lone native species detected, Pacific Golden-Plover is an indigenous migratory shorebird species, which nests in the high Arctic during the late spring and summer months, returning to Hawai'i and the Tropical Pacific to spend the fall and winter months each year. They usually leave Hawai'i for their trip back to the Arctic in late April or the very early part of May.

During the course of this survey we detected two avian species not detected during the 2006 survey of the site, namely Mitred Parakeet (*Aratinga mitrata*), and Common Waxbill (*Estrilda astrild*), (Table 2). Both species are alien to the Hawaiian Islands, The parakeets roost on Mount Hūalalai and fly over the coastal Kona area in search of foraging resources in the early morning, and then fly back upslope in the late afternoon to their night roosts. Common Waxbills are a recently introduced species to the Island of Hawai'i, which is rapidly become established in large numbers. It is a ubiquitous species on all of the other main Islands in the state. During the course of the 2006 survey of the site I detected two species not detected during this current survey, namely, Kalij Pheasant (*Lophura leucomelanos*), and Barn Owl (*Tyto alba*). Kalij Pheasants are usually found in wetter forests than is present on this site, and Barn Owls are an irruptive species, which are currently undergoing one of its low density years in the Kona area. From a statistical perspective the findings of these two surveys are not significantly different from each other (David, 2006, and current document), (Table 2).

Although no seabirds were detected during either the 2006 or this survey, it is probable that both the endangered Hawaiian Petrel (*Pterodroma sandwichensis*), and the threatened endemic sub-species of the Newell's Shearwater (*Puffinus auricularis newelli*), over-fly the project area in small numbers between April and the middle of December each year. Both species have been recorded flying to and from their nesting colonies over the greater Kona area (Day et al., 2003; David 2011). Both of these pelagic seabird species nest high in the mountains in burrows excavated under thick vegetation, especially *uluhe* (*Dicranopteris* linerais) fern. There is no suitable nesting habitat for either of these seabird species on, or close to this site.

The primary cause of mortality in the two aforementioned seabird species is thought to be predation by alien mammalian species at the nesting colonies (USFWS 1983; Simons and Hodges 1998; Ainley et al., 2001). Collision with man-made structures is considered to be the second most significant cause of mortality of these seabird species in Hawai'i. Nocturnally flying seabirds, especially fledglings on their way to sea in the summer and fall,

can become disoriented by exterior lighting. When disoriented, seabirds often collide with manmade structures, and if they are not killed outright, the dazed or injured birds are easy targets of opportunity for feral mammals (Hadley 1961; Telfer 1979; Sincock 1981; Reed et al., 1985; Telfer et al., 1987; Cooper and Day, 1998; Podolsky et al. 1998; Ainley et al., 2001; Hue et al., 2001; Day et al., 2003).

Mammalian Resources

The findings of the mammalian survey are consistent with the location of the site, and the habitat present on it. As well as two previous surveys of the same site conducted by David in 1995 and 2006 (David, 1995, 2006), and with two surveys conducted on portions of the land (David, 2007; David and Guinther, 2011) with several surveys on lands immediately adjacent to portions of the site (David, 2000a, 2000b, 2004a, 2004b, 2005).

All of the terrestrial mammalian species recorded during the course of this current survey of the site are alien to the Hawaiian Islands (Table 3). During the course of the 2006 survey of the site a lone Hawaiian hoary bat was seen "*flying down-slope, (makai), from above the eastern boundary of the site towards the ocean*." (David, 2006). Hawaiian hoary bats are regularly seen *mauka* of the project site and also *makai* of the subject property in the Kaloko-Honokōhau National Historical Park and above the Honokōhau small boat harbor on a seasonal basis (Jacobs 1994, David 2006, 2012). Unlike nocturnally flying seabirds, which often collide with man-made structures, bats are uniquely adapted to avoid collision with most obstacles, man-made or natural. They navigate and locate their prey primarily by using ultrasonic echolocation, which is sensitive enough to allow them to locate and capture small volant insects at night.

Although only European house mice were detected during the course of both this survey and the one conducted in 2006 (David, 2006), it is probable that the other three established *muridae* known from the Island of Hawai'i, roof rat (*Rattus r. rattus*), Norway rat (*Rattus norvegicus*), and possibly Polynesian rat (*Rattus exulans hawaiiensi*) use resources within the subject property at least occasionally. Especially since the site is bound to the north and south by light industrial developments that likely harbor these human commensal species. All of these introduced rodents are deleterious to native ecosystems and the native faunal species that are dependant on them.

Potential Impacts to Protected Species

Botanical

The following listed species of plants have been reported from the project site:

- *'aiea – Nothocestrum breviflorum* (Endangered)
- *hala pepe - Pleomele hawaiiensis* (Endangered)
- *ma'aloa – Neraudia ovata* (Endangered)
- sedge – *Cyperus fauriei* (Endangered)

- *uhiuhi – Caesalpinia kavaiensis* – (Endangered)

As was the case with the previous Whistler survey in 2006[5], no listed plant species were found in the areas of disturbed scrub and forest vegetation (PS and PF areas in Figure 2). Likewise, no species of any particular concern were seen in the older *'a'ā* flows (LF2), although these features supported more commonly occurring native plants. In contrast, all five endangered species of plants are presently known from or have been previously recorded as occurring in the remnant dry land forest area (LF1 in our Figure 2).

Based upon the distribution of listed plant species (Figure 7), the proposed 150-acre Dry Land Forest conservation area (Figure 1) would preserve most of the habitat associated with the LF1 vegetation zone (Kaloko-Honokōhau *'a'ā* lava flow between the 400 and 650-ft elevations south of Hina Lani Street). Whistler (2006) relates that the dry land forest is some 200-ac in extent based upon conversation with USFWS. Potentially critical areas not included in the planning map are the location of an, *'aiea* tree west of the Ane Keohokalole Highway corridor and two *hala pepe* plants on the north side of Hina Lani Street. Only the more *mauka* specimen could be located in our survey. The dry land forest habitat north of Hina Lani is far more degraded than is the case south of the thoroughfare, the lava surface having been graded over much of the areas and having an old unimproved road running through it parallel to Hina Lani. On the other hand, the area west of Ane Keohokalole and south of Hina Lani down to the vicinity of the water tank is the most rugged part of the lava flow remaining intact. This area is such a jumble of large lava boulders, that very few plants of any kind grow here, and a level of relative protection from ungulate browsing and wild fires is provided by the natural substrate.

Seabirds

The principal potential impact that construction and operation of the proposed development poses to protected seabirds is the increased threat that birds will be downed after becoming disoriented by lights associated with the project during the nesting season. The two main areas that outdoor lighting could pose a threat to these nocturnally flying seabirds is if, 1) during construction it is deemed expedient, or necessary to conduct nighttime construction activities, 2) following build-out, the potential operation of streetlights and security lighting during the seabird nesting season.

Hawaiian hoary bat

The principal potential impact that the development of the proposed development poses to bats is during the clearing and grubbing phases of construction as vegetation is removed. The removal of vegetation within the project site may temporarily displace individual bats, which may use the vegetation as a roosting location. As bats use multiple roosts within their home territories, the potential disturbance resulting from the removal of the vegetation is likely to be minimal. During the pupping season female carrying their pups may be less able

[5] And we may note that the same result was reported by Nishida (1993) surveying a 0.5-mile wide swath through the property between the 300 and 400-ft elevations, covering parts of the LF1, LF2, PS, and Q mapped vegetation types of our survey.

to rapidly vacate a roost site as the vegetation is cleared, additionally adult female bats sometimes leave their pups in the roost tree while they themselves forage, very small pups may be unable to flee a tree that is being felled. Potential adverse effects from such disturbance can be avoided or minimized by not clearing woody vegetation taller than 4.6 meters (15-feet), between June 1 and September 15, the period in which bats are potentially at risk from vegetation clearing. With that said there is little vegetation present on the site that is suitable bat roosting habitat.

Recommendations

- If nighttime construction activity or equipment maintenance is proposed during the construction phases of the project, all associated lights should be shielded, and when large flood/work lights are used, they should be placed on poles that are high enough to allow the lights to be pointed directly at the ground.

- Following build-out it is recommended that any streetlights or facility security lighting that may be required for public safety reasons be shielded (Reed et al. 1985, Telfer et al. 1987). This minimization measure would serve the dual purpose of minimizing the threat of disorientation and downing of Hawaiian Petrels and Newell's Shearwaters, while at the same time complying with the Hawai'i County Code § 14 – 50 *et seq*. which requires the shielding of exterior lights so as to lower the ambient glare caused by unshielded lighting to the astronomical observatories located on Mauna Kea.

- It is recommended that to minimize potential impacts to roosting Hawaiian hoary bats, woody vegetation taller than 4.6 meters (15-feet) high not be cleared between June 1 and September 15.

- It is recommended that, where appropriate and practicable, native plant species be used in landscaping efforts. Not only is this ecologically prudent, but also if the appropriate plants are used, it will also likely save maintenance and water costs over the long term.

- The proposed 150-acre Dryland Forest conservation area will preserve the most significant parts of the lowland Kaloko-Honokōhau *a`a* lava flow for native plant conservation. The two (or possibly three) listed plant specimens (i.e. one *hala pepe* and one *`aiea* tree) that occur outside of this designated preservation area will be preserved in place with a 50 foot visible orange screened buffer surrounding each endangered species. The area south of the dryland forest, although separated by a new roadway, an area of 10 to 18 ac between Ane Keohokalole and the old quarry to the southern property boundary includes a number of *ko`oko`olau* and *`ohe makai* plants, in addition to possibly supporting two rare sedges: *Cyperus fauriei* and *Fimbrisylis hawaiïensis*. This separated piece could potentially serve as an area of more intensive management (for example, fencing against ungulates, removal of non-native invasive plants, experimental plantings of rare native plants, etc).

Critical Habitat

There is no federally delineated Critical Habitat present on or adjacent to this property. Thus the development and operation of the proposed development will not result in impacts to federally designated Critical Habitat. There is no equivalent statute under State law.

Glossary

'A'ā – Clinker lava formed by slow moving lava flows
Alien – Introduced to Hawai'i by humans
Commensal – Animals that share human food and lodgings, such as rats and mice.
Domesticated – Feral species, not considered established in the wild on the Island of Hawai'i.
Endangered – Listed and protected under the Endangered Species Act of 1973, as amended (ESA) as an endangered species
Endemic – Native and unique to the Hawaiian Islands
Indigenous – Native to the Hawaiian Islands, but also found elsewhere naturally
Makai – Down-slope, towards the ocean
Mauka – Upslope, towards the mountains
Muridae – Rodents, including rats, mice and voles, one of the most diverse family of mammals
Naturalized – A plant or animal that has become established in an area that it is not indigenous to
Nocturnal – Night-time, after dark
'Ōpe'ape'a – Endemic endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*)
Pāhoehoe – Sheet lava formed by relatively fast moving lava flows
Pelagic – An animal that spends its life at sea – in this case seabirds that only return to land to nest and rear their young
Ruderal – Disturbed, rocky, rubbishy areas, such as old agricultural fields and rock piles
Sign – Biological term referring tracks, scat, rubbing, odor, marks, nests, and other signs created by animals by which their presence may be detected
Threatened – Listed and protected under the ESA as a threatened species
Volant – Flying, capable of flight - as in flying insect

DLNR – Department of Land and Natural resources
DOFAW – Division of Forestry and Wildlife
ESA – Endangered Species Act of 1973, as amended
TMK – Tax Map Key
USFWS – United State Fish & Wildlife Service

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Appendix H

Survey of Terrestrial Invertebrate Resources at Kaloko Makai

Steven Lee Montgomery, Ph.D.

November 2008

Survey of Terrestrial Invertebrate Resources at Kaloko Makai, Kaloko and Kohanaiki, North Kona, Hawai'i Island

DRAFT

Prepared by:
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Submitted to:
Wilson Okamoto Corporation
and
Stanford Carr Development, LLC

For:
SCD Kaloko Makai, LLC

November 15, 2008

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SUMMARY
The Kaloko Makai project site sampled in this biological survey yielded native and adventive arthropods. No invertebrate currently listed as endangered or threatened under either federal or state 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 residential units, areas for retail and commercial use, and supporting infrastructure in North Kona, Hawai'i. SCD Kaloko Makai, LLC, proposes to build on 1,142 acres / 462.2 hectares (h.) of land, within portions of Tax Map Keys: (3) 7-3-009: 017, 025, 026, and 028. This survey was conducted by Steven L. Montgomery, Ph. D., for SCD Kaloko Makai, LLC, as part of a team effort directed by Wilson Okamoto Corporation and Stanford Carr Development, LLC

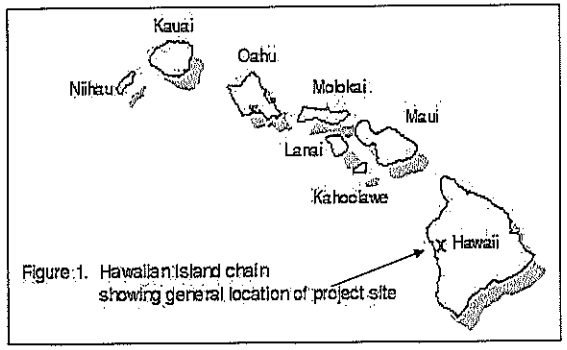


Figure 1. Hawaiian Island chain showing general location of project site

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 or indigenous species, especially those having legal status under either, or both federal and state endangered - threatened species statutes (DLNR 1996, 1997, USFWS 2005a, 2007, 2008).

[1] Animals without backbones: Insects, shrimp, snails, spiders, etc.

Native Hawaiian plant, vertebrate, and invertebrate populations are interdependent. Certain insects are obligatorily attached to host plants and use only that plant as their food. The health of native Hawaiian invertebrate populations depends on habitat quality and absence or low levels of continental predators. 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.

GENERAL SITE DESCRIPTION
The project area is on the leeward coast of the Island of Hawai'i (Figure 1) in the Kaloko and Kohanaiki ahupua'a, North Kona district. The property is approximately one mile mauka of the coastline, between 100 +/- feet (ft.) above sea level (ASL) / 30.5 meters (m.) at the western end to 740 ft. ASL / 213.4 m. at the eastern end. It is bounded by Queen Kaahumanu Highway to the northwest. The makai portion of the property is framed by Kaloko Light Industrial Park, Kohanaiki Industrial Park, and Queen Kaahumanu Highway. The largest part of the property is bisected by Hina Lani Street. (Figure 4).

Figure 2. Typical area of koa haole (*Leucaena leucocephala*) and fountain grass (*Pennisetum setaceum*)

Geologically, the site is mostly pāhoehoe and 'a'ā lavas with lava tubes present throughout the area. Much of the surface is uneven and irregular. The site incorporates several vegetation communities, from a nearly intact lowland dry forest to scrub dominated by koa haole (*Leucaena leucocephala*) or by Christmas berry (*Schinus terebinthifolius*) (Figure 2). Biologically the most interesting area is the "open to closed native forest occurring on the relatively recent lava flow comprising most of the central portion of the southern half of the study area" (Figure 3) (Whistler 2006). The area was recognized as Management Unit 10 in the US Fish & Wildlife Service's *Recovery Plan for the Big Island Plant Cluster* (1998). This dry forest area has supported several native Hawaiian plants of interest as hosts or shelter for native invertebrates.

Figure 3. Typical native dry forest area on 'a'ā lava flow.

The larger site has been through a variety of changes as first Polynesians then Europeans adapted the area to their own needs. Early Hawaiian cultivation of crops, water collection in lava tubes, and establishment of housing began the process of change. Historic grazing of domesticated and feral animals, and more recent bulldozing (Bell et al. 2008a, b, c; Esh 2008) all combined to replace large portions of the native vegetation - and native invertebrate population - with a succession of introduced plants and animals (Whistler 2006; David 2006). The bird and mammal survey found evidence of 20th century host plant damaging goats, sheep, and pigs in the area (David 2006).

There are no natural year-round surface sources of fresh water that would support specialized invertebrates. Some of the lava tubes were used into the historic period for collection of dripping fresh water (Bell et al. 2008a, b, c; Esh 2008).

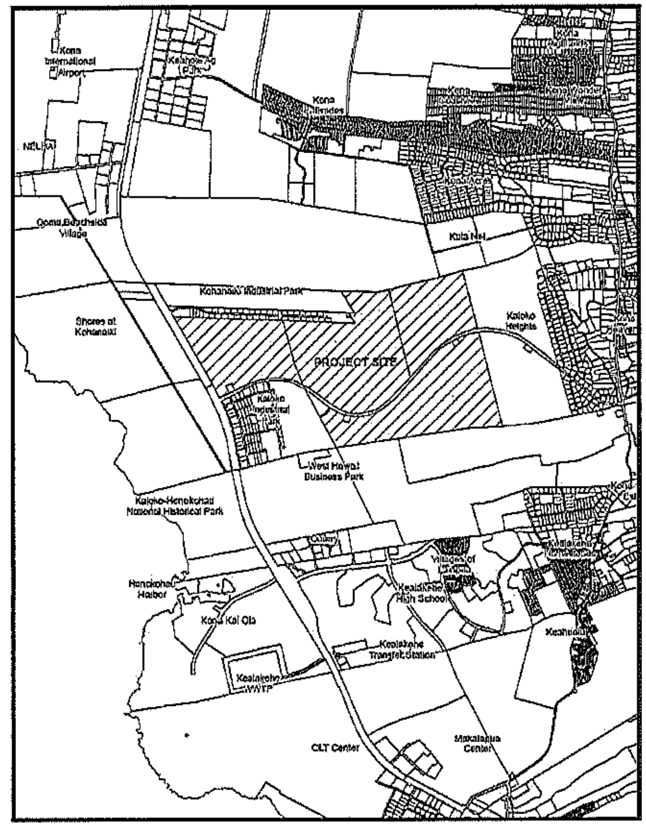


Figure 4. Map showing North Kona, Hawai'i, location of project site.

[from Wilson Okamoto 2007, Figure 1-4]

INVERTEBRATE SURVEY METHODS

Since 1970, I have taken part in field projects at other locations in the Kailua-Kona area and in other dryland locations 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 Kaloko Makai (Bridwell 1920, Swezey 1935). Those experiences and the results of those surveys provided the basis for my study design and my analysis of results.

Previous Surveys and Literature Search

Botanical surveys of the project area have been conducted since at least 1983 (Nagata 1983). A previous Environmental Impact Statement associated with this site (Kimura 1996) was reviewed. Recent avian, mammalian (David 2006), and botanical surveys (Whistler 2006) also were very helpful in preparing for this study. None of the previous studies referenced terrestrial invertebrate surveys or surveys of lava tubes for cave-adapted invertebrate species.

Recent archaeological studies (Bell et al. 2008a, b, c; Esh et al. 2008) showed evidence of extensive lava tubes in the project area, but no mention of cave-adapted invertebrate species.

Searches were made in the Bishop Museum Library, University of Hawai'i Hamilton Library, and State's Office of Environmental Quality Control web site (2008). Surveys done for other projects in the general area were reviewed (Char 1986, 1990, Geometrician 2003; Helber et al. 1986, 1991a, 1991b; PBR 1991, 2007, 2008; Towill 1976, 1988; Wilson Okamoto 2000). Only the planning for Kula Nei, a nearby mauka project, included a survey of lava tube invertebrates (Howarth 2006, SWCA 2006-7).

A search was made for independent studies of invertebrates associated with this site or with nearby sites. Online proprietary data bases of such as AGRIS, Biological Abstracts, Ingenta Connect, and Zoological Record also were searched. Searches were made for publicly available articles mounted on the web (Goggle Scholar) and in regional and national databases which provide geographic access, such as the Pacific Basin Information Node and Hawaii Natural Heritage Program. Data base searches were made in Bishop Museum's Arthropod Checklist, and the University of Hawaii, Hamilton Library's Hawaii-Pacific Journal Index. Access to the project area was limited prior to construction of Queen Ka'ahumanu Highway. The bulldozing of a jeep road by Huehue Ranch in 1955 gave access to part of the property, but travel was mostly through the subject area to reach ocean resources (Bell et al. 2008a). The area lacked

the commercial agriculture which generated much of Hawaii's formal entomological surveys since the 1900s. The combination of these factors makes it unremarkable that this review showed no previous independent invertebrate surveys of the area.

The US Fish & Wildlife Service has demonstrated an interest in the native dry forest area of the property for many years. Since 1995 USFWS personnel have surveyed the property at least once (USFWS 1997). As a part of our literature search a Freedom of Information Act Request (FOIA) was initiated with USFWS regarding those surveys and records were obtained. Unfortunately, detailed cave by cave records were not found. The information resulting from the FOIA request is incorporated in several places in this report.

Fieldwork

Field surveys were conducted in September and October 2008. 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 Nagata (1983), Whistler (2006), and US Fish & Wildlife Service records (see "Previous Surveys and Literature Search" above) were an important focus of my searches, as were lava tubes located by the archaeological survey (Bell et al. 2008a, b, c; Esh et al. 2008).

Fieldwork schedule:

September 12-15, 2008	Site examination, orientation, collecting; light survey
September 28-30, 2008	
October 1-4, 2008	General collecting; light survey; lava tubes surveys
October 7, 2008	Lava tube orientation; general collecting; light survey
October 8-10, 2008	General collecting; light survey; lava tubes surveys

Daylight surveying was concentrated during the cooler early morning and late afternoon hours when temperatures are lower and invertebrates would be more active.

See Figure 7 for light surveying locations within the survey area.

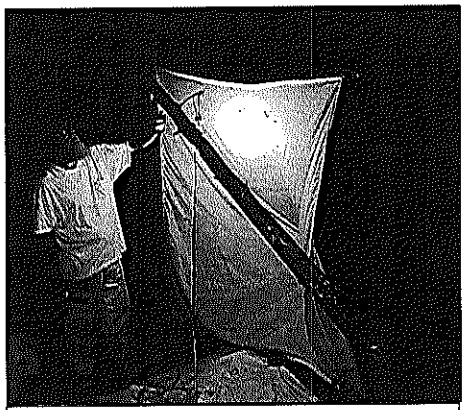
Collecting Methods

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 observed and collected if appropriate. This is much more efficient than roaming the research area seeking cryptic insects. Baiting is a recognized method of censusing lava tubes for cave adapted fauna.

Lava tubes were chosen for baiting from among tubes located in my own work and in the previous archaeological surveys. In choosing lava tubes for baiting I excluded from my survey all lava tubes which archaeological surveying had shown contained human remains and those chosen for preservation. Also excluded were tubes with multiple skylights or a short dark zone. Tubes were chosen for baiting based on the size of the dark zone, presence and amount of intruding roots, and dampness which experience shows create a lava tube environment suitable for cave fauna. Traps used shrimp paste and blue cheese baits, both proven and durable attractants in other lava tube surveys. Baited traps were placed in 3 lava tubes October 10 and retrieved on October 13, 2008.

Host plant searches: Potential host plants, both native and introduced, were searched for arthropods that feed or rest on plants. Wandering transects were followed throughout the inland area with emphasis on reaching native host plants.



© Figure 5. A light census is important to understand the invertebrate fauna.

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 (Figure 5). 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 or under clouds blocking starlight. 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 approximately 11 hours on each night of surveying. The light source was a mercury vapor (MV) bulb. An additional, UV light source was used at all sites. Every effort was made to diminish competing light from

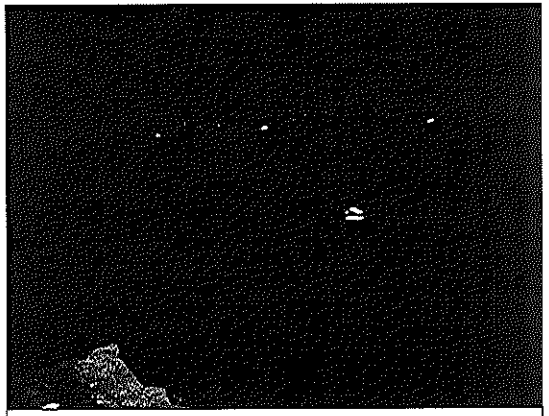


Figure 6. Monitoring locations [blue light] were located away from competing light sources [background] to the extent possible.

housing, street lights and other artificial sources (Figure 6), but these were a factor in response success at some locations.

Locations were chosen based on experience, host plant proximity, and terrain. The botanical survey placed most of the native plants in the dry land forest area. As the interconnection of arthropods and host plants would predict, light sampling in that area yielded the most native arthropods. All light sample locations are marked on Figure 7.

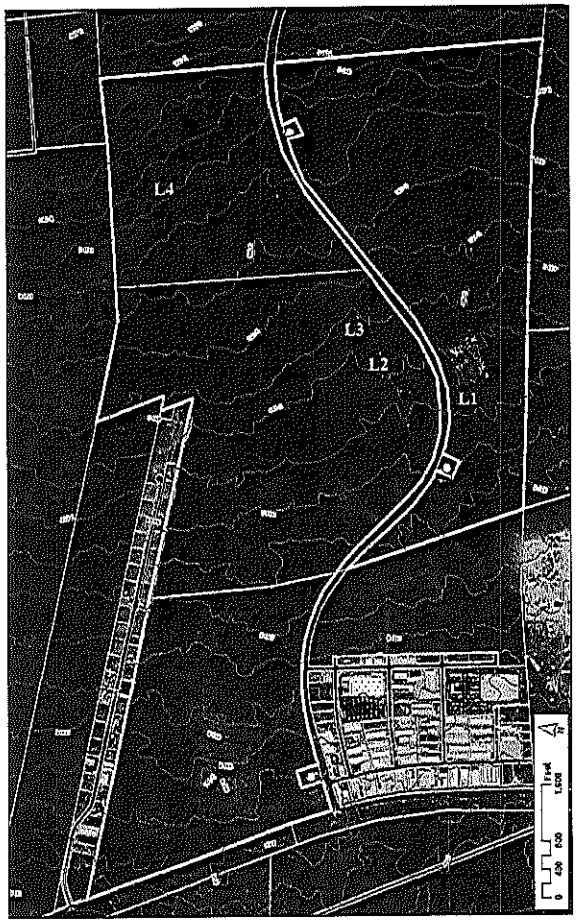


Figure 7. Map of Kaloko Makai project area showing light monitoring sites, lava tube.

L = light monitoring = lava tube

Sweep nets: This is a 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, examining dead wood, and other debris.

Survey Limitations / Conditions
My ability to form advisory opinions is influenced in the following ways:

Collecting conditions:

Weather: Weather was favorable for surveying during each field day. The atmospheric vog did not appear to alter the behavior of invertebrates.

Seasons: Monitoring at a different time of the year might produce a longer or different arthropod list. Weather and seasonal vegetation play 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.

Although there were some small rains in the weeks prior to this survey, true winter rains and vegetation revitalization had not taken place. If vegetation had developed after winter rains, a different insect list might have resulted. Nevertheless, the low level of native plants outside the dry forest zone was a stronger factor in determining the invertebrates encountered than the season or condition of vegetation.

Moon: The moon presented competition to the collecting light on the evenings of September 12-13-14, 2008. The moon rose between 4 and 5 p.m. each night[2] and set between 3 and 4 a.m. the following morning. The moon was described as "waning gibbous" with 85-90% of the Moon illuminated. (USNO) The relative lack of artificial light sources at the chosen sites compensated to a degree for the competition.

The moon did not present any competition to light collecting efforts September 28-October 2, and relatively little on October 3 and 4. At the start of fieldwork, the moon rose during daylight hours and then set before dark. At the end of fieldwork the moon was setting in the early evening 8:00-830 p.m., continuing to provide many moon-free hours for light surveying (USNO) During the short period the moon was 'up,' it presented small competition to my bright light in the largely unlit parcels under study.

Limited duration: Surveying for a longer period of time might enlarge the list of species; however, I believe the survey provides a fair review of the invertebrates present.

Selectivity: My survey was focused on finding any endemic and indigenous Hawaiian land invertebrates species. No attempt was made to collect or completely document the many common alien arthropod species present.

The exclusion of lava tubes based on cultural content and human remains did limit the choice of tubes. A thorough review of color photographs of lava tube interiors and faunal remain listings provided in the archaeological reports (Bell et al. 2008a, b, c; Esh et al. 2008) allowed a useful review of some aspects of the lava tube setting in the excluded tubes (see Lava Tube Species page 20).

RESULTS:

Incidental records:

In addition to the invertebrate results noted below, rats were present as shown by their destruction of kukui seeds (*Aleurites moluccana).* The small Indian mongoose (*Herpestes auropunctatus*) was seen at various locations on the property.

[2] Times given are for Kailua-Kona as closest city tracked by U. S. Naval Observatory

DISCUSSION

Native species of note are discussed. Also, information is provided on adventive species often misidentified by the public, especially those confused with native species. Non-native species in conflict with native species or human beings are discussed.

INVERTEBRATE RESOURCES

ARTHROPODS

CRUSTACEA

DECAPODA (Shrimps, Lobsters, Crabs, Crayfish)

Undetermined species

Parts of three individual crabs (Figure 8) were seen in one lava tube. The examples observed in the lava tube did not appear to be part of any midden. Photographs of the specimens are under review by specialists to determine the species. Further information will be provided as it becomes available.

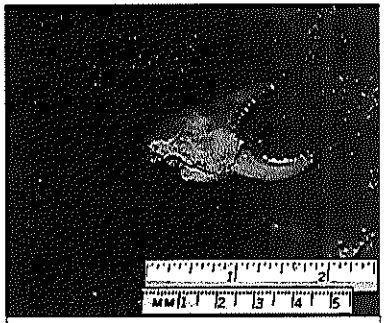


Figure 8. Crab remains seen in several tubes.

ARANEAE (spiders)

Dysderidae: *Dysdera crocota* C L Koch, 1838

This small spider (10-14 mm), known to bite humans, was seen on the floor of a lava tube.

Salticidae: Unidentified species

One immature jumping spider was noted under stones on the inland lava flow. Identification of immatures from one sample is extremely difficult. There are 9 spiders of the family Salticidae reported from Hawai'i Island, four endemics, all of the genus *Sandalodes*, and 5 adventive or introduced spiders. (HBS 2002a, Nishida 2002)

Scytodidae: *Scytodes* sp. or spitting spider
There are three adventive species known on Hawai'i Island: *S. fusca*, *S. longipes*, and *S. stiatipes*. This genus gets its common name from the hunting method of spitting strands of silk from its fangs to fasten down prey for easy dining. (Mascord 1970)

INSECTA
HETEROPTERA (True bugs)
Lygaeidae: *Nysius* sp.
This native seed bug, commonly found in dryland locations, uses many alien and native host plants. It is known from most islands in the Hawaiian chain.

LEPIDOPTERA (butterflies, moths)

Cosmopterigidae: *Hyposmocoma* sp.
Two species of *Hyposmocoma*, as caterpillars, were found in the rocky habitat (Figure 9) and three species, in adult stage (Figure 11), came to light. Considering the population is likely at a low level due to the dry weather, the diversity is noteworthy. In the wet season it could be expected that a higher number of individuals and more species would be recovered. *Hyposmocoma* are called "case bearers" because after an early beginning inside a leaf curl or similar hiding place, the caterpillars create protection in an intricately constructed portable "cave" woven of their own silk. For camouflage, they add bits of their surroundings to the case using silk: snips of dry grass or leaves, flakes of bark, a little dirt (Figure 10). The case is then easily mistaken by a predator as

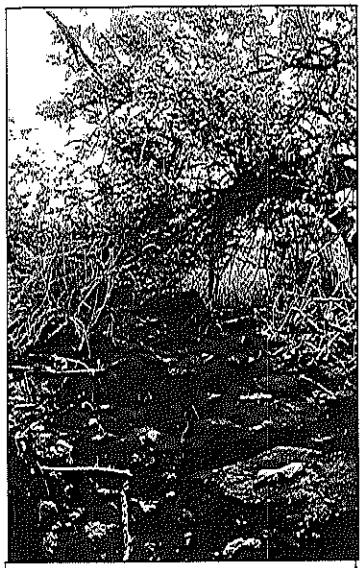
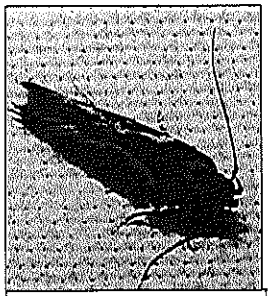


Figure 9. *Hyposmocoma* casebearers were found by lifting up slabs of broken pahoehoe.

another part of the inedible landscape. These bunkers are fitted with a hinged lid (operculum), pulled shut by tiny mandibles to defend them from enemies. Their relationship to the case is similar to that of a hermit crab to his shell. 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 protective armor by their six true legs. Cases are sometimes attached to rocks or tree trunks and foliage. (Manning/Montgomery in Liittschwager & Middleton 2001)

Figure 10. *Hyposmocoma* caterpillars sheltered under rocks. Far left, a pseudoscorpion shared the habitat.



© Figure 11. *Hyposmocoma* sp.
Photo# starr-030724-0089
credit: "Forest & Kim Starr" (HEAR)

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 Dr. Daniel Rubinoff and his students (Rubinoff & Haines 2006).

Crambidae (grass moths)

Tamsica hyacinthina (Meyrick 1899)

This was the most common native species found during the survey. The caterpillars feed on a wide variety of grasses, allowing them to adapt to the changing flora at Kaloko. The genus was described by E. C. Zimmerman as "a cluster of poorly understood, obscure, difficult little species." (1958) Pioneering biologist R. C. L. Perkins noted "They are able to flourish in the driest localities near the coast...." (Perkins 1913).

Gracillariidae:
Caloptilia mabaella (Swezey), 1910 or *Caloptilia azaleella* (Brants), 1913

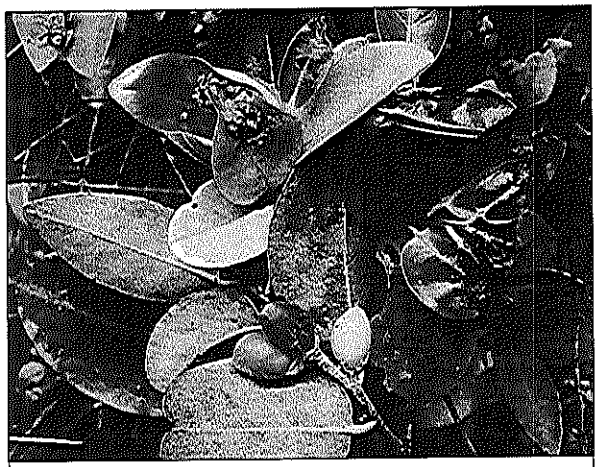
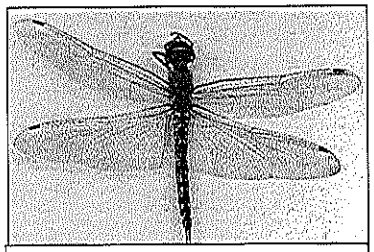


Figure 12. Lama (*Diospyros sandwicensis*) or Hawaiian persimmon at Kaloko dry forest showing damage by leaf miner *Caloptilia* sp.

The young and terminal leaves of lama trees (*Diospyros sandwicensis* or Hawaiian persimmon) in the dry forest area at Kaloko Makai show distinctive feeding damage associated with leaf miner caterpillars (Figure 12). Leaf miners burrow or "mine" inside a leaf, creating scars or bumps on the leaf surface where they have eaten out the inner flesh of the leaf. The most likely adventive pest is *Caloptilia* sp. *C. mabaella*, which has been known in the islands since 1910 (Swezey 1910, 1954), is previously recorded only from O'ahu. *Caloptilia azaleella* is known from O'ahu and Hawai'i Island, but not previously associated with *Diospyros sandwicensis*. (HBS 2002a; HOSTS 2008; Nishida 2002)

Noctuidae: *Schrankia* sp.
This small moth was previously noted in the lava tubes of Kaloko by US Fish & Wildlife Service personnel (USFWS 1997) and was found by this survey as well. The genus is very complex. As noted by Dr. F. G. Howarth (2006): "There are often 2 or 3 morphs in each cave that show different degrees of cave adaptation..."

ODONATA (Dragonflies and Damselflies)
Libellulidae: *Pantala flavescens* Globe skimmer



© Figure 13. Globe skimmers often use human created water sources

This indigenous dragonfly (Figure 13) was observed on the property. 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 stock tanks. Globe skimmers are widely distributed throughout the Hawaiian Islands, from Kure to Hawai'i Island (HBS 2002a, Nishida 2002) and have even been found flying at sea (Howarth & Mull 1992).

ORTHOPTERA (Praying Mantis, Grasshoppers, Crickets)
Gryllidae
Gryllodes sigillatus (Walker), 1869 Flightless field cricket
This world-wide traveler was first recorded in the Hawaiian Islands in 1895 (Zimmerman 1948). In the years since, it spread up and down the island chain.

Although superficially similar in appearance, *Gryllodes sigillatus* males can 'sing' by rubbing vestigial wings together, while the native species, *C. anahulu* (see page 25), is mute.

Table 1: List of Invertebrates:[3] Kaloko Makai, North Kona, Hawai'i

Species	Common Name	Status	Abundance	Notes
ARTHROPODA				
ARACHNIDA				
ARANEAE	spiders			
Dysderidae				
Dysdera crocota C L Koch, 1838		Adv	U	in lava tube
Heteropodidae				
Heteropoda venatoria	large brown spider cane spider	Adv	U	leaf litter
Salticidae	jumping spider			
unidentified immature		?	U	under stones
Scytodidae				
Scytodes sp.	spitting spider	Adv		in lava tube
PSEUDOSCROPIONIDA	pseudoscropions			
unidentified species 1		?		sheltering with casebearers
SCORPIONES	scorpions			
Buthidae				
Isometrus maculatus (De Geer)	lessor brown scorpion	Adv	U	in lava tube
CRUSTACEA				
DECAPODA	Shrimps, Lobsters, Crabs, Crayfish			
Coenobitidae:	Crab			
Coenobita sp.				
INSECTA				
BLATTODEA				
Blattidae	cockroaches			
Periplaneta americana(Linnaeus), 1758:	American cockroach	Adv	C	in lava tubes
COLLEMBOLA	springtails			
Entomobryidae				
undetermined sp. 1		?	R	under stones
HETEROPTERA	true bugs			
Lygaeidae	seed bugs			
Nysius sp.		End	O	at light
HOMOPTERA	planthoppers			
Cixiidae				
Oliarus sp.		End	R	*Reynoldsia* bark

[3] Names authority: Hawaii Biological Survey 2002a; Nishida 2002; Zimmerman 1948-80; Zimmerman 2001

Table 1: continued

Species	Common name	Status	Abundance	Notes
HYMENOPTERA	wasps, bees, ants			
Apidae				
Ceratina smaragdula (Fabricius)	small carpenter bee	Adv	U	at *Sophora*
Formicidae	ants			
Camponotus variegatus	carpenter ant	Adv	C	to light
Pheidole megacephala (Fabricius, 1793)	big-headed ant	Adv	C	on soil
Anoplolepis gracilipes (F. Smith, 1857)	longlegged ant	Adv	C	on soil
Vespidae	wasps			
Polistes exclamans Viereck, 1906	common paper wasp	Adv	C	at flowers
LEPIDOPTERA				
Cosmopterigidae	case bearers			
Hyposmocoma sp. 1	slender wedge case	End	R	under stones
Hyposmocoma sp. 2	broad case	End	U	under stones
Hyposmocoma sp. 3	black, pointed adult	End	A	at light
Crambidae (Pyralidae)	micro-moths			
Mestolobes sp.		End		at light
Orthomecyna sp.		End		at light
Tamsica hyacinthina (Meyrick 1899)		End	A	at light
Noctuidae				
Schrankia		End	O	in lava tube
Oiethreutidae				
Cydia latifemoris (Walsingham, 1907)		End	O	reared from *Sophora* seeds
Plutellidae				
Plutella nohoilo Robinson & Sattler, 2001		End	R	at light
Plutella xylostella (Linnaeus, 1758)		Adv	C	at light
Xyloryctidae				
Thyrocopa abusa Walsingham, 1907		End	R	in leaf litter, twigs uhluhi
ODONATA	dragonflies; damselflies			
Libellulidae	skimmers			
Pantala flavescens (Fabricius, 1798)	globe skimmer	Ind	C	in flight

Table 1: continued

Species	Common name	Status	Abundance	Notes
ORTHOPTERA	praying mantis, grasshoppers, crickets			
Gryllidae	crickets			
Gryllodes sigillatus (Walker)1869	flightless field cricket	Adv	A	on lava
CHILOPODA				
SCOLOPENDROMORPHA				
Scolopendridae	centipedes			
Scolopendra subspinipes Leach, 1815	large centipede	Adv	U	on soil

Status:
End endemic to Hawaiian Islands
Ind indigenous to Hawaiian Islands
Adv adventive
Pur purposefully introduced
? unknown

ABUNDANCE = occurrence ratings:
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
AA Very abundant abundant and dominant

Lava Tube Species

The lava tube survey yielded a few native invertebrates, with *Schrankia* sp. a moth, being the most common native species encountered. The most common arthropod encountered in the small sample of lava tubes surveyed was the adventive *Periplaneta americana* (American cockroach). These results are not surprising given that many of the lava tubes have skylights creating a short dark zone, or none at all (Figure 14). Some tubes lack covering vegetation. In many tubes there is no root system reaching into the lava tubes, and insufficient moisture to support a richer ecosystem. Other tubes have only a few grass roots (Figure 16). The major food source, long roots, (Figure 15) supporting most lava tube arthropod communities, is mostly absent.

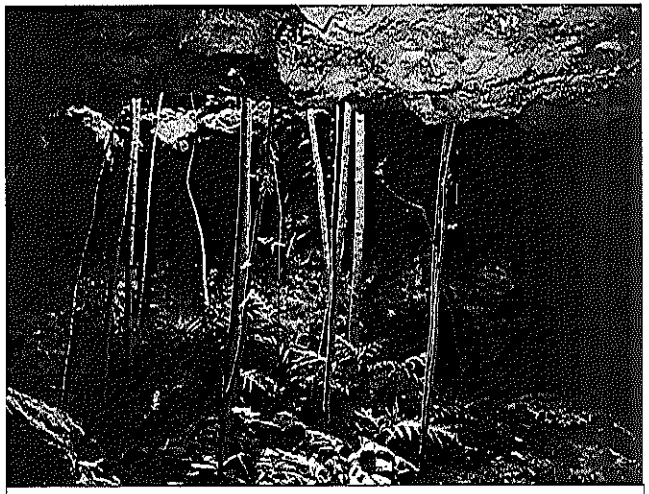


Figure 14. Skylights or openings to the outside, common in the Kaloko tube system, make many of the tubes too dry and too bright for a healthy dark-adapted cave ecosystem.

My examination of a small sample of lava tubes was augmented by a thorough review of color photographs taken inside numerous tubes and of faunal remains listings provided in the archaeological reports (Bell et al. 2008a, b, c; Esh et al. 2008). The images in those reports with very few exceptions show the lava tubes surveyed by archaeologists displaying no descending roots, or short roots.

In wetter lava tubes at other locations, large portions of the wall surface may be covered with a slime, on which the larvae of crane flies (*Limonia* sp.) leave characteristic trails. My review of the small patches in my sample caves (Figure 17) and of the color photographs in the archaeological reports (Bell et al. 2008a, b, c; Esh et al. 2008) shows no evidence of the baseball-stitch pattern (Figure 18) left by the feeding of the larvae of crane flies (*Limonia* sp.). Factors affecting the suitability of a habitat for *Limonia* include low humidity and apparent reduced nutritional content in the coating (Howarth 1973). Kaloko Makai tubes present both low moisture and few overhead plants with descending roots.

My findings seem to parallel those from a 1995 US Fish & Wildlife Service visit to some of the tubes. Fish & Wildlife representatives entered 25-30 caves as part of a survey of the property's dry forest area. US Fish & Wildlife Service reported most caves lacked aspects recognized as necessary to support cave-adapted ecosystems. Moisture levels were low and root penetration into the lava tube system was lacking. Although 6 caves looked more promising, only one species of *Shrankia* moth was seen in those caves. (USFW1997)

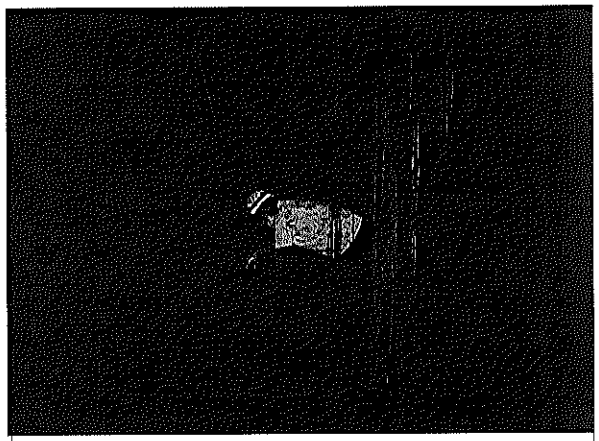


Figure 15. To support a thriving lava tube ecosystem a typical cavern (above) needs a large number of long and healthy roots penetrating from overhead vegetation.

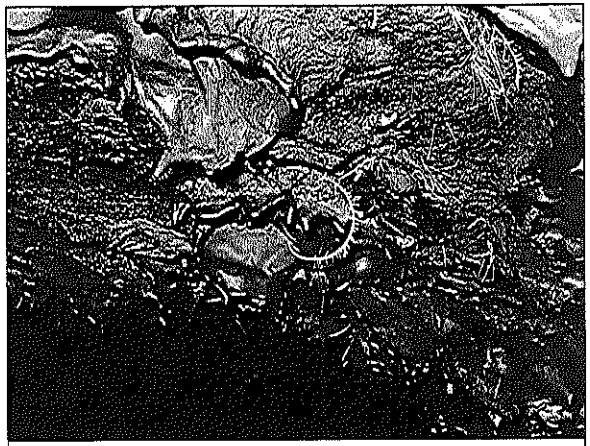


Figure 16. Typical view of short roots penetrating Kaloko Makai lava tubes.

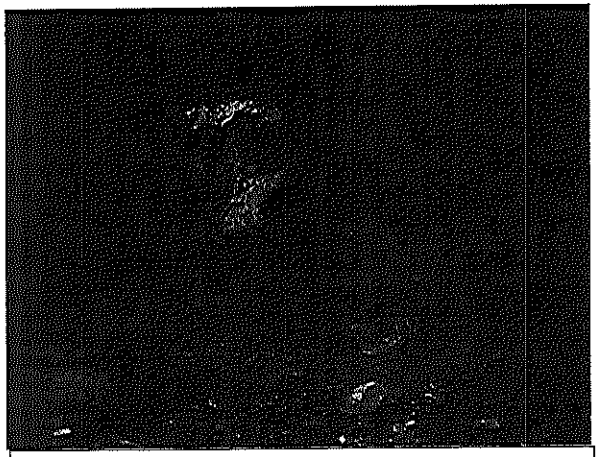


Figure 17. Typical view inside Kaloko lava tube. Slime coverings (white patches) were sporadic and showed none of the patterns created by feeding endemic crane fly larvae (example below).

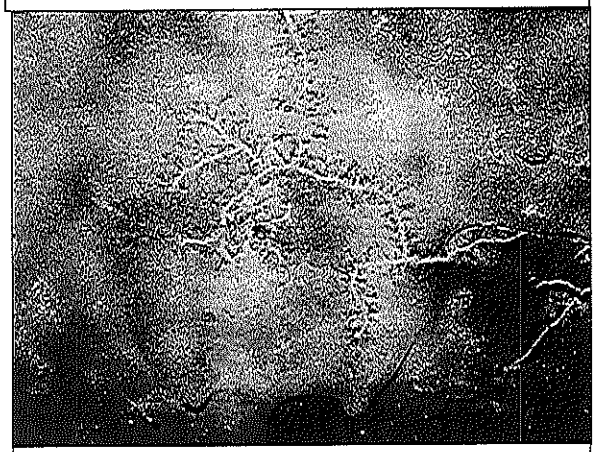


Figure 18. In wetter lava tubes large portions of the surface may be covered with a slime, on which the larvae of crane flies (*Limonia* sp.) leave characteristic trails. © near volcano Feb 2008

Invertebrates Not Present

Alien predatory ants are a major cause of low numbers of native arthropods. The big-headed ant (*Pheidole megacephala*), longlegged ant (*Anoplolepis gracilipes*), and carpenter ant (*Camponotus variegatus*), which prey on other insects (Zimmerman 1948-80), are present on the property. 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 censusing, ants quickly appeared and began attacking the resting moths and smaller insects at my light. Ant populations often do 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

No native snails were observed on the project property.

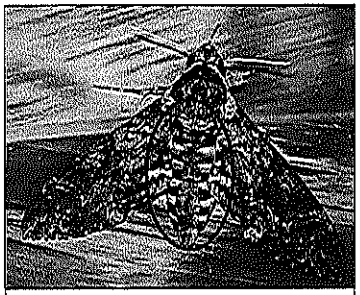
ARTHROPODA

Diptera: Drosophilidae: *Drosophila*

No native *Drosophila* (picture-winged flies) were observed on the property. The location does not provide appropriate habitat for any of the 12 native *Drosophila* species recently listed as endangered or threatened. (USFWS 2006a, b).

Lepidoptera: Sphingidae:

Agrius cingulata Sweet potato hornworm



© Figure 19. Sweetpotato hornworm showing pink markings.

The sweet potato hornworms feed on all sweet potato, morning glory, and related plants. Although it did not respond to my light survey, it is very likely to be seen on the property as it is widely distributed around the Hawaiian Islands and appropriate host plants are present. (HBS 2002a, Nishida 2002) This large and easily seen moth is most easily confused by the public with the Blackburn's sphinx moth (*Manduca blackburni*) described below. The adult *A. cingulata* having PINK markings (Figure 19) along both sides where *Manduca* has orange (Figure 20). When the moth is at rest with wings folded, these color markings are hidden, leading to possible misidentifications.

Manduca blackburni

Blackburn's sphinx moth (*Manduca blackburni*), (Figure 20) an endangered species (Fed Reg 1999-2000) which favors leeward slopes, 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*), were observed on the property in my own survey or the most recent botanical survey (Whistler 2006). *Capparis sandwichiana*, reported to be adult nectar plants is known on the property. Whenever the plants were encountered in my surveying, I was alert for adults feeding on blooming flowers. *Manduca* was not observed.

© Figure 20. Blackburn's sphinx moth is distinguished from other hawk moths by orange markings.

Although the original *Recovery Plan* (USFWS 2005b) for this large sphinx moth proposed two small management areas in North Kona, Hawai'i, the *Final Rule* (USFWS 2003) designated habitat only at the more inland location, Pu'uwa'awa'a.

Orthoptera: (Praying Mantis, Grasshoppers, Crickets)

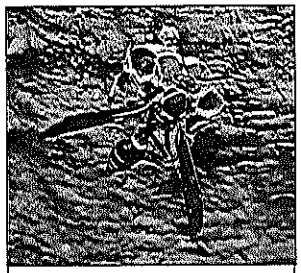
Gryllidae

Caconemobius anahulu Otte, 1994 Lava cricket

This species was first discovered by Dr. D. Otte on barren lava 1 km from 'Anaeho'omalu Bay, Hawai'i Island. In his major revision of Hawaiian crickets Otte writes this species "may be widespread along the western slopes of Hawaii Island." (Otte 1994) It is much less common than *Gryllodes sigillatus* (see page 16) in these extremely barren lavas at Kaloko Makai. Although not found in this survey, it is likely a longer search at another time of year would have recovered this species.

Medically important species

The Kaloko Makai project area includes classic habitat for centipedes, scorpions, and widow spiders, so these medically important species may be present in the area. *Dysdera crocota* , a 10-14 mm spider known to bite humans (page 12), and scorpions were seen inside the lava tubes and in the rocky areas. Common paper wasps (*Polistes exclamans*) (Figure 21) were seen repeatedly on the property. Employees should be alert for these species when working in the area. These species may pose a serious risk to some individuals, and supervisors should be aware of any special allergy of employees. Some individuals can experience anaphylactic reactions to venom. Also note that the ant species reported present (see page 24) are known to bite people. When moving stones or piled brush, use of gloves and long sleeves will greatly reduce the risk of accidental contact and bites with all species noted here. Please see *What Bit Me?* (Nishida & Tenorio 1993) and *What's Bugging Me?* (Tenorio & Nishida 1995).



© Figure 21. Paper wasp

POTENTIAL IMPACTS

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 2008). No anticipated actions related to the proposed project activity in the surveyed locations are expected to threaten an entire species.

RECOMMENDATIONS

Data retrieval

Decapoda

As the presence of the crab remains I observed in my survey had been marked by the archaeological surveyors, they were not collected. A consultation with B. P. Bishop Museum specialists shows that no specimens of this sort have been closely examined by scientists knowledgeable in this group. As the examples in these caves are in relatively good condition, they should be retrieved for specific identification by invertebrate specialists as part of the archaeological data recovery and mitigation process. During data retrieval, a search should be made for additional parts of the crab to aid in identification (i.e., lifting rocks, looking for smaller parts of the crab). Proper and specific identification will provide valuable information to increase both biological and cultural knowledge.

Prevent habitat degradation:
Fulfillment of the plan to preserve some archaeological sites and parts of the dry forest habitat should assist native invertebrate species, including cave adapted species. Selective removal of alien plants in these areas can assist native plants in filling the available niches. Additionally, it is important to prevent establishment of new competitive or predatory alien invertebrate species.

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 runoff, spills, and impact on the makai coastal habitats (Kaloko-Honokōhau National Historical Park) as well as fragile archaeological and biological zones within the property. Establish construction staging areas and storage of materials well away from the fragile areas.

Two factors influence establishment of alien species: access and regular food sources.

Inspect construction materials for hitchhiking seeds or animals.

Clean tools, boots, and equipment used at other sites to minimize the chance of transporting new pest plants or animals to the area. Soil packed in tires, on helicopter runners, or workers' boots can transport seeds, and insect or snail eggs. Ants, snails and slugs, and many other invertebrates can hide in boxes or equipment resting at one location and later be carried to Kaloko Makai.

When establishing plantings after construction, care should be taken to prevent alien plant or animal species from being introduced on the plantings or associated soil.

Remove trash regularly. Predatory species such as ants easily establish in areas where food trash is consistently available. Food trash during construction can increase mongoose (*Herpestes auropunctatus*) populations as well. Construction workers are socialized to simply drop food remains and food wrappers, bottles and containers. Change expectations: Provide trash cans, establish a culture of using them, and empty the cans frequently.

Shield external lighting:
We concur with the advice of David (2006) to shield outdoor lighting. Light is attractive to all arthropods (see *Methods* page 7). The potential presence of *Manduca blackburni* in the greater area makes shielded lighting an important protection for this endangered invertebrate.

Landscape with native dryland plants for lower cost maintenance:

We concur with the advice of Whistler (2006) to revegetate public and common areas with native dryland adapted plants. Given the Kona climate of the project area, it would be both practical and appropriate. Native plants would provide habitat for native arthropods, while creating interesting areas for walking, cultural learning, nature study, and bird watching. Importantly, using dryland plants to landscape can lower long-term watering costs and water draws, following an initial establishment period. Native plants will remain green and thus more fire resistant throughout the summer. Most native plantings will have lower human maintenance costs as well (less hedge trimming, weed whacking). Planted in a mix of ground cover, shrub, and tree heights native plants also help slow run off and retain moisture when rains do come. Native plants usually grow well without the use of fertilizers, reducing the potential for runoff into Kaloko-Honokōhau National Historical Park (David 2006). Native insects will find this refuge over time. The plantings will provide educational, visual, and aesthetic benefits to residents while conserving water at very low on-going cost.

Home buyers should be given guidance on xeriscaping with restrictions being considered as part of covenants or homeowner association rules. Plants that are adapted to dryland areas also will not require doses of fertilizer and pesticides and so reduce non-point pollution. Several southwestern U. S. continental cities have long enforced water / yard planting restrictions due to water concerns. Their experiences may prove helpful in planning.

Resources helpful in understanding Hawaiian plants in an urban setting include *Native Hawaiian Plants For Landscaping, Conservation, and Reforestation* (Bornhorst & Rauch 1994) and *Growing Native Hawaiian Plants* (Bornhorst 2005). By prior arrangement with growers, native Hawaiian plants can be as convenient to mass plant as the introduced plants commonly used to re-vegetate after new construction. Some suppliers of native plants are listed at

http://hbs.bishopmuseum.org/botany/riparian/pdf/propagators.pdf

Some plants have demonstrated their adaptation to the area by growing at the Kaloko Makai site naturally [marked with asterisk (*) in the list below]. Dryland adapted plants suitable for landscaping, many with beautiful foliage or flowers, are listed below. Comments on some of the plants follow.

Ground cover:

'Ilima	*Sida* sp. (prone) (*)
malapilo	*Capparis sandwichiana* (*)
nehe	*Melanthera integrifolia, Melanthera subcordata*
'ohai	*Sesbania tomentosa*
pā'ūohi'iaka	*Jacquemontia ovalifolia*
pili grass	*Heteropogon contortus* (*)
'ulei	*Osteomeles anthyllidifolia*

Shrub:

'a'ali'i	*Dodonaea* sp. (*)
'ākia	*Wikstroemia* sp.
'ille'e	*Plumbago zeylanica*
'ilima	*Sida* sp. (upright) (*)
naio	*Myoporum sandwicense* (*)
pōhinahina	*Vitex rotundifolia*

Tree:

kou	*Cordia subcordata*
milo	*Thespesia pupulnea*
'ohe makai	*Reynoldsia sanwicensis* (*)
'ōhi'a lehua	*Metrosideros polymorpha* (*)
wiliwili	*Erythrina sandwicensis*

'A'ali'i / *Dodonaea* sp.

'A'ali'i (Figure 22) grows at roughly shrub height without hedge trimming. It produces flowers and foliage useful in lei making and is host to several invertebrates. It stays green year round without watering.

© Figure 22. 'A'ali'i *Dodonaea* sp. foliage and blossoms

'Ilima / *Sida* sp.

Figure 23. 'Ilima *Sida* sp.

'Ilima (Figure 23) is host to a large number of native invertebrates, maintains color and foliage during the dry months and needs little maintenance. It grows in a prone, ground cover form and an upright, shrub form. The plant will grow at seaside or inland locations.

Malapilo / *Capparis sandwichiana*)

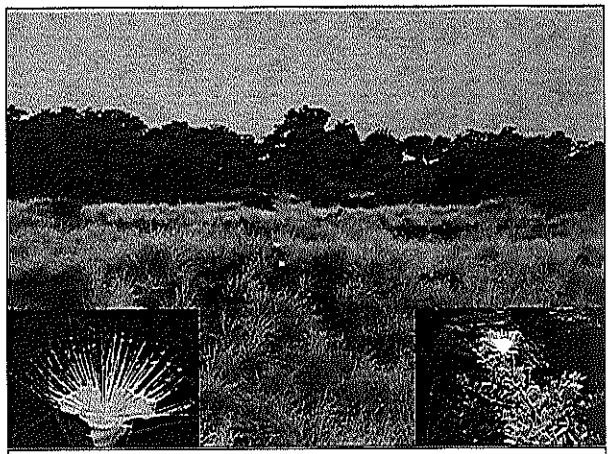
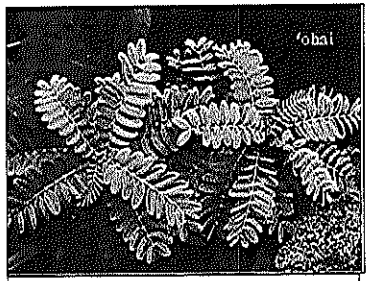


Figure 24. Malapilo (*Capparis sandwichiana*) [center] blooming amidst native pili and alien fountain grasses.

Malapilo (Figure 24), host to several native arthropods, is well adapted to the Kaloko Makai site. The plant bears numerous white flowers, which wilt to a beautiful pink as the day progresses. Already growing on site, malapilo, planted as a ground cover, provides nectar, pollen, and keeps down weeds. Morning walkers and joggers would find them a special attraction.

'Ohai / *Sesbania tomentosa*

Once known from all major islands, 'Ohai (Figure 25) now is rare outside planted areas. It has beautiful, moisture retaining, silvery leaves and dark orange, curved blossoms. It is a short shrub and stays 'green' all summer.



© Figure 25. 'Ohai *Sesbania tomentosa*

'Ōhi'a lehua (*Metrosideros polymorpha*)

'Ōhi'a lehua (Figure 26) can be a bush or tree and is well known for its attractive flowers much desired for lei making. It is now used more frequently in home landscaping on all islands. It could be planted in common areas at Kaloko Makai. In addition to the red flower, there are also other colors.

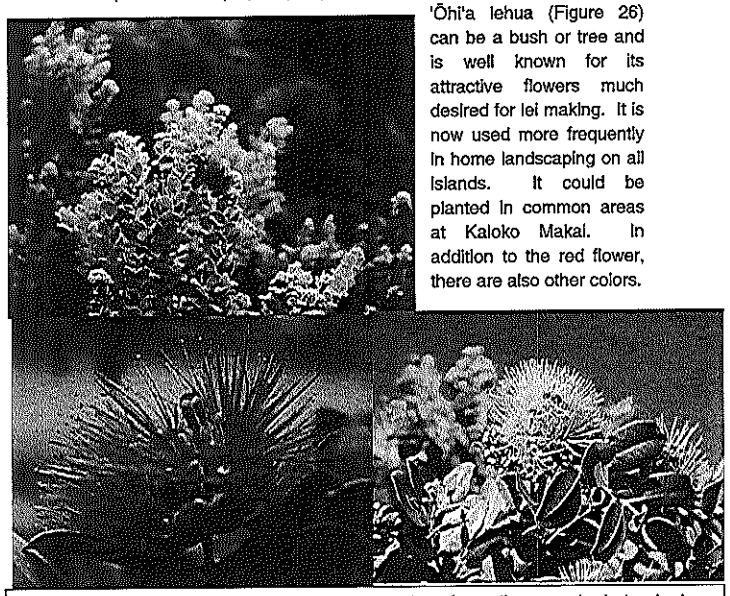


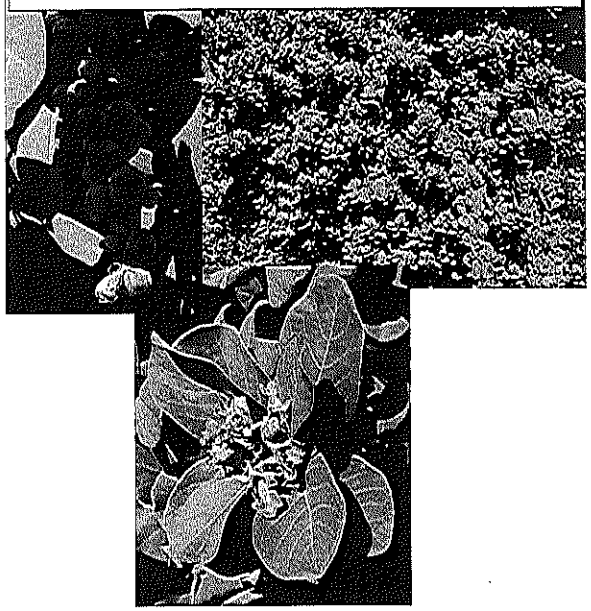
Figure 26. The species name of 'ōhi'a lehua, *polymorpha*, refers to the many physical and color varieties encompassed by the species.

'Ōhi'a is host to many native insects. As it provides a dependable nectar source for birds, the trees would make a reliable location for bird watching when in bloom.

Pōhinahina / beach vitex / *Vitex rotundifolia*

Now considered a beach plant (Figure 27), this hardy, flowering creeper likes to cascade over rocky areas or down small slopes but will form hedges. It 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 pathways, thus keeping people on pathways with grace, beauty, and low upkeep. Spicy smelling leaves, small blue flowers, and brown seed capsules create visual interest. No watering required after establishment. Foliage, flowers, and seed capsules are all good lei making materials.

© Figure 27. Pōhinahina seed capsules, foliage, and flower



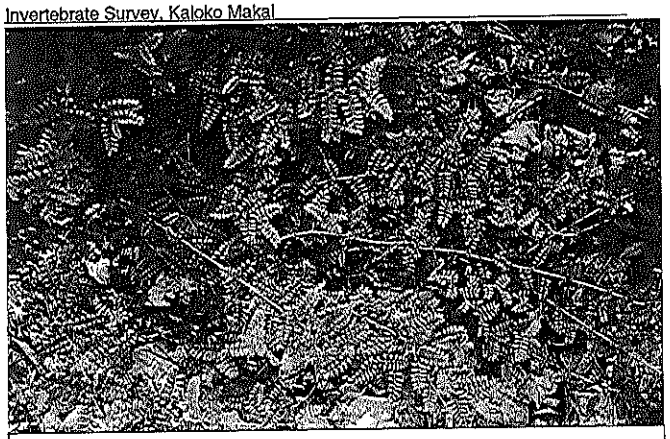
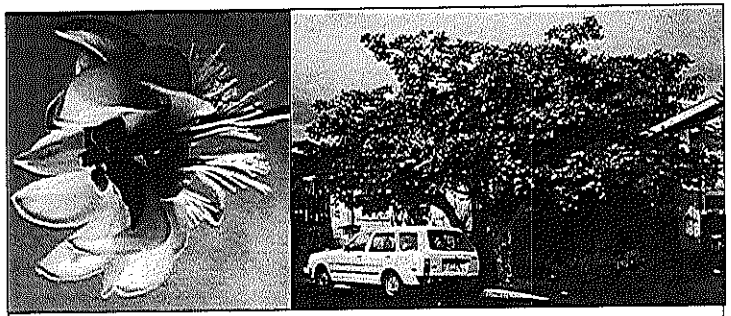


Figure 28. 'Ulei (*Osteomeles anthyllidifolia*)

'Ulei *(Osteomeles anthyllidifolia)*
'Ulei is a low growing plant (Figure 28) making a good ground cover, sometimes combined with other plants. It will grow in open areas or semi-shade. It is slower growing than some plants.

wiliwili / *Erythrina sandwicensis*



© Figure 29. Wiliwili is dryland adapted and needs no watering

Wiliwili (Figure 29) has a proven track record as a dryland decorative, low maintenance planting, co-habiting with homes and parks. Seasonal flushes of flowers provide remarkable beauty. The seeds make beautiful lei.

© Figure 30. Wiliwili receives solar energy through green bark when leaves are dropped.

Although currently wiliwili is under attack from a recently introduced alien gall wasp, a control agent of that pest is expected soon. Wiliwili is summer deciduous - dropping its leaves in summer and relying on minimal photosynthesis through green bark (Figure 30). Native wiliwili have suffered less from the wasp's attacks than the alien *Erythrina* trees, in part because their green bark provides some nutrition during periods when leaves are reduced by the wasp's effect.

Community Education:
The best defense the fragile dry forest ecosystems can have is an informed public. Providing signage and partnering with community environmental groups to provide information and guidance about enjoying the preserved dry forest, archaeological, and natural features, would make preservation more effective. Providing defined pathways would reduce trampling of plants and disturbance of wildlife.

ACKNOWLEDGMENTS
Thanks are extended to Stanford Carr Development, Wilson Okamoto Corporation, and Jim Medlin for assistance in site access. Dr. Francis Howarth provided access to identifications of the Kula Nei survey results. Karen Marlowe, U. S. Fish & Wildlife Service, assisted with a Freedom of Information Act request for USFWS files related to the dry forest portion of the property. Mindy Simonson, of Rechtman Consulting, provided on-site guidance to locate lava tubes. Thanks are extended to the personnel of the Dept of Land and Natural Resources for permits to conduct this work.

Steven Lee Montgomery conducted all collecting and is responsible for all conclusions. Anita Manning contributed to preparation of this report. Some images used in this report were not taken in the course of this project. These photos, marked by © symbol were made by Anita Manning and/or S. L. Montgomery prior to this contract and were chosen because they best illustrate the subject.

STANDARD NOMENCLATURE

Bird names follow *Hawaii's Birds* (Hawaii Audubon Society 2005).
Invertebrate names follow
Freshwater & Terrestrial Mollusk Checklist (HBS 2002b)
Common Names of Insects & Related Organisms (HES 1990)
Hawaiian Terrestrial Arthropod Checklist (HBS2002a; Nishida 2002)
Mammal names follow *Mammals in Hawaii* (Tomich 1986).
Place name spelling follows *Place Names of Hawaii* (Pukui et al. 1976).
Plant names follow
Manual of the Flowering Plants of Hawaii (Wagner et al. 1999)
A Tropical Garden Flora (Staples and Herbst 2005)

ABBREVIATIONS

ASL	above mean sea level
DLNR	Department of Land and Natural Resources, State of Hawai'i
DOFAW	Division of Forestry and Wildlife, State of Hawai'i
FOIA	Freedom of Information Act Request
ft	feet
HBS	Hawai'i Biological Survey
m	meter
MV	Mercury Vapor
n.	new
sp.	species
spp.	more than one species
TMK	Tax Map Key
UH	University of Hawai'i
USFWS	United States Fish and Wildlife Service
UV	Ultraviolet

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.
Aspiration: invertebrates are transferred from the original location (leaf, net, etc.) into a large vial. Two tubes are lodged in one stopper in the vial. Air drawn in on one tube, creates suction at the end of the second tube; the target insect is drawn into the vial by the pulling air.
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.
Gibbous: describes the Moon or a planet before and after it is full, when it has more than half its disk illuminated; swollen on one side.
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.
Makai: toward the ocean
Mauka: toward the mountains
Midden: food refuse in an archaeological setting, often in a heap or pile
Mollusk: invertebrates in the phylum Mollusca. Common representatives are snails, slugs, mussels, clams, oysters, squids, and octopuses.
Morph: one form of a polymorphic (or many formed) population which despite their physical differences are part of the same genus or species.
Native: organism that originated in area where it lives without human assistance. May be indigenous or endemic.
Naturalized: an alien organism that, with time, yet without further human assisted releases or plantings, has become established in an area to which it is not native.

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.

Nocturnal: active or most apparent at night.
Pupa: the stage between larva and adult in insects with complete metamorphosis, a non-feeding and inactive stage often inside a case
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.
Waning: describes a gradual decrease in the amount of the moon's disk that is visible; shrinking

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Appendix I

Summary Report of Archaeological Inventory Survey for Kaloko Makai Cultural Surveys Hawaii, Inc. May 2008

The Archaeological Inventory Survey (March 2008 and May 2008) consists of seven volumes. The complete report has been filed with Department of Land and Natural Resources State Historic Preservation, the Office of Environmental Quality Control, State Land Use Commission, and Office of Hawaiian Affairs.

Kaloko Makai Project Draft EIS Draft Summation of Archaeology

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INTRODUCTION

Project Background

At the request of Stanford Carr Development, LLC, Cultural Surveys Hawai'i, Inc. (CSH) conducted archaeological inventory surveys covering the entire Kaloko Makai project lands. Given the large size of the total project area (over 1,100-acres) and the large number of archaeological sites identified (341) the work has been organized within separate studies for each of the four Tax Map Key parcels (TMK: [3] 7-3-009:017, 025, 026 & 028) as follows:

- *Archaeological Inventory Survey of a 224.43-Acre Parcel within Portions of Kaloko and Kohanaiki Ahupua'a, North Kona District, Hawai'i Island TMK: [3] 7-3-009:017* (Bell, Groza, Shideler, and Hammatt 2008),
- *Archaeological Inventory Survey of a 360.131-Acre Parcel within Portions of Kohanaiki Ahupua'a and Kaloko Ahupua'a, North Kona District, Hawai'i Island TMK: [3] 7-3-009:025*(Bell, Groza, Simonson, Shideler, and Hammatt 2008),
- *Archaeological Inventory Survey of a 194.324-Acre Parcel within portions of Kohanaiki Ahupua'a and Kaloko Ahupua'a, North Kona District, Hawai'i Island TMK: [3] 7-3-009:026* (Bell, Simonson, Esh, Groza, Shideler, and Hammatt 2008), and
- *Archaeological Inventory Survey of a 363.106-Acre Parcel within Portions of Kaloko Ahupua'a, North Kona District, Hawai'i Island TMK: [3] 7-3-009:028* (Esh, Bell, Simonson, Shideler, and Hammatt 2008)

The work to prepare these studies was carried out between March 2007 and April 2008 and involved approximately 6 archaeologist-years of work.

Historic Preservation Regulatory Context and Document Purpose

As a privately funded venture on private lands, the proposed development is a "project" subject to state of Hawai'i historic preservation review legislation (Hawaii Revised Statutes [HRS] Chapter 6E-42 and Hawai'i Administrative Rules [HAR] Chapter 13-284). Based on the project's scope, cultural setting, and the results of previous cultural resource management investigations in the vicinity, Stanford Carr Development, LLC had these archaeological inventory survey investigations completed. These investigations were carried out as part of and in compliance with the proposed development's historic preservation review.

Under Hawai'i state historic preservation legislation, archaeological inventory surveys are designed to identify, document, and provide significance and mitigation recommendations for historic properties. Under this legislation, historic properties are defined as any "building, structure, object, district, area, or site, including *heiau* and underwater site, which is over fifty years old." A project's effect and potential mitigation measures are evaluated based on the project's potential impact to "significant" historic properties (those historic properties determined eligible, based on established significance criteria, for inclusion in the Hawai'i Register of Historic Places [Hawai'i Register]). Determinations of eligibility to the Hawai'i Register result when a state agency official's historic property "significance assessment" is approved by the State Historic Preservation Division (SHPD), or when SHPD itself makes an eligibility determination for an historic property (HAR Chapter 13-284).

In consultation with SHPD, these inventory survey investigations were designed to fulfill the state requirements for archaeological inventory surveys (HAR Chapter 13-276). The inventory survey reports were prepared to support the proposed project's historic preservation review. The reports include project-specific effect recommendations and mitigation recommendations for the project area's historic properties that are recommended eligible to the Hawai'i Register. These documents are intended to support project-related historic preservation consultation among state agencies and interested Native Hawaiian and community groups.

Scope of Work

The following archaeological inventory survey scope of work was developed and implemented to satisfy SHPD requirements. The scope of work for this inventory survey was designed in accord with State Historic Preservation Division rules governing standards for archaeological inventory surveys and reports (HAR 13-13-276):

1) Appropriate consultation with knowledgeable members of the community, requesting information on historic properties in the project area.
2) A complete ground survey of the entire project area for the purpose of historic property identification and documentation. All historic properties would be located, described, and mapped with evaluation of function, interrelationships, and significance. Documentation is to include photographs and scale drawings of selected historic properties. All historic properties are to be assigned *Inventory of Historic Properties* numbers by the State.
3) Subsurface testing to determine if subsurface deposits are located in the project area, and, if so, evaluate their significance. If appropriate samples from these excavations were found, they were analyzed for chronological and/or paleoenvironmental information.
4) Research on historic and archaeological background, including search of historic maps, written records, and Land Commission Award documents. This research was to focus on the specific area with general background on the *ahupua'a* and district and was to emphasize settlement patterns.
5) Preparation of a survey report to include the following:
    a. A topographic map of the survey area showing 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 prehistoric 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;
    f. 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 will be developed in consultation with the client and the State agencies.

This scope of work includes full coordination with the State Historic Preservation Division (SHPD) relating to archaeological matters. This coordination takes place after consent of the landowner or representatives.

METHODS

Field Methods

The fieldwork effort for the archaeological inventory surveys was carried out by Matthew Bell, B.A., Mindy Simonson, M.A., David Shideler, M.A., Kelley Esh, M.A., Jason Pickin, B.A., Shawn Fehrenbach, B.A., Sarah Wilkinson, B.A., Randy Groza, M.A., Amy Hammermeister, B.A., Todd McCurdy, M.A., Michelle Pammer, B.A, Doreen Hrivnak, B.A., Mark Oxley, B.A. and Hallett H. Hammatt, Ph.D (principle investigator).

The fieldwork component of the archaeological inventory survey was carried out under archaeological permit numbers 07-19 and 08-14 issued by the Hawai'i State Historic Preservation Division/Department of Land and Natural Resources (SHPD/DLNR), per Hawai'i Administrative Rules (HAR) Chapter 13-282.

Fieldwork consisted of a 100% coverage pedestrian inspection of each of the four study areas with subsurface testing at select archaeological sites. The pedestrian inspection of the study areas was accomplished through systematic sweeps. The interval between the archaeologists was generally 5 to 10 meters, varying based on visibility due to vegetation cover. Overall, heavy vegetation throughout the parcels was an impediment to ground and site visibility, and relatively narrowly spaced survey lines attempted to mitigate this issue. All historic properties encountered were recorded and documented with a written field description, scale drawings, photographs, and located with high quality GPS units including Garmin 60CSx high sensitivity units (accuracy +/- 3 m). Sites requiring the highest precision available, such as those recommended for preservation, were further located using Trimble Pro XR GPS survey technology (accuracy +/- 1 m).

Subsurface testing consisted of the partial excavation, by hand, of selected surface archaeological features located during the pedestrian survey. 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. In order to focus subsurface testing at sites with the best excavation potential, depth of deposits or construction was assessed as part of determining excavation potential. This assessment consisted of careful observation of the depth of crevices, stacked rock and piled rock that included careful removal and replacement of small portions of the top course of construction. In the event this minor removal of material allowed a natural ground surface to be observed and an absence of cultural material to be confirmed, excavation potential was generally observed to be poor. Otherwise, if necessary to determine or confirm function, a formal excavation was generally undertaken and reported in detail in conjunction with the respective site description.

All excavated material was sifted through a 1/8-inch wire mesh screen to separate out the soil matrix. Any cultural material was collected for analysis in the lab, except in the event excavation determined the site was a burial (or probable burial) in which case cultural material was carefully returned to the excavation. 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. While a stratigraphic profile is usually generated for at least one soil profile per test unit, most excavation units during the inventory survey had very shallow soil layers, if any. Some soil layers encountered consisted only of a shallow natural deposition with no cultural material, and few excavation units had more than one significant soil stratum present. Graphic presentations would thus not aid in most strata description and were therefore not included with some testing results.

Recording Agricultural Sites

Agricultural features are pervasive in a low density throughout the project area. The majority of these features tended to be minimal modification, low energy-investment and spread over broad areas (sometimes over several hundred meters). For recording purposes, a site number was given to the pervasive agricultural features within each project area, with feature and sub-feature designations serving to differentiate various levels of intensity and variations in form. The far *mauka* portion of the northeastern project area (TMK: [3] 7-3-009:026) is subject to higher rainfall and has a large area of higher density and more formal agricultural modification that is noticeably more intense than the agricultural activity in the rest of the Kaloko Makai project area. This *mauka* area is consistent with the expansive Kona Field System (SIHP # 50-10-28-6601) and was recorded as a portion of that larger site. Minor agricultural activity associated directly with a site primarily functioning for other purposes (i.e., habitation), was included in the description for that site.

Recording Lava Tubes

Lava tubes are ubiquitous within portions of the Kaloko Makai project area, especially on the *pāhoehoe*, and vary greatly in size and shape. All openings in the bedrock were examined for the presence of cultural modification or cultural material. Any opening that appeared large enough to explore was examined thoroughly. Generally, an average size person can fit through a tube entrance 30 centimeters in diameter or greater, but the shape and geology of lava tubes varies greatly and occasionally a smaller size opening could be entered; likewise, sometimes a larger than 30 centimeter opening could not be traversed due to jagged edges, etc. Every effort was made to explore the entirety of all lava tubes to their terminus, within reason as far as tube size and safety (i.e., heavily collapsed tubes were entered with caution). When a tube can no longer be explored due to size or safety, this is considered its cultural terminus, and is denoted as impassable on maps. It should be noted that cultural material and burials have been located in lava tubes with entrances which were only barely physically passable, even for the most petite archaeologists in our group.

The primary purpose for the intensive exploration of lava tubes is to locate any human remains that may be present in remote areas of a lava tube, in addition to locating other cultural material. Lava tubes were traditionally used for concealment of burials, and human remains are often located far from any other cultural modification, sometimes at great distances from tube entrances; these burials may have been placed in the lava tube using an entrance that was then filled and concealed on the surface. Therefore, in an effort to locate all burial locations within the project area, a thorough effort was made to explore all lava tubes and side tubes to their natural or cultural terminus.

As mentioned above, human utilization of lava tubes sometimes involved blockage of entrances and inner side tubes. In order to complete the inventory survey, it was necessary to pass this type of blockage; when possible, this was done by finding another passageway for access behind the blockage or attempting to assess what was behind the blockage (i.e., solid lava tube wall vs. a continuing passageway) without disturbing the blockage. If it was determined that the tube did continue past blockage and there was no other way to access the tube, a photo was taken of the blocked area and then rocks were carefully removed until an archaeologist could pass through. After inspection of the lava tube, the rocks were replaced as carefully as possible to their original position.

All lava tubes with cultural material present were mapped using a compass for bearing and a laser for distances (Stanley FatMax Tru-laser Distance Measurer; stated accuracy for this device is +/- 6 cm). The laser reflects well off most surfaces in tubes, and is an excellent alternative to the rather impractical method of pulling measuring tapes through cramped areas, or simply estimating distances (it is extremely difficult to accurately estimate distances in lava tubes; see Wolforth 2005:24). The laser method may actually increase the efficiency of mapping tubes, since accurate measurements can be obtained nearly instantaneously; overall the this technology seems to produce more accurate maps than simply estimating distances in about the same amount of time. In small tubes a regular measuring tape was used when practical.

Occasionally lava tubes extend long distances beyond any cultural modification. When this occurs, lava tubes are explored to their natural or cultural terminus. Maps are produced for all areas containing cultural materials, and the rest of the lava tube is described but not necessarily mapped. A distance and bearing from the site tag is given for all burials within lava tubes.

Laboratory Methods

Laboratory analyses of material recovered from limited subsurface testing within the project area included:

1. Preparation and submittal of datable material, such as charcoal, to Beta Analytic for radiocarbon dating.
2. Identification of invertebrate midden. Common marine shells were identified and analyzed at the Cultural Surveys Hawai'i laboratory in Kailua, Hawai'i.
3. Identification of vertebrate faunal material. All vertebrate faunal material was identified and analyzed at the Cultural Surveys Hawai'i laboratory in Kailua, Hawai'i.
4. Identification and cataloguing of traditional Hawaiian artifacts. Any artifacts collected *in situ* at the project area or contained within sediment samples were measured, weighed and classified by material type and artifact form. The analysis then focused on distinguishing artifact function.

Document Review

Background research included a review of previous archaeological studies on file at the State Historic Preservation Division (SHPD) of the Department of Land and Natural Resources (DLNR); a review of geology and cultural history documents at Hamilton Library of the University of Hawai'i, the Hawai'i State Archives, the Mission Houses Museum Library, the Hawai'i Public Library, and the Archives of the Bishop Museum; study of historic photographs

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 DLNR and the Land Survey Division of the Department of Accounting and General Services. Information on LCAs was accessed through Waihona 'Āina Corporation's Māhele Data Base (www.waihona.com).

This research provided the environmental, cultural, historic, and archaeological background for the project area. The sources studied were used to formulate a predictive model regarding the expected type and location of sub-surface pre and post-contact historic properties in the project area.

Consultation

A cultural impact assessment (Hammatt & Shideler 1996) was conducted for TMK 7-3-09:17, in 1996. Informants knowledgeable of TMK 7-3-09:17 and the project area vicinity were interviewed. These consultations focused on identifying traditional cultural practices conducted adjacent to the project area as well as addressed community concerns regarding possible burial sites.

Cultural Surveys Hawaii, Inc. is currently conducting consultation with organizations and the community to identify *kūpuna* and other individuals with knowledge of the history of the project area and its surroundings. The results of these interviews will be presented in a companion report for this project, titled "Cultural Impact Assessment for a 1,150-Acre Parcel within portions of Kohanaiki and Kaloko Ahupua'a, North Kona District, Hawai'i Island TMK: [3] 7-3-009:017, 025, 026, 028" (Monahan et al. 2008). This CIA will include consultation for all four parcels within the Kaloko Makai project. The on-going consultation with organizations includes the State Historic Preservation Division (SHPD), the Office of Hawaiian Affairs (OHA), and the Hawai'i Island Burial Council.

Further consultation will be conducted in the course of the preparation of project burial treatment and site preservation plans.

BACKGROUND RESEARCH

A synopsis of the background research is presented below. More detailed background research is presented within each of the four archaeological inventory survey studies.

Traditional and Historical Background

Mythological and Traditional Accounts

The *ahupua'a* of Kohanaiki and Kaloko lie at the southern end of Kekaha, the portion of North Kona extending from Honokōhau to 'Anaeho'omalu. The character of Kekaha - as it had been established in the Hawaiian consciousness - is represented in a traditional saying recorded by Mary Kawena Pukui and in a brief description by John Papa 'Ī'ī. The saying, "*Kekaha wai 'ole na Kona*", is defined by Pukui as "waterless Kekaha of the Kona district" and explicated by her as "Kekaha in Kona, Hawai'i, is known for its scarcity of water but is dearly loved by its inhabitants" (Pukui 1983:184). 'Ī'ī describes:

> ...a cold wind from Kekaha, the Hoolua. Because of the calm of that land, people often slept outside of [sic] the tapa drying sites at night. It is said to be a land that grows cold with a dew-laden breeze, but perhaps not so cold as in Hilo when the Alahonua blows ['Ī'ī 1959:122].

These passages suggest that Kekaha was firmly identified with its austere physical environment. A legend told in Maguire (1966) reveals the importance of water resources in this general area. The story focuses on a man named Ko'amokumokuohe'eia, who moved to an upland area and was told by the residents there that water was very scarce. Water, he was told, could be found in "celebrated" caves, but these caves were *kapu* (forbidden), and trespassers would be killed by the owner of the cave. However, Ko'amokumokuohe'eia discovered a very small cave entrance that no else knew about. The cave had water dripping from its roof (Maguire 1966:30). Ko'amokumokuohe'eia and his father used carved *'ōhi'a* and *wiliwili* trees to capture the dripping water, and his family was thus able to survive during dry spells. This legend clearly demonstrates the importance of water as a difficult to procure resource, as well as highlighting the importance of water collection caves.

Describing the apportioning of land by the *ali'i* (royalty) before the ascendancy of Kamehameha, the pioneer nineteenth-century Hawaiian historian Samuel M. Kamakau records this information about the lands of Kekaha:

> Waimea was given to the Pa'ao kahuna class in perpetuity and was held by them up to the time of Kamehameha III when titles had to be obtained. But there was one land title held by the kahuna class for many years and that was Puuepa in Kohala. In the same way the land of Kekaha was held by the kahuna class of Ka-uahi and Nahulu [Kamakau 1961:231].

Kamakau further records that during the 1770s, "Kekaha and the lands of that section" were held by descendants of the Nahulu line, the Ka-me'e-ia-moku and Ka-manawa, the twin half brothers of Ke'e-au-moku, the Hawai'i island chief (Kamakau 1961:310).

Kamakau mentions Kaloko in an episode that suggests that *ahupua'a's* significance within the pre-contact Kekaha landscape. Kamakau recounts an extraordinary day's reconnaissance of the west coast of Hawai'i Island by the spy Ka-uhi-o-ka-lani, sent to the island by Kama-lala-walu, chief of Maui. Having reached Kawaihae by canoe at night, Ka-uhi-o-ka-lani "ran about that same evening [reaching as far south as Ka'awaloa] and returned before the canoes were dismantled..." Ka-uhi-o-ka-lani, recounting his journey and the landmarks he had observed, relates: "I went on to the long stretch of sand, to the small bay with a point on that side and one on this side. There are large inland ponds." He is told that the "sandy stretch is 'Ohiki, and the walled-in ponds are Kaloko and Honokōhau" (Kamakau 1961:56). This event unfolds during the time of the sixteenth-century Hawai'i Island *ali'i* Lono-i-ka-makahiki, suggesting that by the 1500s Kaloko and its fishpond were well-known features in the Kekaha landscape.

Intensive archaeological investigation during recent decades has clarified the picture of pre-contact Hawaiian life within Kekaha and the two *ahupua'a* under study. Especially detailed study of Kaloko has resulted in the following analysis of the development of pre-contact settlement throughout the *ahupua'a*:

> Throughout its span of occupation Kaloko was but part of a larger society. Kaloko was apparently a unified community after A.D. 1200-1300. When initially occupied

> (A.D. 1000-1500), it may have been an outlier of another community. Nevertheless, from its initial occupation, Kaloko had 1 or more internal local residence groups containing constituent households. By A.D. 1200-1300 at least 2 residential groups were present in the community, and by contact (circa A.D. 1778) at least 4 residential groups had dwelled in the area. Each residential group performed religious functions as well as being a leisure unit. Members of the group held use rights to adjacent farm lands and probably to areas where forest and marine resources were located. Within each residential group, 1 household seems to have been dominant, being the spatial focus for its group's religious activities. It is suggested that such dominance was a function of consanguineal seniority and/or wealth. (Cordy et al. 1993:45)

While exact population figures for Kaloko were not possible, the study suggested that the "community seems to have gradually grown in size but could never have been larger than 118 and most likely was about 60-100 in size" (Cordy et al. 1993:45). The general pattern of land use and settlement suggested for Kaloko may also have existed within the similar environment of neighboring Kohanaiki.

A detailed study of Kaloko by Cordy et al. (1991) for the National Parks Service has developed a model of pre-contact settlement throughout the *ahupua'a*. The following is a summary of this model provided by the National Parks Service (2001):

> Permanent settlements in the leeward portions of Hawai'i Island began by the A.D. 900s to 1000s, and possibly earlier. These would have occurred near favorable water sources, Kaloko bay probably having been one of the most sheltered and inviting large inlets along the Kona Coast. Coastal habitations had expanded by the 1200s, utilizing inland fields as well as sea resources for subsistence. The Kekaha lands north of Kaloko and extending to Kohala are thought to have undergone initial permanent settlement beginning in the 1400s, with subsequent occupation of the coast north and south over the next few centuries.
>
> Sometime during the period of 1580 to 1600, Laeanuikaumanamana, the *kahuna-nui* of the ruling chief, Liloa, acquired the Kekaha region. It is thought that the construction of fishponds at Kaloko and Honokahau began during this time, with Kaloko Fishpond dating from at least the 1400s to 1500s. During the 1600s to 1700s, as the Kona Coast population grew with the establishment of the royal residence of 'Umi-a-Liloa at Kona and the consequent increased demand for food production, Kaloko also increased to probably almost 200 residents. It continually supported a higher population than other Kekaha areas because of its fishpond and extensive inland field system [National Parks Service 2001].

The general pattern of land use and settlement suggested for Kaloko may also have existed within the similar environment of neighboring Kohanaiki.

Into the last decades of the 18th century - following western contact - Kohanaiki and Kaloko - as elements of the larger Kekaha area -remained under the control of Ka-me'e-ia-moku, who resided to the north at Ka'ūpūlehu (Kamakau 1961:147).

Early Historic Period

By the first decades of the 19th century, the inhabitants of Kaloko and Kohanaiki would have long experienced the social pressures and consequences of western contact. "As early as 1788, Hawaiians began enlisting as seamen on the foreign ships that stopped at Island ports, and their number increased rapidly with the growth of whaling in the Pacific" (Schmitt 1973:16). As harbor facilities were developed at Kailua and Kealakekua during the early 1800s, these burgeoning ports became centers of a population drawn from increasingly isolated (economically and socially) areas like Kaloko and Kohanaiki. Newly-introduced diseases cut the population severely.

Kaloko is recorded by Kamakau as the site where Kamehameha's bones were cached after his death in 1819:

> Kamehameha had...entrusted his bones to Ulu-maheihei Hoa-pili with instructions to put them in a place which would never be pointed out to anyone. At midnight, therefore, when black darkness had fallen and no one was likely to be on the road and the rough lava plains of Pu'ukaloa lay hushed, Hoa-pili sent his man, Ho'olulu, to bring the container of wicker work in which the bones of Kamehameha were kept to Kaloko in Kekaha...The next morning Hoa-pili and Ke-opu-lani took canoe to Kaloko where Hoa-pili met the man who had charge of the secret cave and together they placed the bones there [Kamakau 1961:215].

Kamakau's account, if accurate, suggests that Kaloko's population, toward the end of the 19th century's second decade, had diminished to such an extent that the *ahupua'a* could provide the necessary isolation and secrecy for the burial.

Missionary censuses of the 1830s chart the diminishing population of Kekaha and North Kona. In 1834, the total population of Kekaha is recorded as 1,244, comprising 21% of the total North Kona population of 5,957 (Schmitt 1973:31). The North Kona figure represents a population loss of 692 since the previous census of 1831 (during which no figure specific to Kekaha was noted), which recorded 6,649 persons in the district (Schmitt 1973:9). One factor - inter-island migration - inducing the diminishing population of Kona was specifically noted by missionaries in 1832: "We have been sensible for some time that the number of inhabitants in this island is on the decrease. There is an almost constant moving of the people to the leeward islands, especially since the removal of the governor (Kuakini) to Oahu. Some leave by order of the chiefs, and others go on their own responsibility" (cited in Schmitt 1973:16).

Records generated during the 1840s for Land Commission Awards (LCAs) conferred at mid-century document the disposition of population and land use within Kohanaiki and Kaloko *ahupua'a* that had evolved since western contact. At the Māhele of 1848, Kaloko was claimed by and awarded (LCA 7715) to Lot Kamehameha (who would become Kamehameha V). Kohanaiki was classified as Government Land. Subsequently, 18 *kuleana* claims - by commoners claiming to occupy and/or cultivate land parcels - were made in Kaloko. Twelve of these claims were awarded. All claims were for *mauka* lands - between 1200 and 1700 ft. elevation - adjacent to or just *makai* of the Government Road. Only testimony for Kahiona's LCA 9205/9237 claim (which was not awarded) mentions a fishpond; no site within the coastal area is claimed. Farmlands claimed are *māla*, *kīhāpai*, and *mo'o*, i.e. forms of dry land agriculture; actual crops identified in the award testimonies are taro and sweet potato. Only five of the total 18 claims mention residence on or use of the Kaloko lands dating to the time of Kamehameha I, the first

decades of the nineteenth century; the remaining claims testify to residence/use beginning in the 1830s and 1840s.

Parcels within Kohanaiki, having become Government Land, were subject to sale - designated grants - by the Hawaiian government. Land sales began in the 1850s with Grant 2030 to Kaiakoili in 1856, awarding 102 acres adjacent to and *makai* of the Government Road. Also beginning in the 1850s, the first taxpayer rolls for Kohanaiki and Kaloko were documented: they indicate, within Kohanaiki, 8, 13 and 12 taxpayers during the years 1857, 1859 and 1860, respectively; within Kaloko, during the same years, 19, 21 and 23 taxpayers were recorded. Just past the middle of the 19th century, the populations of Kaloko and Kohanaiki have been drawn beyond the original subsistence-based economy into the western commercial paradigm.

As Cordy notes about Kaloko: "The historical documents suggest that by the 1840s-1850s, the Coastal Zone had been abandoned as a residential area, except probably for a house used by the fishpond's caretaker. This pattern would have been a stunning change from prehistoric and early historic times, when many coastal residences were present" (Cordy 1991:288). This pattern likely also held for Kohanaiki.

Mid- to late -1800s

The division of Kohanaiki - through sales of Government lands -continued throughout the remainder of the 19th and into the 20th century. Grant 2942 in 1864 awarded to Hulikoa 929.75 acres which included the width of the *ahupua'a*, extending *makai* from Kaiakoili's grant. In 1871, Grant 3086 awarded 154 acres to Kapena; this parcel extended *makai* from Hulikoa's grant to the shoreline.

Kaloko is documented during the 1870s in testimonies by Hawaiians before the government's Boundary Commission. Testifying on August 12, 1873, Nahuina (who had earlier received LCA 10327 in Kaloko) describes himself as "born at Kaloko North Kona Hawaii at the time of Keikepuipui, the building of the *heiau* at Kailua, and have always lived there" and states that the boundaries of Kaloko were shown to him by his father, the former *konohiki* of the *ahupua'a*. Identifying the *mauka* portions of the boundary, Nahuina notes bounds defined by vegetation and a wall (*iwi 'āina*), and recalls a former habitation site:

> ...From the *makai* side of Kaupulehu the boundary runs along said land, the koa being on Kaloko and the mamani and pukeawe [sic] on Kaupulehu to the corner of Lanihau 2nd Keahuolu and Honokohaunui...Ohiawela, a *pali*, on the road through the woods is a point on the boundary. This place is above Honokohaunui, thence turn makai to Kahua, a place in the fern where houses used to stand, from thence the boundary runs makai along an *iwi aina* to Kapokalani, at the Government road. Thence *makai* still following the *iwi aina* to Kiikii an *ili aina*, thence to Kaohe, a grove of trees thence to *aa*...

Nahuina adds that Kaloko has "ancient fishing rights extending out to sea." Testifying on the same date, Hoohia, who "moved to Honokohauiki when quite small and reside[s] there now", adds details that suggest the *mauka* Kaloko-Honokohau boundary was defined by different vegetation that also reflected former traditional gathering rights: "Honokohaunui ends at Ohiawela, a *pali*. Kaloko takes the *koa*, and Honokohaunui, the *ohia*...The *olona* grows on Honokohaunui and Kealakehe and the koa on Kaloko."

During the 1880s, Kona lands - including Kaloko and Kohanaiki - were surveyed by J. S. Emerson for the Hawaiian government. Emerson produced three maps corresponding to the project area during this time period: Registered Map (RM) 1280, RM 1449, and RM 1512 (Figure 1 and Figure 2). Figure 1 shows the locations of the three Kohanaiki grants described above, as well as "Kealiihelepa Hse" at the coast above the Kaloko fish pond and, near the government roads, "Kaloko Cath. Church" and "Kohanaiki Church". This is likely the Protestant church recorded as built by a minister, Kaanohimaka, and his congregation in the 1870s (Kelly 1971:14). A portion of Emerson's Registered Map (RM) 1449 and 1512 (Figure 2) show a trail through the current project area; the trail ran from the Kohanaiki Homesteads to the Kaloko fishpond. As noted by Cordy (1991:418), Emerson's map of the area including the Kohanaiki Church indicates "a set of about 16 stone house enclosures and a Protestant church, collectively called the Kohanaiki Homesteads"; Cordy suggests a "late 1880s age for the formation of the Kohanaiki Homesteads." The resident population in the late 1880s is understood to have been in a belt at the elevation of the Kohanaiki Church, Kaloko Catholic Church and Honokōhau School house shown on the Emerson map as located east of the present project lands at an elevation of greater rainfall. Kelly (1971) notes that the Kohanaiki Homesteads would draw people as other areas of North Kona were abandoned. Government records of Kohanaiki grants show 18 parcels ranging in size from .73 acres to 25.45 acres awarded from 1895 to 1904.

While all three Emerson maps are informative of the area, there are inconsistencies between them that are difficult to interpret. RM 1280 was likely produced with a somewhat different intent than the other two maps though they were all surveyed in such a short time period. Suggestive of the different intent, RM 1280 does not indicate survey stations as the others do. However, perhaps the largest inconsistency is the route of the two roads extending *makai* from the homesteads – on RM 1280 crossing into Kaloko just outside of the homesteads and on RM 1449 further *makai*. Since RM 1280 does not give a name to this road and the date of the map is somewhat uncertain, it could be that there were two roads, one superseding the other. It is also likely that RM 1280 was a simply a preliminary survey (if the dates for J. Perryman's sketches date the map) and was less accurate (didn't extensively use survey markers).

A few newspaper articles detailing life and the customs in Kekaha during the last half of the 19th century (written between 1928 and 1930) mention water collection. Kepā Maly (2003:41-42) translated serial accounts from *Ka Hōkū o Hawai'i* written by John Ka'elemakule Sr., a Kekaha native, and the following two excerpts demonstrate the significance of water catchment:

> There were not many water holes, and the water that accumulated from rain dried up quickly. Also there would be weeks in which no rain fell... The water which the people who lived in the uplands of Kekaha drank, was found in caves. There are many caves from which the people of the uplands got water... [*Ka Hoku o Hawaii*, September 17, 1929:3].
>
> ...The kūpuna had very strict *kapu* (restrictions) on these water caves. A woman who had her menstrual cycle could not enter the caves. The ancient people kept this as a sacred *kapu* from past generations. If a woman did not know that her time was coming and she entered the water cave, the water would die, that is, it would dry up. The water would stop dripping. This was a sign that the *kapu* of Kāne-of-the-water-of-life (Kaneikawaiola) had been desecrated. Through this, we learn that the ancient people of Kekaha believed that Kāne was the one who made the water drip from within the earth, even the water that entered the sea from the caves. This is

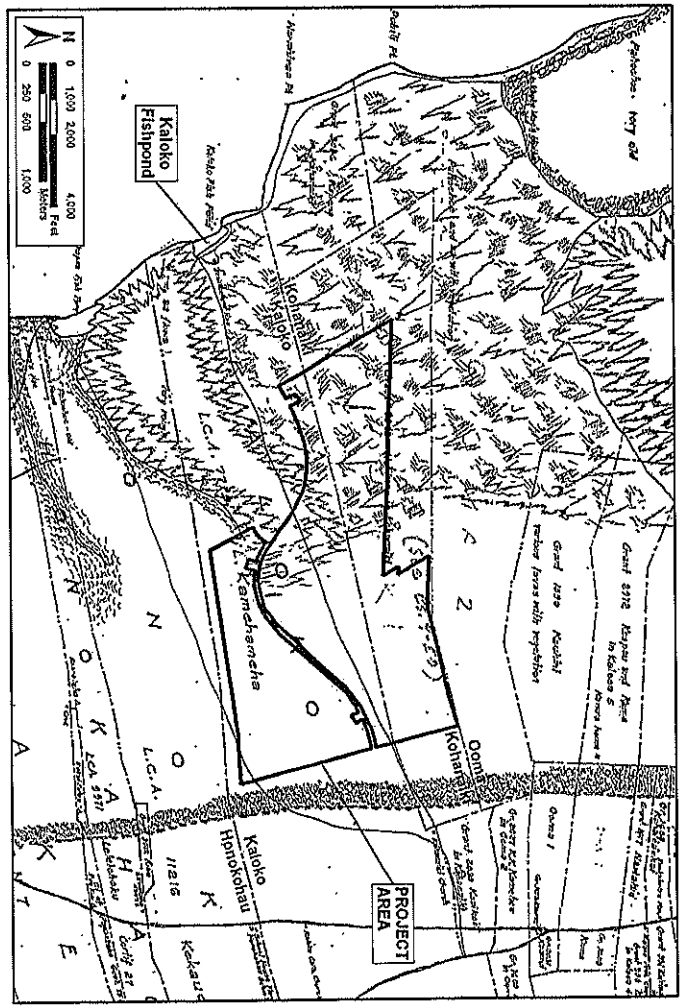

Figure 1. Portion of Emerson's Registered Map (RM) 1280, showing approximate location of project area. The location of "Kohanaiki Church" and Kaloko Fishpond are also shown.

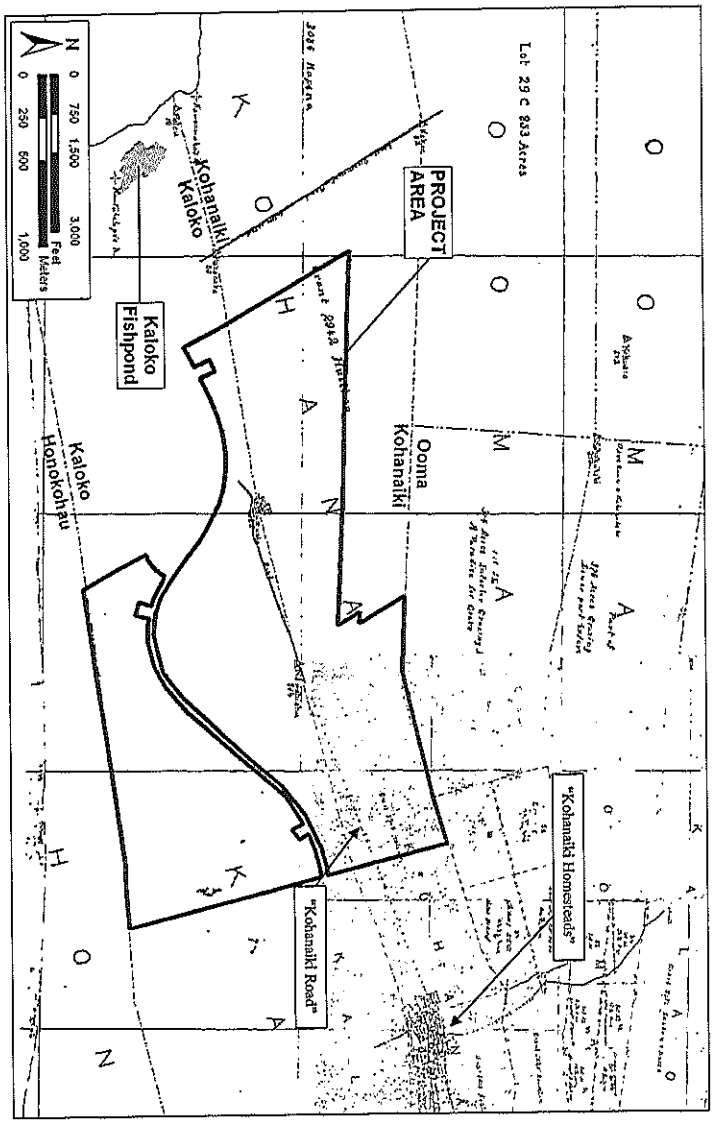

Figure 2. Portion of Emerson's Registered Map (RM) 1449 and 1512, showing project area and "Kohanaiki Road" leading from the Kohanaiki Homesteads to Kaloko Fishpond.

> what the ancient people of Kekaha wai 'ole believed, and there were people who were *kia'i* (guardians) who watched over and cleaned the caves, the house of Kāne... [*Ka Hoku o Hawaii*, September 24, 1929:3].

Kaloko and most of Kohanaiki continued to be held by the *ali'i* throughout the remainder of the 19th century, passing, after the death of Lot Kamehameha, successively to Bernice Pauahi Bishop, Kalākaua and Kapi'olani.

Oral history interviews (Maly and Maly 2003) relate that in the mid 1800s only a few residences were on the coastal lands, in the uplands above 900 ft. elevation, and in the vicinity of Māmalahoa Highway (east of the project area). The land between 900 ft. and the coast was cattle, donkey, and goat pasturage. *Mauka/makai* trails through Kohanaiki, Kaloko, Kalaoa, and Honokōhau were utilized by upland families to access the coast to fish, and gather water during upland droughts.

1900s

During the 20th century, major developments focused on Kaloko Ahupua'a, with continuing commercial use of the fishpond and increasing animal husbandry. The Kohanaiki Homesteads were apparently in decline during the early part of the century (Maly and Maly 2003), and are mentioned only in passing in H.W. Kinney's 1913 visitor's guide, which notes that it is an "inland settlement without much interest".

Ranching, however, steadily increased. Once John Maguire purchased the former chiefly lands of Kaloko in 1906 (after the deaths of Kalakaua and Kapiolani; Kelly 1971:29), the *ahupua'a* uplands were developed into the Huehue Ranch. Maly and Maly (2003) discuss the acquisition of these lands and the types of ranching that were common:

> In 1899, John A. Maguire, founder of Huehue Ranch applied for a Patent Grant on... lots in 'O'oma 2nd, but he only secured Grant No. 4536.... Maguire's Huehue Ranch did secure General Lease No.'s 1001 and 590 for grazing purposes on the remaining government lands in the Kohanaiki and 'O'oma vicinity. Thus, by the turn of the century, Huehue Ranch, utilized both the upper forest lands and lower kula lands to the shore for ranching purposes. Oral history interviews with elder former ranch hands record that this use extended across the Kapena and Huliko'a grant lands of Kohanaiki, from the fee and leasehold lands of Kaloko and 'O'oma. Nineteenth century goat drives, gave way to formalized cattle drives and round ups on these lands [Maly and Maly 2003:78].

Until the construction of the Queen Ka'ahumanu Highway in the 1970s, access to the "kula kai (shoreward plains)" (Maly and Maly 2003:101) was limited to local residents. The 1924 USGS map (Figure 3) shows "the road to the sea" connecting the Kohanaiki Homesteads with the Kaloko fishpond, and crossing the project area at the *ahupua'a* boundary between Kohanaiki and Kaloko. In the first half of the 20th century, the primary method of travel was "by foot or on horse or donkey, and those who traveled the land, were almost always native residents of Kalaoa, 'O'oma, Kohanaiki, Kaloko and Honokōhau" (Maly and Maly 2003:99). Huehue Ranch bulldozed a jeep road to the shore around 1955 (Figure 4) during the construction of the Kailua pier, and this was used primarily by the ranch employees for duties or for going fishing along the coast.

The Kaloko fishpond - leased from the Huehue ranch - continued as a commercial fishing operation until the 1950s. During the 1970s, the pond was incorporated into the newly-established Kaloko-Honokōhau National Historic Park.

Modern Land Use

While the present project area is largely undeveloped, surrounding areas have seen increasing modern use. The Huehue Ranch jeep road and other signs of animal husbandry activity can be seen on the 1959 USGS map (Figure 4). More recent nearby development is largely industrial, and the Kaloko Industrial Area is just southwest of the project area, including large stores such as Home Depot and Coscto. Huliko'a Road, just northwest of the project area, is also heavily developed, primarily as an industrial area. Hina-Lani Street runs through the central portion of the project area, and leads *mauka* to a residential area (Kona Heavens) before the Palani Road junction (at Māmalahoa Highway), as well as leading *makai* to the modern Queen Ka'ahumanu Highway. Bulldozing and modern trash are present in some portions of the project area, primarily on the Kaloko Ahupua'a side; some of this area has been used by squatters for campsites, leaving a variety of trash and furniture. However, the majority of this disturbance is near Hina Lani Street, and most of the project area shows little sign of modern intrusion.

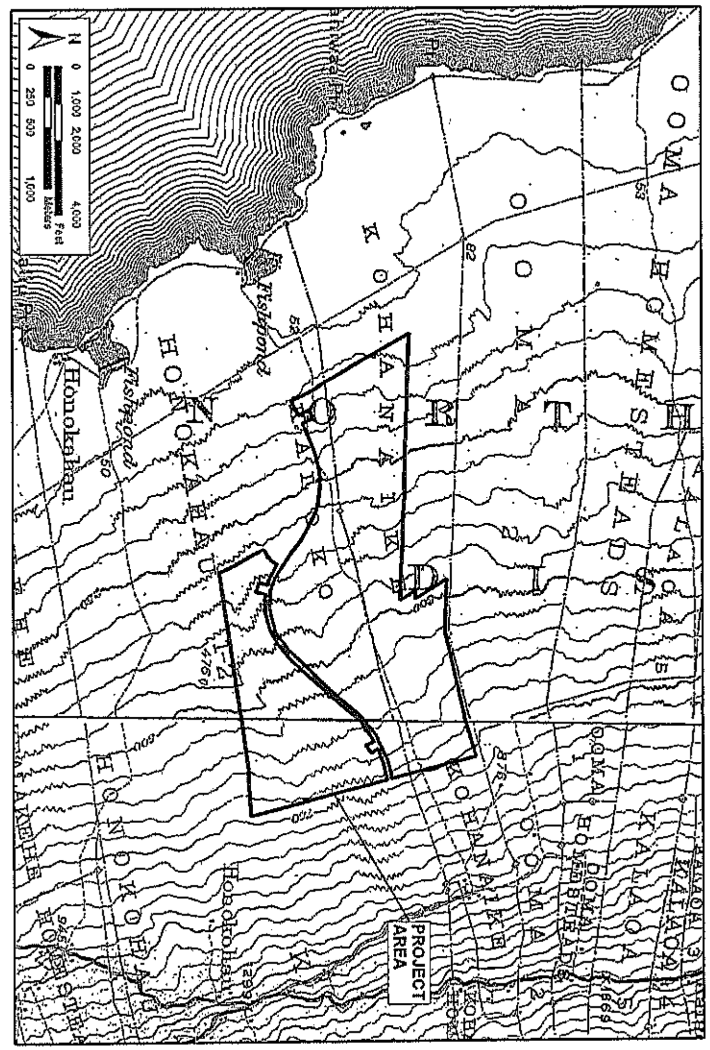

Figure 3. Portion of 1924 USGS map, Keahole Point and Kailua quadrangles, with overlay of project area

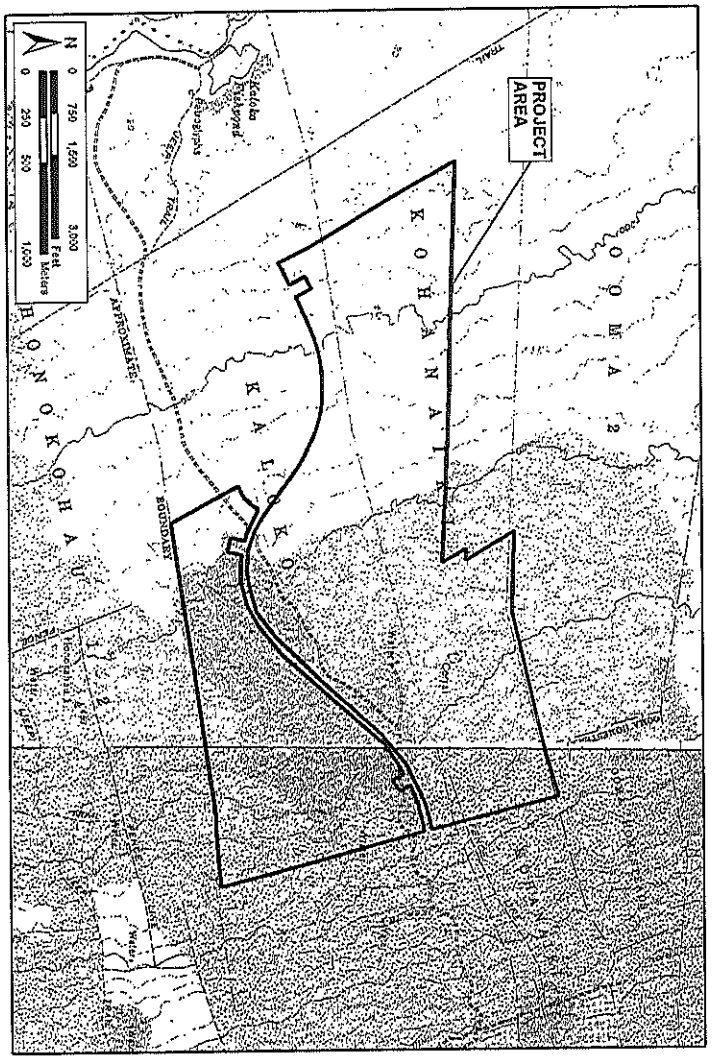

Figure 4. Portion of 1959 USGS map, Keahole Point quadrangle, with overlay of project area showing jeep road and signs of historic/modern animal husbandry

Previous Archaeological Research

Overview of Archaeological Studies Conducted within Kohanaiki and Kaloko

This section provides a synopsis of archaeological studies in Kaloko and Kohanaiki *ahupua'a* (Figure 5). Table 1 lists archaeological studies in this area with brief comments; studies most relevant to the current project are discussed in additional detail in the text. Studies previously conducted within the project area are highlighted within Table 1 in bold.

Previous archaeological surveys conducted within portions of Kohanaiki and Kaloko *ahupua'a* began with the early coastal survey conducted by John Reinecke for the Bernice P. Bishop Museum in 1929-1930 (Reinecke 1930). This was a cursory survey in which approximate site locations and very brief site descriptions were recorded. John Reinecke (1930) recorded eight sites at the coast of Kohanaiki; the sites - minimally documented and mapped - included habitation sites and a *heiau*. The next survey was undertaken by Kenneth Emory and Lloyd Soehren in 1961 (Emory and Soehren 1971). This was also a coastal survey, and focused specifically upon the coast of Kaloko, Honokohau, and Kealakehe. In 1970 and 1971, Robert Renger and students from the University of California at Santa Barbara conducted an intensive survey of Kaloko and Honōkohau between present day Queen Ka'ahumanu Highway and the coast (Cordy et al. 1991). This survey also included subsurface testing of selected sites. These three surveys identified a total of 94 sites within Kaloko between the coast and Queen Ka'ahumanu Highway as of 1971.

Survey work was undertaken in 1970-71 by Renger inland of the highway - i.e. that middle zone of Kaloko that includes a portion of the present study area. Although the findings of much of this fieldwork within the middle zone were written up in detail (Cordy et al. 1991), the findings from the survey sample conducted specifically within the project area (i.e. that portion of the middle zone situated on the inland side of the Queen Ka'ahumanu Highway) were not included because, "regrettably... it appears that the maps and survey records have been misplaced since the end of the 1971 field season" (Cordy et al. 1991:340). Renger's summary of the findings from that part of the survey indicated that fifteen features were identified:

> Very few sites were discovered within the "transitional middle zone" ... between the coastal and upland exploitation zones ...Seven lava tube shelters, four trails (coast-upland), three platforms, two cairns ... two low-walled enclosures, and an L-shaped structure were recorded. (cited in Cordy et al. 1991:340)

These sites are presumably the subject of a set of Renger's (1971) "Kaloko Field Notes" that begins "*Mauka* Excavations" but in the apparent absence of any site location map it is difficult to relate these notes to specific sites in the field.

It is our understanding that Lloyd Soehren (1979) conducted a reconnaissance survey of the Kaloko access road corridor, understood as the present alignment of present Hina-Lani Street, but identified no sites.

Additional archaeological work and historical research undertaken within or about Kaloko during the 1970s and 1980s include: an historical study by Marion Kelly (Kelly 1971); research relating to the establishment of the Kaloko-Honokohau National Park (e.g. Honokohau Study Advisory Commission 1974, National Park Service 1975); and several reconnaissance-level studies (Ching 1980, Hammatt 1980, Soehren 1983).

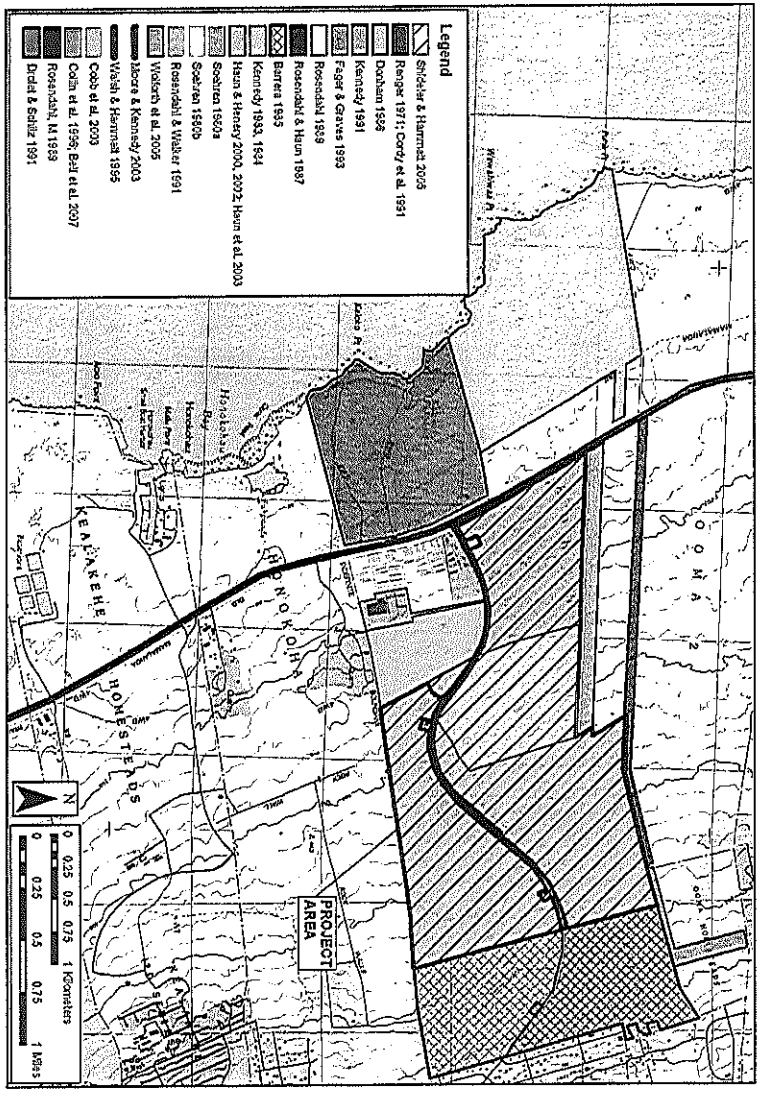

Figure 5. Previous archaeological studies in the vicinity of the project area

Table 1. Previous Archaeological Studies Within Kohanaiki and Kaloko *ahupua'a* (projects in present study area are in bold)

Source	Nature of Study	Area of Study	Finds	Comments
Reinecke 1930	Cursory survey	Coastal Survey	Briefly notes numerous sites	All sites *makai* of present project area
Emory & Soehren 1971	Cursory survey	Coastal Survey	Briefly notes numerous sites	All sites *makai* of present project area
Kelly 1971	Historical survey and background	Kaloko and Kuki'o *ahupua'a*	Background study	Good background study
Renger 1971	**"Field Notes" of "*Mauka* excavations"**	**"*Mauka* excavations"**	**"Field Notes" describe several sites**	**No site location map thus hard to be sure where sites are**
Soehren 1979	**Letter Report Reconnaissance Survey**	**Kaloko Access Road Corridor (Hina-Lani Street)**	**No finds**	**Letter Report not actually seen**
Soehren 1980a	Letter Report Reconnaissance Survey	Kaloko lowlands	No finds	Letter Report not actually seen
Soehren 1980b	Letter Report Reconnaissance Survey	Kaloko Access Road Corridor	Discusses 3 stepping stone trails, 2 *ahu* & a lava tube complex	Hina-Lani Street Letter Report not actually seen
Hammatt (ARCH) 1980	Archaeological Reconnaissance	410 acre parcel	Identified 2 sites	*Mauka* of present project area
Barrera Jr. 1983	Archaeological Reconnaissance	TMK 7-3-9:19	No finds	No map
Soehren 1983	Archaeological Reconnaissance Letter Report	-	-	Not seen
Kennedy 1983	**Archaeological Reconnaissance**	***Makai* of present project area**	**Identifies 27 sites**	**Within present project area**
Kennedy 1984	**Intensive Archaeological Survey**	***Makai* of present project area**	**Results of investigations of 25 sites**	**Within present project area**
Barrera Jr. 1985	Archaeological Survey	409 acres 700 to 1080' elevation	58 sites	*Mauka* of present project area

Source	Nature of Study	Area of Study	Finds	Comments
Donham 1986	Archaeological Reconnaissance Survey	470-acres *makai* of Queen K Hwy	105 sites	Kohana-iki development
Rosendahl & Haun 1987	**Archaeological Reconnaissance Survey**	**3 1-acre parcels**	**Their project area *mauka* of present project area had one site**	**Water tanks along Hina-Lani Street**
Barrera Jr. 1988	Archaeological Excavations	YO Project Area	60 sites	Report not actually seen
Rosendahl, M 1989	Archaeological Inventory Survey	200 ft.-wide corridor along boundary separating O'oma 2 and Kohanaiki	Identified 4 sites; site 5699 extends into current project area	Adjacent to and north of present project area
Rosendahl 1989a	**Letter Report Addendum to Archaeological Inventory Survey**	**Addl info re: site 13493 stepping stone trail by *makai* tank**	**Identified one *pāhoehoe* slab trail (site 13493)**	**Water tank *makai* end of present project area**
Rosendahl 1989b	Field Inspection	Kaloko Mauka Parcel # 1	Identified 4 sites	Report not actually seen
Rosendahl 1989c	Field Inspection	Kaloko Mauka Parcel # 2	No sites identified	Report not actually seen
Rosendahl & Walker 1990	**Addendum to Archaeological Inventory Survey**	**Addl info re: site 13493 trail by *makai* tank**	**Addl info re: site 13493 trail by *makai* tank**	**Water tank *makai* end of present project area**
Rosendahl & Walker 1991	**Archaeological Field Inspection**	**Industrial crusher site, 2 adjacent 10 acre parcels**	**Identified a trail with two cairns**	**Within present project area**
Barrera Jr. 1991	Archaeological Inventory Survey & Data Recovery Report	800 to 1100'	Identified 61 sites	*Mauka* of present project area
Cordy et al 1991	An Ahupua'a Study: The 1971 Archaeological Work at Kaloko	Kaloko-Honokōhau National Park	76 sites identified, 20 sites relocated	*Makai* of present project area
Kennedy 1991	Surface Reconnaissance	Long thin industrial development	No significant finds	North of present project area

Source	Nature of Study	Area of Study	Finds	Comments
Drolet & Schilz 1991	Archaeological Inventory Survey	8.8 acres in O'oma 2	29 sites identified; **Site - 16103 extends into project area**	Adjacent to and north of present project area
Barrera Jr. 1993	Archaeological Inventory Survey	5.7 acres; 1450 to 1630' elevation	Identified 40 features of Kona Field System	*Mauka* of present project area
Fager & Graves 1993	Archaeological Inventory Survey	Kaloko Industrial Park parcel	Identified 17 sites with 60 component features	*Makai* of present project area, south of Hina-Lani Street
Fager & Rosendahl 1993	Interim Report Archaeological Inventory Survey	Kaloko Industrial Park parcel; 15+ acres	Identified 17 sites with 60 component features	*Makai* of present project area, south of Hina-Lani Street
Henry & Graves 1993	Archaeological Inventory Survey	Transmission line project *mauka* side of Queen K Hwy.	Identified 8 sites *makai* of project area	*Makai* of present project area
O'Hare & Rosendahl 1993	Report on burials	On coast	Report on burials	Kohana-iki Resort project
Rosendahl 1993	Archaeological Field Inspection	Kaloko Mauka Parcel	4 sites discussed	Report not actually seen
Nees & Williams 1995	Archaeological Investigations	110 acres, 2100 to 2900' elevation	Identified enclosure, lava tube, terrace, wall, mounds	*Mauka* of Present Project Area
Walsh & Hammatt 1995	Archaeological Inventory Survey	Queen K Hwy Right-of-Way	Identified 9 sites adjacent to *makai* side of Hwy in Kohanaiki & Kaloko	*Makai* of Present Project Area
Colin et al. 1996	**Archaeological Inventory Survey**	**224 acres *makai* of present project area**	**Identified 55 sites**	**Within present project area**
Rechtman 1998	**Archaeological Field Inspection**	**2400-2500' elevation**	**No finds**	***Mauka* of Present Project Area**
Rechtman & Henry 1999	**Archaeological Inventory Survey**	**1450-1620' elevation**	**Identified 15 sites**	***Mauka* of Present Project Area**

Source	Nature of Study	Area of Study	Finds	Comments
Wolforth 1999	Monitoring Report	HELCO Keāhole-Kailua Transmission line corridor	Describes one site 21258	Says Walsh & Hammatt previously id'd site as 19946 (on *makai* side of hwy)
Haun & Henry 2000	Archaeological Inventory Survey	Kaloko Industrial Park TMK: 7-3-51:60; 102-acre parcel	45 sites with 81 features	*Makai* of present project area south of Hina-Lani Street
Rosendahl 2000	Archaeological Assessment	2435-2730' elevation	No finds	*Mauka* of Present Project Area
Clark & Rechtman 2002	Archaeological Inventory Survey	1200' to 1600' elevation	Identified 5 sites	*Mauka* of Present Project Area
Haun & Henry 2002	Data Recovery Plan	Kaloko Industrial Park TMK: 7-3-51:60; 102-acre	Data Recovery Plan addresses 8 specific sites	*Makai* of present project area south of Hina-Lani Street
Rechtman & Rivera 2002	Archaeological Assessment	3-7-3-26:4; 3,100'	No finds	*Mauka* of Present Project Area
Cobb, Elmore, and Kennedy 2003	**Archaeological Assessment**	**TMK: 7-3-09:25, 26 & 28 at Kaloko and Kohanaiki (400 acres)**	**Briefly identifies 154 features, within present project area**	**Descriptions quite brief; map hard to correlate with sites found in present survey**
Haun 2003	**Archaeological Assessment**	**400-Acre Portion of TMK 7-3-09:28 Kaloko**	**Identifies 8 sites (63 features) north of present project area**	**Helicopter flight overhead led him to focus on open *'a'ā* area**
Haun et al. 2003	Data Recovery Report	Kaloko Industrial Park TMK: 7-3-51:60; 102-acre	Data Recovery Report addresses 8 specific sites	*Makai* of present project area south of Hina-Lani Street
Moore & Kennedy 2003	**Archaeological Inventory Survey**	**Roadway Corridor**	**Identified 1 site (23973) 2 mounds**	**Runs through center of project area**
Puette & Dye 2003	Archaeological Inventory Survey	22 acres 2100 to 2400' elevation	No finds	*Mauka* of Present Project Area

Source	Nature of Study	Area of Study	Finds	Comments
Rechtman 2003	Archaeological Assessment	3-7-3-26:5; 3,1000' elevation	No finds	*Mauka* of Present Project Area
Elmore et al. 2004	Archaeological Inventory Survey	1400' elevation	Identified one historic site 24133	*Mauka* of present project area
Shideler, and Hammatt 2005	**Archaeological Field Inspection and Literature Review**	**1,200+ Acres in Kaloko and Kohanaiki**	**Numerous pre-contact sites observed, including: habitations, agricultural features, petroglyphs, boundary walls, and burials**	**Within present project area**
Wolforth et al. 2005	Archaeological Inventory Survey	TMK: [3] 7-3-09: 032	A total of 89 sites were identified, consisting of burials, perm. habitation, temp. habitations, religious sites, trails, boundary walls, and agricultural sites	Immediately *mauka* of present project area
Nelson et al. 2006 (currently under review by SHPD)	Archaeological Inventory Survey	TMK:3-7-3-009:007	**Identified site -16103, which extends into project area**	Adjacent to and north of present project area; **one site extends into project area**

During the 1980s, PHRI began investigations of the entire *makai* portion of Kohanaiki Ahupua'a, bounded by its boundaries with 'O'oma 2 and Kaloko, and by the Pacific Ocean and the Māmalahoa Trail. During an inventory survey in 1986 (Donham 1986), "14 previously recorded sites were relocated and 91 sites were newly identified...Habitation sites represented over half of the identified site total, and included habitation complexes, habitation/ceremonial and/or habitation/burial complexes, and temporary habitation sites" (Donham 1986:7-8). In 1991, PHRI performed data recovery of the project area (O'Hare and Goodfellow 1992); this work included: "detailed recording of (a) 31 sites (224 features) previously recorded in the project area, and (b) seven sites newly recorded during the Phase II work" (O'Hare and Goodfellow 1992:ii). Summarizing Kohanaiki settlement pattern within the zones represented by the project area, the report notes:

> The data recovery work indicates that permanent habitation sites between Puhili and Wawahiwaa Points are concentrated in the coastal zone, near the shoreline. In the coastal area south of Wawahiwaa Point permanent habitation sites were near the shoreline and further inland. Temporary habitation sites were present in all areas of the coastal zone and in the barren rockland zones. The radiocarbon date ranges indicate that sites in the northern coastal zone might have been inhabited as early as AD 1020. Sites in the southern coastal zone may have been inhabited as early as AD 1370, and sites in the barren rockland zones may have been inhabited as early as AD 1180. In the barren rockland zones, use of the sites was terminated before the historic period, and in the coastal zone most of the sites were not used in the historic period [O'Hare and Goodfellow 1992:ii].

Cordy (1981) conducted a survey of the coastal area (up to 1/2 mile inland) of Kohanaiki in 1975; twelve sites were recorded including: pavings, platforms, enclosures and a trail. Eleven of the sites were interpreted as habitation constructs including sleeping houses, men's houses, special purpose, and a canoe house/men's house.

In 1983 Joseph Kennedy conducted a reconnaissance and subsequent intensive survey (1984) of a parcel that is within the present project area. The 1983 reconnaissance located and briefly described twenty-seven sites. These sites included 17 lava tubes, 3 *ahu* or cairns, 2 walls, 2 platforms, an enclosure, a modified outcrop, and a trail. The 1984 intensive survey identified:

> 45 separate cave openings and approximately 200 chambers in these caves. In addition there were 4 walls recorded, 5 enclosures, 13 platforms, 9 *ahu*, 2 trails and 2 sets of petroglyphs. Out of the 79 separate features on the property, 30 were judged to be worthy of re-investigation ... the remaining 49 sites that were not reinvestigated were comprised almost exclusively of relatively shallow caves with little or no evidence of cultural remains or associated modifications [Kennedy 1984:18].

Many (but not all) of the sites identified in 1984 are described and some of these sites were not mapped. Excavations were carried out in three caves (Sites 11, 22 and 49 in the Kennedy 1984 numbering system). Of the twenty-five sites for which information is presented in the Kennedy 1984 study, twenty-two sites are recommended for no further work and three (Kennedy 1984 site #s 11, 22 & 32) are recommended for preservation.

In 1985, Barrera (1985) surveyed approximately 409 acres within Kaloko and Kohanaiki *ahupua'a*; the 409-acre parcel is located between Māmalahoa Highway and Queen Ka'ahumanu

Highway, just *mauka* of the present project area. Four sites were recorded in Kaloko, including an enclosure, a lava tube cave, a wall and a platform (possible burial). Fifty-five sites were recorded within Kohanaiki and include mounds, platforms, habitation complexes, walls, and terraces. A portion of the study area included the historic period Kohanaiki Homestead. Barrera's site #59 comprises constructions associated with the homestead and is described as a "series of Habitation areas enclosed by large stone walls." No estimate is given of the ages of the other fifty-eight sites.

In 1987, Paul H. Rosendahl Inc. accomplished an archaeological reconnaissance survey of three one-acre parcels - proposed water tank sites - in Kaloko (TMK: 7-3-09:Por.1,17) (Rosendahl and Haun 1987), along the south side of the then "main access road between Queen Ka'ahumanu Highway and Kona Heavens Subdivision" - i.e. the present Hina-Lani Street. The parcels were located at 350 ft. above mean sea level (A.M.S.L.), 630 ft. A.M.S.L., and 910 ft. A.M.S.L. Only one site (State site 10-28-10887) - an historic wall interpreted as a boundary or cattle wall - was recorded within the *mauka*-most parcel. Subsequently, in 1989, an additional water tank site parcel (TMK: 3-7-3-10:Por.17) - measuring 360 ft. north/south and east/west - was subject of an archaeological inventory survey (Rosendahl 1989). The parcel bordered the north side of the then "proposed Kamanu Street extension in the Kaloko Light Industrial Park" at the south boundary along Hina-Lani Road. One site was recorded and designated state site 50-10-27-13493:

> a steppingstone trail segment measuring 7.5 m (24.6 ft.) long (E-W) by 0.6-0.7 m wide (1.97-2.30 ft.) (N-S)...located on a section of aa lava...The segment consists of approximately six flat and roughly round pahoehoe slab steppingstones set on worn aa gravel. The steppingstones measure c. 0.4 m (1.31 ft.) in diameter by 0.1 m (0.33 ft.) thick. The trail is oriented c. 159 degrees Az. (magnetic). No portable remains were present in association with the trail. The trail appears to be prehistoric, and appears to have been used as a secondary transportation route [Rosendahl 1989:1].

In 1988, Cordy et al. (1991) began preparing a study of Kaloko *ahupua'a* for the new Kaloko-Honokōhau National Park. The study was based on Renger's 1971 fieldwork conducted for planned development of coastal Kaloko for Huehue Ranch. The fieldwork "included survey work in the intermediate and upland zones of Kaloko, which located additional sites, extensive excavation in the coastal area, and some excavation in the intermediate and upland sites" (Cordy et al. 1991:2). Renger identified, and in some cases re-identified, 94 sites that included 59 in the Coastal Zone, 30 in the Middle Zone, and five *mauka/makai* trails that crossed both zones and continued heading inland. As only "summary papers" had been previously written, the monograph published in 1991 includes the 1971 fieldwork data and resultant analyses, plus fieldwork conducted by Cordy and Hitchcock in the 1970s and 1980s (Cordy et al. 1991:2, 44).

In 1989 Margaret Rosendahl conducted an archaeological inventory survey of a 200 ft.-wide corridor along the boundary separating O'oma 2 and Kohanaiki, north of the project area, for a water system. Survey results included the identification of four sites that included quarrying pits, a ceremonial/habitation complex, a marker, and a historic wall. The wall, Site -5699, ran along "the inland boundary of the survey corridor" (Rosendahl, M 1989:13). During the current survey, 15 m of the wall's south end extends within the project area, and continues roughly north for at least 500 m. The rubble-fill method of construction indicates the wall is historic. No further work was originally recommended, although possible inclusion into landscaping was suggested for consideration (Rosendahl 1989:14).

In 1991, Archaeological Consultants of Hawaii (Kennedy 1991) performed a reconnaissance survey of a narrow corridor - 500 ft. north/south by 7260 ft. *mauka/makai* (TMK: 7-3-09:15) - in Kohanaiki extending *mauka* from Queen Ka'ahumanu Highway, located adjacent to the southern boundary of the present study area. No sites or features were observed; seven caves "were examined to term and were determined to be devoid of cultural materials" (Kennedy 1991:C-1).

In 1991 William Barrera produced an archaeological inventory survey and data recovery report of an extensive area just inland (*mauka*/east) of the present study area in which he identified 61 sites. These sites were rather clumped in the east central portion of his project area.

In 1991 Drolet and Schilz conducted an archaeological inventory survey of 8.8 acres in O'oma 2, north of and adjacent to the current project area. Survey findings included the identification of 29 sites including two cave complexes, site -16103 and -16104, that extend into the current project area. Nelson et al. (2006:66) found that the two caves connect and actually consist of one subsurface complex. They referred to the sites as -16103. Drolet and Schilz (1991:27-28) determined that the sites were significant and their project, as planned, would avoid the sites and provide a "10 meter buffer zone" around them. Nelson et al. (2006:66) describe the site as contaning "several architectural modifications, a plethora of cultural debris, and a single human burial." They determined that "site 16103 retains integrity of location and is in good condition for an archaeological ruin" (Nelson et al 2006:66). CSH only had access to this particular site description since the report is currently under review by SHPD.

Rosendahl and Walker (1991) carried out an Archaeological Field Inspection for proposed Kaloko Industrial crusher sites just south of Hina Lani Street at an elevation of approximately 450 ft. a.m.s.l. A trail and two associated cairns were identified.

In 1993, Paul H. Rosendahl Inc. conducted an inventory survey (Fager and Graves 1993) of an approximately 15-acre parcel adjacent to, and *mauka* of the Kaloko Industrial Park, which includes a road corridor extended from the main project area to Kamanu Street. The survey recorded 17 sites incorporating 60 component features. The sites were judged

> ...in poor to good condition and comprised the following formal types: terraces, modified outcrops, mounds, walls, caves, pahoehoe excavations, cairns, filled cracks, enclosures, and a trail. The formal types comprised the following functional types: animal husbandry, temporary habitation, agriculture, marker, quarry, and transportation [Fager and Graves 1993:ii].

In 1995, Cultural Surveys Hawai'i conducted an archaeological inventory survey with limited subsurface testing within a narrow strip of land, averaging 300 ft wide, along Queen Ka'ahumanu Highway between Palani Road and the Keāhole Airport entrance road (Walsh and Hammatt 1995). Three sites were identified in Kohanaiki: two trails and a set of three cairns. One of the trails - a *mauka-makai* trail - had been previously identified and designated Site 50-10-27-15324. The site is described as consisting of:

> ...two converging trail segments designated Features A and B...Both trail segments extend in a roughly mauka-makai direction, but angle toward each other and converge into one trail that continues inland. The point where the two trails meet is located at the edge of the bulldozed portion of the present highway right of way, 164 feet (50 m.) from the makai edge of the highway pavement...On the mauka side of the highway, the trail was observed at the edge of the bulldozed portion of the

> powerline (the new right-of-way boundary) and continuing inland at 65 degrees T.N. for at least another 100 feet (30 m.) [Walsh and Hammatt 1995:51].

In 1996, Cultural Surveys Hawai'i conducted an archaeological inventory survey (Colin et al. 1996) with limited subsurface testing within a 224.43-acre project site (TMK [3] 7-3-09: 017) for Kimura International. Fifty-five (55) sites were identified within the project area. All identified sites were of pre-Contact traditional Hawaiian origin and included the following site types: *ahu* (rock cairn) simple agricultural features, recurrent and temporary habitation sites, trails, enclosures, walls, and a quarry. The Colin et al. 1996 report was reviewed by the State Historic Preservation Division twice (8/15/1996 and 4/7/1997), however, during the review process the project was terminated; project funding stopped and final revisions to the report were not completed. Thus the Colin et al. report (1996) was never accepted by SHPD. An update for this report is currently in the process of being re-submitted to SHPD after recent re-survey; this updated reported comprises the TMK 17 portion of the current CSH Kaloko Makai (Kohan 1) project.

A series of studies (Haun & Henry 2000, 2002, Haun et al. 2003) were carried out on a 102-acre Kaloko Industrial Park parcel *makai* of the present project area on the south side of Hina-Lani Street. Of note is the fairly dense and widely distributed site concentration and also extensive areas of both *'a'ā* flow and bulldozing that are shown as widening as they approach the present study area adjacent to the east. Also of note is the jeep road in their project area labeled "Huehue Ranch Road", which continues into the current project area. This is likely the road that was cut around 1955 by Huehue Ranch during construction of the Kailua pier.

In recent years a number of studies have been undertaken in the Kaloko Mauka lands (east and upslope from the present project area) including studies by Barrera Jr. (1993), Nees & Williams (1995), Rechtman (1998), Rechtman and Henry (1999), Rosendahl (2000), Clark & Rechtman (2002), Rechtman and Rivera (2002), Puette & Dye (2003), Rechtman (2003), and Elmore et al. (2004).

In 2003, Archaeological Consultants of the Pacific, Inc. (Cobb et al. 2003) conducted an archaeological assessment of TMK (3) 7-3-009: 025, 026, and 028. One hundred fifty-four (154) features were identified and included "caves, walls, mounds, platforms, enclosures, trails, *cairn*, "C"-shaped structures, possible *heiau*, terraces, alignments and modified outcrops" (Cobb et al. 2003:1). Each feature was identified with a number prefaced with "TF", and descriptions included feature type, a brief description, possible function and a preliminary significance evaluation. The report map does not show the location of particular sites found during the survey but has colored points for sites indicating "High Concern, Potential High Concern, and Minimal Concern" (Cobb et al. 2003:5). The current project area was included in the survey and several site tags from the 2003 survey were found in sites recorded during the current project.

Haun (2003) also did an archaeological assessment of a portion of the current project area, largely via helicopter to cover the *'a'ā* terrain, but also by foot in the thicker vegetation. He identified eight sites, all of which correlate to sites documented in the current Kaloko Makai inventory survey report for TMK 28.

In 2005 Wolforth et al. conducted an archaeological inventory survey of the northern portion of the Kaloko Heights Project (TMK [3] 7-3-09: 032), located immediately east of the current project area. A total of 89 sites were identified, consisting of burials, permanent habitations, temporary habitations, religious sites, trails, boundary walls, and agricultural sites. A historic

wall that runs along the *ahupua'a* boundary between Kaloko and Kohanaiki extends from TMK 32 into TMK 25.

In 2005 CSH completed an archaeological field inspection of a 1200+ acre project area in Kaloko and Kohanaiki [TMK (3) 7-3-009:017, 025, 026, and 028] that included the current project area. Numerous pre-contact sites including, habitations, agricultural features, petroglyphs, boundary walls, and burials were observed (Shideler & Hammatt 2005).

RESULTS OF ARCHAEOLOGICAL INVENTORY SURVEY

A total of 341 archaeological sites were identified in the course of the archaeological inventory survey work (59 sites in TMK 17, 121 sites in TMK 25, 120 sites in TMK 26 and 41sites in TMK 28; see Figure 6). Site density for each parcel by acre is summarized in Table 2. Summaries of these sites are presented for each tax map key parcel in the following Table 3 through Table 8. An overview of the formal feature types, functional categories, and significance criteria is presented below followed by a summary discussion of the finds.

Table 2. Site density by parcel and acreage

	Acreage	# of Sites	Sites/Acre
TMK 17	224.43	59	0.26
TMK 25	360.131	121	0.34
TMK 26	194.324	120	0.62
TMK 28	363.106	41	0.11
Total	**1141.991**	**341**	**0.33**

Formal Feature Types

Formal feature type designations are descriptive - based on physical characteristics - and commonly refer to structural elements of a site. Fifteen primary feature types were identified within the project area. The following are brief descriptions of the different feature types encountered during the inventory survey:

Alignment: A single row of stones one courses high.
Cairn: A marker of stacked or piled stones. Cairns are frequently referred to as *ahu*.
Enclosure: A walled structure that completely encloses an area.
Lava blister: A small subterranean lava formation. Unlike lava tubes, however, they tend to be circular and do not extend in any direction for a great length.
Lava tube: Modifications or apparent usage of a subterranean lava formation characteristic of *pāhoehoe* lava flows.
Modified depression: An area in which stones have been removed to create a depression or to expose a soil area. Two types of modified depressions were encountered, one type (encountered on a lava flow) appears to have functioned as a storage area and the second type in which the only modification consists of the removal of stones to create an area suitable for agriculture either in soil or possibly through mulching.
Modified outcrop: An area within an existing lava flow in which a portion of the flow has been humanly modified by the placement or removal of stones (a modified tumulus differs from a modified outcrop in that a modified tumulus is in a field of exposed outcrop whereas a modified outcrop may be surrounded by soil).
Mound: Linear, circular or amorphous stone pile which typically lacks a vertical face and level surface.
Pavement: A stone-filled floor or surface.
Platform: A raised free-standing stone structure with three or more vertical faces.

Rock art: A carving or inscription on a boulder, cobble, or slab.
Terrace: A raised stone construction partially built against, or level to, a ground or outcrop surface. These structures commonly resemble platforms. Unlike platforms, however, they are not totally free-standing.
Trail: A trodden lava surface, pavement or stone alignment set into the ground or outcrop surface.
Wall: A bi-faced and free-standing stone structure which is an isolated segment or defines large boundaries.

Function Interpretation

Function interpretation of a site or feature is determined by criteria which included: site construction and complexity; locational context (association with other sites and/or geological determinates); analysis of cultural remains (surface and subsurface); and external correlations with other archaeological sites in Hawai'i. Ten primary function categories were identified among the sites within the project area: agriculture; animal husbandry; habitation; human burial, ceremonial; indeterminate; marker; mining (quarrying) and storage (activity areas); rock art, transportation; and water collection (activity area). The following are brief descriptions of the different function types commonly encountered in this general area:

Activity area: The feature represents the extent of space serving a special function, or the scope of a specific activity; this category may include lithic production, water collection, storage, fishhook manufacture, quarrying or mining, etc.
Agriculture: Primary function is for farming, horticulture, or subsistence planting.
Animal husbandry: The feature is associated with the care of livestock.
Burial: Used for the interment of human skeletal remains. This functional category is also used for human remains found out of primary context.
Ceremonial: Used for ritual or religious purposes.
Fireplace: Burn pit or lens of burned material in a limited area.
Habitation: A place for living, which may be either temporary or permanent habitation. Habitation sites are generally distinguished from shelters by an increased energy investment in modification and formal construction.
Marker: A point visibly marked for the purpose of identifying a point on a line on the surface of the earth such as a boundary or trail.
Rock art: Petroglyphs and pictographs are functionally rock art.
Transportation: The feature was used as a road or trail.

Significance Assessments

Sites were evaluated for significance according to the broad criteria established for the State Register. The five criteria are:

A Site reflects major trends or events in the history of the state or nation.
B Site is associated with the lives of persons significant in our past.
C Site is an excellent example of a site type.
D Site may be likely to yield information important in prehistory or history.
E Site has cultural significance; probable religious structures (shrines, heiau) and/or burials present.

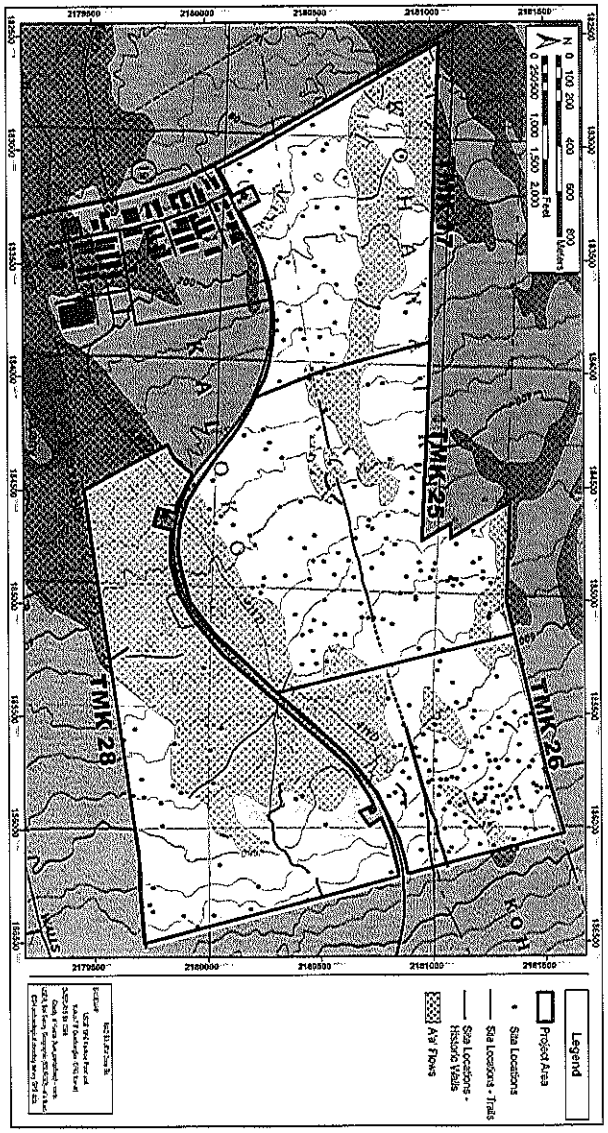

Figure 6. Historic properties location map for Kaloko Makai project area

SIHP No. 50-10-27-	Site Type	Function	Significance	Age	Mitigation Recommendation
20715	Terrace	Temporary habitation	D	Pre-Contact	Data Recovery
20716	Modified tumulus	Possible Burial	D,E*	Pre-Contact	Preservation
20717	Modified tumulus	Temporary habitation	D	Pre-Contact	No Further Work
20718	Modified tumulus	Agriculture	D	Pre-Contact	No Further Work
20719	Rock shelter / Hearth	Temporary habitation	D	Pre-Contact	Data Recovery
20720	Terrace	Possible Burial (destroyed)	D,E*	Pre-Contact	No Further Work
20721	Modified tumulus	Temporary habitation	D	Pre-Contact	Data Recovery
20722	Trail	Transportation	D	Pre-Contact	No Further Work
20724	Trail	Transportation	D	Pre-Contact	No Further Work
20725	Modified tumulus	Temporary habitation	D	Pre-Contact	Data Recovery
20726	Trail	Transportation	D	Pre-Contact	No Further Work
20727	Lava tube	Temporary habitation	D	Pre-Contact	Data Recovery
20728	Enclosure	Temporary habitation	D	Pre-Contact	No Further Work
20729	See -15329	N/A	N/A	N/A	No Further Work
20730	Modified tumulus	Temporary habitation	D	Pre-Contact	Data Recovery
20731	Modified tumulus	Indeterminate	D	Pre-Contact	No Further Work
20732	Trail	Transportation	D	Pre-Contact	No Further Work
20733	Trail	Transportation	D	Pre-Contact	No Further Work
20734	Modified depression	Agriculture	D	Pre-Contact	No Further Work
20735	See -15325	N/A	N/A	N/A	No Further Work
20736	Trail	Transportation	D	Pre-Contact	No Further Work
20737	Trail	Transportation	D	Pre-Contact	No Further Work
20738	Enclosure	Agriculture	D	Pre-Contact	No Further Work
20739	Enclosure / Trail	Transportation	D	Pre-Contact	No Further Work
20740	Modified tumulus	Agriculture	D	Pre-Contact	No Further Work
20742	Lava tube	Temporary habitation	D	Pre-Contact	No Further Work
20743	Modified tumulus	Indeterminate	D	Pre-Contact	No Further Work
20744	Trail	Transportation	D	Pre-Contact	No Further Work
20745	Trail	Transportation	D	Pre-Contact	No Further Work
20746	Lava tube	Temporary Habitation	D	Pre-Contact	No Further Work

Table 3. Archaeological Site Summary for TMK Parcel 17

SIHP No. 50-10-27-	Site Type	Function	Significance	Age	Mitigation Recommendation
13493	Trail	Transportation	D	Pre-Contact	No Further Work
15324	Trail	Transportation	D, E*	Pre-Contact	No Further Work
15325	Wall, modified depressions, mound	Temporary habitation / Transportation / Storage	D	Pre-Contact	Data Recovery
15329	Modified tumulus	Temporary habitation	D	Pre-Contact	No Further Work
20696	Lava tube	Temporary habitation	D	Pre-Contact	No Further Work
20697	Modified tumulus	Temporary habitation	D	Pre-Contact	Data Recovery
20698	Pavements	Temporary habitation	D	Pre-Contact	Data Recovery
20699	Modified tumulus	Indeterminate	D	Pre-Contact	No Further Work
20700	Modified tumulus, Enclosure	Temporary habitation / Agriculture	D	Pre-Contact	Data Recovery
20701	Modified tumulus	Temporary habitation	D	Pre-Contact	No Further Work
20702	Mod. tumulus/terrace	Temporary habitation	D	Pre-Contact	Data Recovery
20703	Terrace, Pavement, Modified tumulus	Temporary habitation / Mining	D	Pre-Contact	Data Recovery
20704	Trails, walls	Temporary habitation / Transportation	D	Pre-Contact	No Further Work
20705	Modified tumulus	Possible burial	D, E*	Pre-Contact	Preservation
20706†	Modified tumulus	Temporary habitation	D	Pre-Contact	No Further Work
20707	Lava tube	Temporary habitation	D	Pre-Contact	No Further Work
20708	Modified tumulus	Temporary habitation	D	Pre-Contact	Data Recovery
20709	Platform, enclosures, modified lava blister	Recurrent habitation / Agriculture / Storage	C,D	Pre-Contact	Preservation
20710	Lava tube, Alignment, Mound, Modified tumulus, Pavement	Temporary habitation	D	Pre-Contact	Data Recovery
20711	Enclosure	Temporary habitation	D	Pre-Contact	Data Recovery
20712	C-shape	Temporary habitation	D	Pre-Contact	No Further Work
20713	Cairn	Marker	D	Pre-Contact	No Further Work
20714	Wall	Temporary habitation	D	Pre-Contact	No Further Work

Table 4. Archaeological Site Summary for TMK Parcel 25

SIHP No. 50-10-27-	Site Type	Function	Significance	Age	Mitigation Recommendations
10712	Wall	Animal Husbandry	D	Historic	Preservation
20741	Complex	Temporary Habitation	C, D	Pre-Contact	Preservation
26275	Complex	Ceremonial	C, D, E	Pre-Contact	Preservation
26276	Modified depression	Temporary Habitation	D	Pre-Contact	No Further Work
26277	Complex	Temporary Habitation	D	Pre-Contact	Data recovery
26278	Trail	Transportation	D	Pre-Contact	No Further Work
26279	Modified outcrop	Indeterminate	D	Pre-Contact	No Further Work
26280	Lava blister	Temporary Habitation	D	Pre-Contact	No Further Work
26281	Mounds	Agriculture	D	Pre-Contact	No Further Work
26282	Lava blister	Temporary Habitation	D	Pre-Contact	No Further Work
26283	Enclosure	Temporary Habitation	D	Pre-Contact	No Further Work
26284	Complex	Permanent Habitation	C, D	Pre-Contact	Preservation
26285	Enclosure	Temporary Habitation	D	Pre-Contact	No Further Work
26286	Modified outcrop	Quarry	D	Pre-Contact	No Further Work
26287	Lava tube	Temporary Habitation	D	Pre-Contact	No Further Work
26288	Complex	Temporary Habitation	C, D	Pre-Contact	Preservation
26289	Lava tube	Temporary Habitation	D	Pre-Contact	Data recovery
26290	Lava tube	Burial	D, E*	Pre-Contact	Preservation
26291	Lava tube	Temporary Habitation/Quarry	D	Pre-Contact	Data Recovery
26292	Lava tube	Temporary Habitation	D	Pre-Contact	No Further Work
26293	Lava tube	Temporary Habitation	D	Pre-Contact	Data recovery
26294	Wall	Indeterminate	D	Pre-Contact/ Historic	No Further Work
26295	Cairn	Marker	D	Pre-Contact	No Further Work
26296	Enclosure	Permanent Habitation	C, D	Pre-Contact/ Historic	Preservation
26297	Lava tube	Temporary Habitation	D	Pre-Contact	Data recovery
26298	Platform	Temporary Habitation	D	Pre-Contact	No Further Work
26299	Lava tube	Temporary Habitation	D	Pre-Contact	No Further Work
26300	Lava tube	Temporary Habitation	D	Pre-Contact	Data recovery
26301	Terrace	Temporary Habitation	D	Pre-Contact	No Further Work

SIHP No. 50-10-27-	Site Type	Function	Significance	Age	Mitigation Recommendation
20747	Trail	Transportation	D	Pre-Contact	No Further Work
20748	Lava tube	Storage	D	Pre-Contact	No Further Work
20749	Lava tube, terrace	Temporary habitation	D	Pre-Contact	Data Recovery
26259	Trail	Transportation	D	Pre-Contact	No Further Work
26260	Lava tube	Temporary habitation	D	Pre-Contact	Data Recovery
26261	Terrace	Temporary habitation	D	Pre-Contact	Data Recovery
26262	C-shape	Temporary habitation	D	Pre-Contact	No Further Work
26263	Lava tube	Temporary habitation	D	Pre-Contact	Data Recovery
26264	Modified tumulus	Agriculture	D	Pre-Contact	No Further Work

* Site is a probable burial

† Site was found to be outside project area

SIHP No. 50-10-27-	Site Type	Function	Significance	Age	Mitigation Recommendations
26332	Enclosure	Temporary Habitation	D	Pre-Contact	No Further Work
26333	Lava tube	Temporary Habitation	D	Pre-Contact	No Further Work
26334	Complex	Temporary Habitation	D	Pre-Contact	Data recovery
26335	Enclosure	Permanent Habitation	D	Pre-Contact	No Further Work
26336	Trail	Transportation	D	Pre-Contact	No Further Work
26337	Complex	Temporary Habitation	D	Pre-Contact	Data recovery
26338	Lava tube	Temporary Habitation	D	Pre-Contact	No Further Work
26339	Lava tube	Temporary Habitation	D	Pre-Contact	No Further Work
26340	Trail	Transportation	D	Pre-Contact	No Further Work
26341	Lava tube	Temporary Habitation	D	Pre-Contact	Data recovery
26342	Lava tube	Temporary Habitation	D	Pre-Contact/ Historic	Data recovery
26343	Lava tube	Temporary Habitation	D	Pre-Contact	Data recovery
26344	Complex	Permanent Habitation	D	Pre-Contact	Data recovery
26345	Modified outcrop/ Lava tube	Quarry	D	Pre-Contact	No Further Work
26346	Trail	Transportation	D	Pre-Contact	No Further Work
26347	Lava tube	Temporary Habitation	D	Pre-Contact	Data recovery
26348	Complex	Permanent Habitation	C, D	Pre-Contact	Preserve
26349	Complex	Temporary Habitation	D	Pre-Contact	Data recovery
26350	Complex	Permanent Habitation	C, D	Pre-Contact	Preserve
26351	Lava blister	Temporary Habitation	D	Pre-Contact	No Further Work
26352	Cairn	Marker	D	Historic	No Further Work
26353	Trail	Transportation	D, E	Pre-Contact	Preserve
26354	Complex	Temporary Habitation	D	Pre-Contact	Data recovery
26355	Trail/Wall	Transportation	D	Pre-Contact/ Historic	No Further Work
26356	Lava blister	Temporary Habitation	D	Pre-Contact	No Further Work
26357	Lava tube	Temporary Habitation	D	Pre-Contact	No Further Work
26358	Unknown/Bulldozed	Habitation/Indeterminate	D	Pre-Contact	No Further Work
26359	Trail	Transportation	D	Pre-Contact	No Further Work
26360	Wall	Animal Husbandry	D	Historic	No Further Work

SIHP No. 50-10-27-	Site Type	Function	Significance	Age	Mitigation Recommendations
26302	Cairn	Marker	D	Pre-Contact	No Further Work
26303	Lava tube	Temporary Habitation	D	Pre-Contact	Data recovery
26304	Lava tube	Temporary Habitation	D	Pre-Contact	Data recovery
26305	Modified outcrop	Temporary Habitation	D	Pre-Contact	No Further Work
26306	Modified outcrop	Indeterminate	D	Pre-Contact	No Further Work
26307	Complex	Ceremonial	C, D, E	Pre-Contact	Preservation
26308	Enclosure	Temporary Habitation	D	Historic	No Further Work
26309	Complex	Temporary Habitation	D	Pre-Contact	No Further Work
26310	Lava tube	Temporary Habitation/Burial	D, E*	Pre-Contact	Preservation
26311	Lava tube	Burial	D, E*	Pre-Contact	Preservation
26312	Cairn	Marker	D	Pre-Contact	No Further Work
26313	Enclosure	Temporary Habitation	D	Pre-Contact	No Further Work
26314	Enclosure	Permanent Habitation	D	Pre-Contact	No Further Work
26315	Complex	Temporary Habitation	D	Pre-Contact	Data recovery
26316	Lava tube	Temporary Habitation	D	Pre-Contact	No Further Work
26317	Lava tube	Temporary Habitation/Quarry	D	Pre-Contact	No Further Work
26318	Lava tube	Temporary Habitation	D	Pre-Contact	Data recovery
26319	Lava tube	Activity Area	D	Pre-Contact	No Further Work
26320	Lava tube	Temporary Habitation	D	Pre-Contact	No Further Work
26321	Lava tube	Temporary Habitation	D	Pre-Contact	Data recovery
26322	Cairn	Marker	D	Pre-Contact	No Further Work
26323	Lava tube	Temporary Habitation	D	Pre-Contact	No Further Work
26324	Lava tube	Temporary Habitation	D, E**	Pre-Contact	Preserve
26325	Lava tube	Temporary Habitation	D	Pre-Contact	No Further Work
26326	Lava tube	Temporary Habitation	D	Pre-Contact	Data recovery
26327	Lava tube	Temporary Habitation	D	Pre-Contact	No Further Work
26328	Platform	Temporary Habitation	D	Pre-Contact	Data recovery
26329	Enclosure	Temporary Habitation	D	Pre-Contact	No Further Work
26330	Lava tube	Temporary Habitation	D	Pre-Contact	No Further Work
26331	Complex	Permanent Habitation	C, D	Pre-Contact	Preserve

SIHP No. 50-10-27-	Site Type	Function	Significance	Age	Mitigation Recommendations
26390	Lava Blister	Temporary Habitation	D	Pre-Contact	No Further Work
26391	Lava Tube	Temporary Habitation	D	Pre-Contact	No Further Work
26392	Mound	Agriculture	D	Pre-Contact	No Further Work
26393	Mound	Agriculture	D	Pre-Contact	No Further Work

* Site contains confirmed human remains

** Site contained human remains removed during a previous study (Kennedy 1983/1984)

SIHP No. 50-10-27-	Site Type	Function	Significance	Age	Mitigation Recommendations
26361	Trail	Transportation	D	Pre-Contact	No Further Work
26362	Lava tube	Burial	D, E*	Pre-Contact	Preserve
26363	Lava tube	Temporary Habitation	D	Pre-Contact	No Further Work
26364	Lava tube	Temporary Habitation	D, E	Pre-Contact	Preserve
26365	Lava tube	Temporary Habitation	D	Pre-Contact	Data recovery
26366	Wall	Animal Husbandry	D	Historic	No Further Work
26367	Enclosure	Animal Husbandry	D	Historic	No Further Work
26368	Trail	Transportation	D	Pre-Contact	No Further Work
26369	Trail	Transportation	D	Pre-Contact	No Further Work
26370	Lava tube	Temporary Habitation	D	Pre-Contact	No Further Work
26371	Trail	Transportation	D	Historic	No Further Work
26372	Trail	Transportation	D	Pre-Contact	No Further Work
26373	Lava tube	Temporary Habitation	D	Pre-Contact/ Historic	Data recovery
26374	Lava tube	Temporary Habitation	D	Pre-Contact	Data recovery
26375	Modified outcrop	Quarry	D	Pre-Contact	No Further Work
26376	Enclosure	Temporary Habitation	D	Pre-Contact	No Further Work
26377	Lava tube	Temporary Habitation	D	Pre-Contact	No Further Work
26378	Lava tube	Temporary Habitation	D	Pre-Contact	No Further Work
26379	Complex	Temporary Habitation/ Agriculture	D	Pre-Contact	Data recovery
26380	Lava tube	Temporary Habitation	D	Pre-Contact	Data recovery
26381	Enclosure	Permanent Habitation	C, D	Pre-Contact	Preserve
26382	Trail	Transportation	D	Pre-Contact	No Further Work
26383	Enclosure	Temporary Habitation	D	Pre-Contact	No Further Work
26384	Lava tube	Temporary Habitation	D	Pre-Contact	No Further Work
26385	Mounds	Temporary Habitation	D	Pre-Contact	No Further Work
26386	Modified outcrop	Activity Area	D	Pre-Contact	No Further Work
26387	Modified outcrop	Activity Area	D	Pre-Contact	No Further Work
26388	Lava tube	Temporary Habitation	D	Pre-Contact	Data recovery
26389	Enclosure	Permanent Habitation	D	Pre-Contact	Data recovery

SIHP No. 50-10-28-	Site Type	Function	Significance	Age	Mitigation Recommendations
26490	Lava tube	Shelter	D	Pre-Contact	No Further Work
26491	Platform	Permanent Habitation	D	Pre-Contact	No Further Work
26492	Lava tube	Water Collection	D	Pre-Contact	No Further Work
26493	Lava tube	Water Collection	D	Pre-Contact	No Further Work
26494	Complex	Permanent Habitation	D	Pre-Contact	Preservation
26495	Lava tube	Temporary Habitation	D	Pre-Contact	Preservation & Data Recovery
26496	Complex	Temporary Habitation	D	Pre-Contact	No Further Work
26497	Modified outcrop	Indeterminate	D	Pre-Contact	No Further Work
26498	Lava tube	Temporary Habitation & Burial	D, E	Pre-Contact	Preservation & Data Recovery
26499	Lava tube	Shelter	D	Pre-Contact	Data Recovery
26500	Lava tube	Temporary Habitation	D	Pre-Contact	Data Recovery
26501	Lava tube	Water Collection & Burial	D, E*	Pre-Contact	Preservation
26502	Complex	Permanent Habitation	D	Pre-Contact	Data Recovery
26503	Lava tube	Water Collection & Burial	D, E	Pre-Contact	Preservation
26504	Lava tube	Water Collection	D	Pre-Contact	No Further Work
26505	Lava tube	Water Collection	D	Pre-Contact	No Further Work
26506	Lava tube	Shelter	D	Pre-Contact	No Further Work
26507	Complex	Agriculture	D	Pre-Contact	Data Recovery
26508	Lava tube	Temporary Habitation	D	Pre-Contact	No Further Work
26509	Lava tube	Burial	D, E	Pre-Contact	Preservation
26510	Complex	Water Collection, Burial, & Ceremonial	D, E	Pre-Contact	Preservation & Data Recovery
26511	Lava tube	Shelter	D	Pre-Contact	No Further Work
26512	Lava tube	Shelter	D	Pre-Contact	No Further Work
26513	Complex	Temporary Habitation	D	Pre-Contact	Data Recovery
26514	Complex	Permanent Habitation	D	Pre-Contact	Data Recovery
26515	Platform & Cairns	Burial & Marker	D, E	Pre-Contact	Preservation
26516	Modified outcrop	Storage	D	Pre-Contact	No Further Work

Table 5. Archaeological Site Summary for TMK Parcel 26 (Keahole Pt. Quad)

SIHP No. 50-10-27-	Site Type	Function	Significance	Age	Mitigation Recommendations
10712	Wall	Animal Husbandry	D	Historic	Preservation
26418	Trail	Transportation	D	Pre-Contact	No Further Work
26475	Lava tube	Shelter	D	Pre-Contact	No Further Work
26476	Mound	Agriculture	D	Historic	No Further Work
26477	Lava tube	Shelter	D	Pre-Contact	No Further Work
26478	Complex	Temporary Habitation & Burial	D, E	Pre-Contact	Preservation & Data Recovery
26479	Enclosure	Permanent Habitation	D	Pre-Contact	No Further Work
26480	Lava tube	Shelter & Burial	D, E	Pre-Contact	Preservation
26481	Lava tube	Temporary Habitation	D	Pre-Contact	No Further Work
26482	Lava tube	Water Collection	D	Pre-Contact	Data Recovery
26483	Lava tube	Water Collection	D	Pre-Contact	Data Recovery
26484	Lava tube	Water Collection	D	Pre-Contact	No Further Work
26485	Lava tube	Permanent Habitation	D	Pre-Contact	Data Recovery

Table 6. Archaeological Site Summary for TMK Parcel 26 (Kailua Quad)

SIHP No. 50-10-28-	Site Type	Function	Significance	Age	Mitigation Recommendations
5699	Wall	Animal Husbandry	D	Historic	No Further Work
6601	Complex	Agriculture	D	Pre-Contact	Data Recovery
10714	Trail	Transportation	D, E	Pre-Contact/ Historic	Preservation
16103	Lava tube	Permanent Habitation & Burial	D, E	Pre-Contact	Preservation & Data Recovery
26486	Complex	Permanent Habitation	D	Pre-Contact	Preservation
26487	Enclosure	Permanent Habitation	D	Pre-Contact	No Further Work
26488	Lava tube	Burial	D, E	Pre-Contact	Preservation
26489	Complex	Permanent Habitation	D, E	Pre-Contact	Preservation

SIHP No. 50-10-28-	Site Type	Function	Significance	Age	Mitigation Recommendations
26543	Wall	Marker	D	Pre-Contact	No Further Work
26544	Enclosure	Permanent Habitation	C, D	Pre-Contact	Preservation
26545	Lava tube	Activity Area	D	Pre-Contact	Data Recovery
26546	Lava tube	Water Collection	D	Pre-Contact	Data Recovery
26547	Lava tube	Burial	D, E	Pre-Contact	Preservation
26548	Lava tube	Temporary Habitation	D	Pre-Contact	Data Recovery
26549	Terrace	Agriculture	D	Pre-Contact	No Further Work
26550	Lava tube	Temporary Habitation	D	Pre-Contact	No Further Work
26551	Modified outcrop	Quarrying	D	Pre-Contact	No Further Work
26552	Complex	Permanent Habitation	D	Pre-Contact	Data Recovery
26553	Lava tube	Temporary Habitation	D	Pre-Contact	No Further Work
26554	Lava tube	Water Collection	D	Pre-Contact	No Further Work
26555	Lava tube	Shelter	D	Pre-Contact	No Further Work
26556	Platform	Burial	D, E	Pre-Contact	Preservation
26557	Lava tube	Water Collection	D	Pre-Contact	No Further Work
26558	Platform	Permanent Habitation	D	Pre-Contact	Data Recovery
26559	Platform	Burial	D, E	Pre-Contact	Preservation
26560	Trail	Transportation	D, E	Pre-Contact	No Further Work
26561	Cairn	Marker	D	Pre-Contact	No Further Work
26562	Complex	Permanent Habitation & Burial	D, E	Pre-Contact	Preservation
26563	Lava tube	Water Collection	D	Pre-Contact	No Further Work
26564	Lava tube	Burial	D, E	Pre-Contact	Preservation
26565	Complex	Permanent Habitation	D	Pre-Contact	Data Recovery
26566	Lava tube	Water Collection	D	Pre-Contact	Data Recovery
26567	Mound	Agriculture	D	Pre-Contact	No Further Work
26568	Lava tube	Water Collection & Burial	D, E	Pre-Contact	Preservation
26569	Lava tube	Water Collection & Burial	D, E	Pre-Contact	Preservation
26570	Lava tube	Water Collection & Burial	D, E	Pre-Contact/ Historic	Preservation
26571	Cairn	Marker	D	Pre-Contact	No Further Work

SIHP No. 50-10-28-	Site Type	Function	Significance	Age	Mitigation Recommendations
26517	Lava tube	Water Collection	D	Pre-Contact	No Further Work
26518	Enclosure	Permanent Habitation	D	Pre-Contact	No Further Work
26519	Complex	Permanent Habitation	C, D, E	Pre-Contact	Preservation
26520	Lava tube	Burial, Ceremonial, & Animal Husbandry	D, E	Pre-Contact/ Historic	Preservation & Data Recovery
26521	Lava tube	Shelter	D	Pre-Contact	Data Recovery
26522	Lava tube	Burial & Water Collection	D, E	Pre-Contact/ Historic	Preservation & Data Recovery
26523	Platform	Temporary Habitation	D	Pre-Contact	No Further Work
26524	Lava tube	Shelter	D	Pre-Contact	No Further Work
26525	Lava tube	Shelter	D	Pre-Contact	No Further Work
26526	Cairn	Marker	D	Pre-Contact	No Further Work
26527	Lava tube	Temporary Habitation	D	Pre-Contact	Data Recovery
26528	Lava tube	Water Collection	D	Pre-Contact	Data Recovery
26529	Lava tube	Water Collection & Burial	D, E	Pre-Contact	Preservation
26530	Platform	Temporary Habitation	D	Pre-Contact	No Further Work
26531	Enclosure	Agriculture	D	Pre-Contact	No Further Work
26532	Lava tube	Temporary Habitation & Burial	D, E	Pre-Contact	Preservation
26533	Platform	Agriculture	D	Pre-Contact	No Further Work
26534	Complex	Permanent Habitation	C, D	Historic	Preservation
26535	Platform	Permanent Habitation	D	Pre-Contact	No Further Work
26536	Wall	Animal Husbandry	D	Historic	No Further Work
26537	Lava tube	Water Collection	D	Pre-Contact	No Further Work
26538	Lava tube	Temporary Habitation & Burial	D, E	Pre-Contact	Preservation & Data Recovery
26539	Complex	Temporary Habitation	D	Pre-Contact	No Further Work
26540	Cairn	Marker	D	Pre-Contact	No Further Work
26541	Cairn	Marker	D	Pre-Contact	No Further Work
26542	Platform	Temporary Habitation	D	Pre-Contact	No Further Work

Table 7. Archaeological Site Summary for TMK Parcel 28 (Keahole Pt. Quad)

SIHP No. 50-10-27-	Site Type	Function	Significance	Age	Mitigation Recommendations
26371	Trail	Transportation	D	Historic	Preserve
26414	Wall	Animal Husbandry	D	Historic	Preserve
26415	Trail	Transportation	D	Pre-Contact	No Further Work
26416	Lava Tube	Burial	D, E	Pre-Contact	Preserve

Table 8. Archaeological Site Summary for TMK Parcel 28 (Kailua Quad)

SIHP No. 50-10-28-	Site Type	Function	Significance	Age	Mitigation Recommendations
26417	Mounds/Modified Depressions	Agriculture	D	Pre-Contact	No Further Work
26418	Trail	Transportation	C, D	Pre-Contact	Preserve
26419	Trail	Transportation	D	Pre-Contact	No Further Work
26420	Lava Tube	Activity Area	D	Pre-Contact	No Further Work
26421	Lava Tube	Temporary Habitation	D	Pre-Contact	No Further Work
26422	Trail	Transportation	D	Pre-Contact	No Further Work
26423	Lava Tube/ Modified Tumulus	Burial	D, E	Pre-Contact	Preserve
26424	Enclosure	Ceremonial	C, D, E	Pre-Contact	Preserve
26425	Lava Tube/ Modified Tumulus	Temporary Habitation/ Burial	D, E	Pre-Contact	Preserve & Data Recovery
26426	Modified Tumulus	Marker	D	Historic	No Further Work
26427	Lava Tube	Burial	D, E	Pre-Contact	Preserve
26428	Platform	Permanent Habitation	D	Pre-Contact	Data Recovery
26429	Modified Tumulus	Activity Area	D	Pre-Contact	No Further Work
26430	Modified Tumulus/ Platform/Terrace	Temporary Habitation	D	Pre-Contact	Data Recovery
26431	Lava Tube	Activity Area	D	Pre-Contact	Data Recovery

SIHP No. 50-10-28-	Site Type	Function	Significance	Age	Mitigation Recommendations
26572	Complex	Agriculture	D, E	Pre-Contact	No Further Work
26573	Lava tube	Temporary Habitation	D	Pre-Contact	Data Recovery
26574	Complex	Permanent Habitation	D, E	Pre-Contact	Preservation
26575	Lava tube	Water Collection	D	Pre-Contact	No Further Work
26576	Lava tube	Burial & Shelter	D, E	Pre-Contact	Preservation
26577	Mound	Permanent Habitation	D	Pre-Contact	Data Recovery
26578	Lava tube	Shelter	D	Pre-Contact	Data Recovery
26579	Cairn	Marker	D	Pre-Contact	No Further Work
26580	Enclosure	Permanent Habitation	D	Pre-Contact	Preservation
26581	Lava tube	Temporary Habitation	D	Pre-Contact	Data Recovery
26582	Lava tube	Burial	D, E	Pre-Contact	Preservation
26583	Complex	Permanent Habitation & Ceremonial	C, D, E	Pre-Contact	Preservation
26584	Complex	Transportation	D	Pre-Contact	No Further Work
26585	Complex	Agriculture & Temporary Habitation	D	Pre-Contact	No Further Work
26586	Cairn	Marker	D	Pre-Contact	No Further Work
26587	Platform	Agriculture	D	Pre-Contact	No Further Work
26588	Enclosure	Permanent Habitation	C, D	Pre-Contact	Preservation

* Site is a probable burial

SIHP No. 50-10-28-	Site Type	Function	Significance	Age	Mitigation Recommendations
26432	Wall	Animal Husbandry	D	Historic	No Further Work
26433	Trail	Transportation	D	Pre-Contact	No Further Work
26434	Lava Tube	Temporary Habitation	D	Pre-Contact	Data Recovery
26435	Wall	Animal Husbandry	D	Historic	No Further Work
26436	Wall/Cairn	Animal Husbandry	D	Historic	No Further Work
26437	Cairn	Marker/Animal Husbandry	D	Historic	No Further Work
26438	Lava Tube	Temporary Habitation/ Burial	D, E	Pre-Contact	Preserve & Data Recovery
26439	Lava Tube	Temp. Habitation	D	Pre-Contact	Data Recovery
26440	Lava Tube	Temporary Habitation/ Burial*	D, E	Pre-Contact	Preserve
26441	Lava Tube	Activity Area	D	Pre-Contact	No Further Work
26442	Wall	Animal Husbandry	D	Historic	No Further Work
26443	Enclosure	Permanent Habitation	D	Pre-Contact	Preserve
26444	Wall	Animal Husbandry	D	Historic	No Further Work
26445	Modified Tumulus	Temporary Habitation	D	Pre-Contact	Data Recovery
26446	Lava Tube	Temporary Habitation	D	Pre-Contact	Data Recovery
26447	Lava Tube	Temporary Habitation	D	Pre-Contact	No Further Work
26448	Modified Tumulus	Temporary Habitation	D	Pre-Contact	No Further Work
26449	Lava Tube	Temporary Habitation	D	Pre-Contact	Data Recovery
26450	Wall	Animal Husbandry	D	Historic	No Further Work
26451	Modified Tumulus	Temporary Habitation	D	Pre-Contact	No Further Work
26452	Lava Tube	Activity Area**	D, E	Pre-Contact	Preserve & Data Recovery
26453	Platform	Burial*	D, E	Pre-Contact	Preserve

* Site is a probable burial

** Site contains burials located outside of the project area

Summary of Feature Types and Site Function

Table 9 tallies the total occurrences of these formal feature types in the Kaloko Makai project area by parcel. There are a total of 658 features in the project area at 341 sites. Lava tubes are the most common feature type, and are particularly dense in TMK 26. Other common feature types include modified outcrops, enclosures, platforms, walls and trails. The majority of these feature types in the project area predominantly represent a pre-contact style of land use. Walls are an exception to this pattern as many are related to post-contact animal husbandry, including the landmark *ahupua'a* wall running through much of the project area. Other post-contact sites are relatively few, but include burials, trails and at least one enclosure as a post-contact habitation.

Percentages of functional categories are summarized in Table 10. These percentages represent the primary functional types for each site. Since some sites have multiple primary functions (i.e. a site may have both a habitation component as well as being a burial location), only overall percentages are given rather than total counts, as more than one functional category may be counted for a single site. Habitation is by far the most common function for sites within the project area, with permanent habitation increasing in the *mauka* parcel (TMK 26). Burial is also a common function, especially in TMK 26. Temporary habitation and trails are more common in the *makai* parcels.

Table 9. Summary Occurrences of Formal Feature Types (Total number of features: 658)

Feature Type	TMK 17		TMK 25		TMK 26		TMK 28		All TMKs	
	No.	%	No.	%	No.	%	No.	%	No.	%
Alignment	1	1	3	1.4	2	0.7	0	0	6	0.9
Cairn	1	1	8	3.6	17	6.1	2	3.3	28	4.3
Cupboard	2	2	0	0	0	0.0	0	0	2	0.3
Enclosure	12	12.1	31	14	19	6.9	2	3.3	64	9.7
Hearth	1	1	0	0	1	0.4	0	0	2	0.3
Lava blister	1	1	5	2.3	2	0.7	0	0	8	1.2
Lava tube	10	10.1	80	36.2	70	25.3	17	27.9	177	26.9
Modified depression	2	2	9	4.1	4	1.4	4	6.6	19	2.9
Modified outcrop	26	26.3	14	6.3	16	5.8	9	14.7	65	9.9
Mound*	3	3	8	3.6	26	9.4	4	6.6	41	6.2
Pavement	7	7.1	6	2.7	5	1.8	0	0	18	2.7
Platform	2	2	8	3.6	44	15.9	5	8.2	59	9.0
Rock art	0	0	2	0.9	4	1.4	0	0	6	0.9
Rock shelter	1	1	0	0	0	0.0	0	0	1	0.2
Terrace	7	7.1	13	5.9	23	8.3	3	4.9	46	7.0
Trail	21	21.2	17	7.7	12	4.3	7	11.5	57	8.7
Wall	2	2	17	7.7	32	11.6	8	13.1	59	9.0
Total # of Features (% of total features)	**99 (15%)**		**221 (34%)**		**277 (42%)**		**61 (9%)**		**658 (100%)**	

*There are several pervasive agricultural sites in the project area with widespread clearing and planting mounds. As these individual mounds are considered sub-features of the larger sites, each site/feature counts as one occurrence of the formal feature type.

Table 10. Summary Occurrences of Formal Site Function (Total number of sites: 341*)

Function	TMK 17		TMK 25		TMK 26		TMK 28		TOTAL
	No.	%	No.	%	No.	%	No.	%	%
Activity Area	0	0.0	3	2.3	24	17.1	3	7.0	**8.0**
Agriculture	7	10.6	4	3.1	9	6.4	1	2.3	**5.6**
Animal husbandry	0	0.0	4	3.1	3	2.1	7	16.3	**3.7**
Burial (Known)	0	0.0	5	3.9	24	17.9	5	11.6	**9.3**
Burial (Probable)	3	4.5	1	0.8	2	2.1	2	4.7	**2.4**
Ceremonial	0	0.0	2	1.6	2	1.4	1	2.3	**1.3**
Indeterminate	3	4.5	4	3.1	1	0.7	0	0.0	**2.1**
Marker	1	1.5	5	3.9	8	5.7	2	4.7	**4.2**
Quarrying	1	1.5	5	3.9	1	0.7	1	2.3	**2.1**
Storage	3	4.5	0	0.0	1	0.7	0	0.0	**1.1**
Permanent Habitation	1	1.5	10	7.8	25	17.9	2	4.7	**10.1**
Temporary Habitation	31	47.0	72	56.3	34	24.3	13	30.2	**39.8**
Transportation	16	24.2	13	10.2	4	2.9	6	14.0	**10.3**

*Since some sites have dual primary functions, i.e. habitation and burial, these functions are each counted as one instance each in the table; thus, the total counts for each parcel here are slightly different than the actual total number of sites (341), for this table only.

SUMMARY AND INTERPRETATION

Summary of Site Type and Function within the Project Area

The inventory survey of the more than 1100-acre parcel resulted in the identification and documentation of 341 archaeological sites. Based on historic background literature and previous archaeological studies, the site density appears consistent with general ideas about settlement of this area (see the Background Research section of this report), with site density increasing substantially in the *mauka* portions of the project area. The types, functions, and distribution of sites present match closely the anticipated finds for the Intermediate and Upland zones of the Kekaha region of North Kona within which the project area lies.

The Kekaha region, or "Kekaha-Waiole, the desolate land without water" (Kelly 1973:74) refers to the barren lava fields extending north from Kailua-Kona to Anaeho'omalu (Kelly 1973:74). As has been observed in Kaloko, Kohanaiki and other *ahupua'a* in Kekaha, this band of barren lava fields does not encompass the entire *ahupua'a* nor does it inhibit land usage from occurring along the coast and inland where rainfall is sufficient for intensive agriculture. Instead, Kekaha refers more accurately to portions or "zones" of the regions where lava flows encompass the lands which - according to elevation - sustain little rainfall. Correspondingly, the lands of Kekaha are suggested, based on ethnographies, ethno-histories and archaeological sources, to contain three general terrestrial zones that directly influenced land usage of prehistoric and historic populations. These three zones include: (1) Coastal; (2) Intermediate or Transitional and; (3) Upland.

The current project area falls into the Intermediate and Upland Zones. Based on the archaeological record of the present study area and previous archaeology in the Kaloko *ahupua'a* (Cordy et al. 1991), the Intermediate Zone contained a scattered distribution of habitations of different modes (i.e. temporary and recurrent) which were generally located within the vicinity of *mauka/makai* trails or in association with other functional site types like agricultural and lithic resource procurement. The general lack of consistent rainfall and virtual absence of soil directly limits agricultural use within the Intermediate Zone. Nonetheless, small concentrations of mounds, modified outcrops (enclosing minimal soil areas), enclosures, and some *pāhoehoe* excavations evidence a degree of agricultural productivity. Lava tubes and blisters are abundant in this zone and contain temporary components, and post-habitation burial interments. The Intermediate Zone is also characterized by an extensive network of *mauka/makai* trails. These trails facilitated inter-*ahupua'a* travel of residence between their coastal habitation and the Upland agricultural fields. TMK 17, TMK 25, and the *makai* portion of TMK 28 are located in the Intermediate Zone.

In contrast, the Upland Zone is characterized by an increase in permanent habitation sites, in association with intensive non-irrigated (dry land) agricultural features. Gradually, the ascending natural landscape contains a greater soil base and due to an increase in elevation, the rainfall is more plentiful and consistent. The *mauka* portion of the project area in TMK 26 and TMK 28 is located within this zone. Intensive non-irrigated agriculture is characteristic of the Kona slopes and other regions of Hawaii and Maui where irrigation, because of the lack of perennial waterways, is not possible.

The present project area's location within the interpreted Intermediate and Upland Zones places it within an area where an increase of permanent habitation and agricultural intensity is expected

upslope. The lower elevation (*makai*) portion of the project area is closer to the "intermediate zone" and therefore is somewhat outside the major areas of pre-contact Hawaiian habitation and activity; a lower density of archaeological sites is expected in this region. The higher (*mauka*) regions of the project area have higher rainfall, some soil formation, and a greater number of large lava tubes; overall, density of sites increases with elevation as expected.

Historic properties within the project area range from the pre-contact period to the historic ranching era. Feature types typically involve formal and informal stone construction (ranging from formal habitation and ceremonial structures to informal shelters and planting/clearing mounds), modification of lava tubes, construction of trails, and agricultural modification and clearing. Site functions include habitation, burial, ceremonial, transportation, agriculture, water collection and animal husbandry among other minor functions such as storage and quarrying. The following discussion summarizes the most common types of modification present within the Kaloko Makai project area and discusses the interpreted function of these sites, with a summary of site distributions and overall conclusions following.

Agriculture

The terrain throughout the majority of the project area severely limits agricultural productivity, since large portions of the project area are barren *'a'ā* lava or rough *pāhoehoe* with no soil development. However, some of the *pāhoehoe* areas do have soil development, although these tend to be fairly small and shallow everywhere except for the far *mauka* extent of the project area. The agriculture related features throughout most of the lower elevations of the project area represent more of an opportunistic approach versus the more expansive/intensive approach practiced at higher, more productive elevations.

Agricultural features in the project area ranged from minimal constructions, characterized by the removal of stones to clear small depressions in *pāhoehoe* lava, to larger more defined concentrations of clearing and/or planting mounds. Other agricultural features included excavated blisters, informal enclosures, terracing, and the use of small cobble mulch. Throughout most of the project area, these features are fairly informal and somewhat ephemeral, tending to occur in low density concentrations often in gulch areas or low natural depressions in the topography. In the *mauka* portion of the southern parcel (TMK 28), eroded *'a'ā* flows appear to be used as planting areas with high concentrations of small *'a'ā* cobble mounds in geologically distinct areas.

The agricultural sites within the project area are collectively characteristic of and are a variation of what is currently termed the "Kona Field System" (State site 50-10-37-6601). The Kona Field System is an intensive, non-irrigated dry land agriculture complex, which has been identified along the upland slopes of North and South Kona, leeward Hawai'i, from Kealakekua Bay to beyond the northern limits of Kailua Town. Numerous archaeological studies in this region (e.g., Newman 1970; Yen 1978; Schilt 1984; Barrera 1990; Hammatt et al. 1995, among others) define the field system as a grid-like patterning of rectangular fields formed by earthen and stone boundaries. Although variants occur, the fields' long axis walls (*kuaīwi*) extend in a *mauka/makai* direction and are intersected by shorter walled boundaries cross-cutting the slope.

The definition of the Kona Field System as a "system" relies on the interaction of four terrestrial ecozones or subzones classifying areas of differential agricultural use in *ahupua'a* or district, as it is most commonly applied. Classification of these subzones was initially introduced by T. Stell

Newman (1970) with subsequent contributions by Marion Kelly (1983). Newman defined the terrestrial subzones using aerial photography in correlation with historic accounts of early visitors to Hawai'i. Kelly's subsequent research of the Native Claims Registers (from 1846 to 1848) provided Hawaiian names of the subzones and, based on reported claims, what type of traditional or historic crop was cultivated in each subzone. The subzones follow rainfall gradients generally predicted by elevation in Kona and delineate optimum areas for intensive agriculture. Rose Schilt in "Subsistence and Conflict in Kona Hawai'i" presents a comprehensive summary of the subzones using Newman and Kelly's studies and rainfall data compiled during her research (Schilt 1984:6). The following subzone classifications are based on Schilt's compiled data (the first and second zones, *Kula* and *Kaluulu*, are most applicable to the present study area):

Kula Subzone/Coastal Area

Elevation: Sea level to 500 ft (0 to 150 m)
Annual Rainfall: c. 30-50 in. (0.8-1.2 mm.)
Late Pre-contact crops: Sweet potatoes (*'uala*), gourd (*ipu*), and mulberry (*wauke*).

Kaluulu Subzone/Seaward Slope

Elevation: 500-1000 ft. (c. 150-300 m)
Annual Rainfall: c. 40-55 in. (1.00-1.35 mm.)
Late Pre-contact Crop: Breadfruit (*'ulu*), with sweet potatoes (*'uala*) and mulberry (*wauke*) interspersed; mountain apple (*'ōhia'ai*) and some taro (*kalo*).

'Apa'a Subzone/Upland Slope

Elevation: 1000-2500 ft (300-750 m)
Annual Rainfall: c. 55-80 in. (1.35-2.00 mm.)
Late Pre-contact Crop: Taro (*kalo*), sweet potatoes (*'uala*), ti (*kā*), and sugarcane (*kō*).

'Ama'u Subzone/Upland Jungle

Elevation: 2500-4000 ft (750-1200 m)
Annual Rainfall: c. 80 in. (2.0 mm.)
Pre-contact Crops: Bananas and plantains (*mai'a*)

It is notable that historic period crops were also cultivated in the *Kaluulu* and *'Apa'a* subzones and to a lesser degree in the *Kula* subzone. These crops included cabbage, melons, onions, oranges, tobacco, beans, coffee, corn, cotton, pineapple, Irish potatoes, and pumpkin.

The agricultural sites within the project area are regarded as interrelated components of a non-intensive, non-irrigated field system with the *ahupua'a*, and are believed to generally reflect utilization of the *Kula* and *Kaluulu* subzones presented above. Given relatively low rainfall within most of the project area, despite its slightly higher elevation, it is reasonable to assume that most areas follow a pattern more consistent with the *Kula* subzone. Overall, this suggests that sweet potato, gourds, mulberry, and possibly taro are the most likely crops to have been grown in this area. As noted in the Background Research section above, the actual crops identified in the award testimonies during the Māhele of 1848 for Kaloko lands are taro and sweet potato.

Sweet potato was likely the most abundantly grown crop in the *makai* portion of the project area because of its adaptability to stony and dry environments. It was commonly planted in mounds and in *pāhoehoe* excavations. Henry J. Lyman son of missionary couple that first arrived in Hilo in 1831, describes features in Puna similar to *pāhoehoe* clearings, as seen in the project, which were cultivated with sweet potatoes:

> Whereever the lava could be pounded into scoria, a plantation of sweet potatoes was laboriously formed by digging among the stones and filling in the holes with dried grass brought from the mountainside. Placed in the nest, the tuberous buds were covered with gravel, and there grew with astonishing luxuriance, yielding the largest and finest potatoes on the island [in Frierson 1991:167].

During the mid 1800's, Captain Charles Wilkes of the American Exploring Team comments on the agricultural use of *pāhoehoe* excavations (similar to the modification of *pāhoehoe* outcrop seen in the project) which he observed specifically in the Kona region:

> Cultivation is carried on in many places where it would be deemed almost impractical in any other country. The natives, during the rainy season, also plant, in excavations among the lava rocks, sweet potatoes, melons, and pine-apples, all of which produce a crop (Wilkes 1845:91).

Sweet potatoes were also cultivated within walled fields or depressions in the walls themselves. E.S. Craighill Handy and Elizabeth Green Handy reveal this method using an account taken from the Hawaiian newspaper *Ka Nupepa Ku'oko'a* March 24, 1922):

> Rocky lands in the olden days were walled up all around with the big and small stones of the patch until there was a wall (*kuaīwi*) about 2 feet high and in the enclosure were put weeds of every kind, *'ī* tree ferns and so on, and then topped well with soil taken from the patch itself, to enrich tī, or in other words to rot the rubbish and weeds to make soil.
>
> After several months, the rotted weeds were converted into soil of the best grade. The farmer waited for the time when he knew that the rains would fall, then he made the patch ready for planting. If for sweet potatoes, he made mounds for them and for taro too, on some places on Hawai'i [in Handy and Handy 1972:131].

The above accounts describe agricultural modifications in rough rocky terrain similar to that of the present project area; while no walled (i.e. *kuaīwi*) fields are present in the *makai* portions of the project area, there are several located in the *mauka* portion of TMK 26.

In contrast, the *mauka* portion of the project area has increased rainfall at the higher elevation and considerably more formal agricultural modification, consistent with the area formally designated as the Kona Field System (Site -6601). This upland area would likely have been able to support a wider range of crops, likely including breadfruit (*'ulu*), sweet potatoes (*'uala*), with interspersed mulberry (*wauke*), mountain apple (*'ōhia'ai*) and some taro (*kalo*). It is interesting to note that some of the upland enclosures within Site -6601 in the project area are likely for arboriculture, which were not observed in lower elevation agricultural areas.

Animal Husbandry

Walls built for animal husbandry were a commonly identified feature type throughout the project area. The walls suggest a fairly major historic presence of cattle or goat ranching within the southeastern portion of the project area, which is not unexpected given the presence of the Huehue Ranch in Kaloko beginning in the late nineteenth and early twentieth century. The presence of barbed wire fences, troughs, and sheds in association with historic walls (primarily in TMK 28) suggests that ranching continued into the modern area. Other definitive signs of animal husbandry in the area are the large number of goat (and cattle) skeletons found in lava tubes.

Historical research suggests that both goat and cattle grazing probably took place within the project area. Captain George Vancouver gave Ke'eaumoku, an *ali'i*, a pair of goats in 1792, and the following year, he brought Ke'eaumoku four sheep. Vancouver also brought the first cattle, California longhorns, to Kamehameha in 1793. Historic documents related to the Government Homestead Program of the late 1880s indicate officials determined that goats were the only animals that were adept at grazing within arid, rocky Kaloko and Kohanaiki (Maly and Maly 2003:76, 79). Goats were present in the area prior to the late 1880s and may have been present within the project area. Limited cattle ranching was practiced at the same time, although by 1900, cattle ranching had for the most part replaced the goats (Maly and Maly 2003:75).

Post-contact animal husbandry appears to be most extensive in the southeastern portion (TMK 28) of the project area, again likely associated with nearby activity at the Huehue Ranch. The majority of the southern project area parcel is inappropriate for grazing, and most archaeological remains of animal husbandry in this area appear to be an attempt to keep cattle off the rougher *'a'ā* flows, and within the level *pāhoehoe* flow at the far *mauka* end. Other historic animal husbandry sites in the rest of the project area confirm that there was at least minimal use of this land for ranching purposes, and the large number of bulldozer roads in certain areas may be related to modern ranching activity.

Burials

There are a total of sixty-five confirmed burials at more than thirty sites. Fifty-five (85%) of these are located in TMK 26. Numerical designations given to burials by CSH are sequential for the entire Kohan 1 project (including the present project area as well as TMK: [3] 7-3-009: 017, 025 and 026), resulting in non-sequential numbers for burials within each of the four parcels. The CSH burial numbers correspond to the burial numbers reported to SHPD upon initial discovery of a burial, and therefore represent the order of discovery during the Kohan 1 project fieldwork. The numerical designations have been retained to ensure consistency between the records of initial discovery (as reported to SHPD) and discussion in the inventory survey report.

The majority of confirmed burials (with identified human remains) are located within lava tubes, which vary in size from very small to fairly large tubes. There is often a single burial per site, but in some cases there are several individuals present at the same site and/or in the same burial chamber. In most cases, there are no directly associated burial goods, although several of the burials have modification associated with them (e.g., placed rocks designating the boundary of the burial area) or possible burial items nearby (e.g., modified shell). However, there are several historic burials that do have coffins and historic artifacts associated with them (buttons, cloth fragments, etc.). Burials in lava tubes with no associated historic artifacts are generally assumed to date to the pre-contact period.

In addition to confirmed burials, there are several probable burials within the project area (no identified human remains, but strong archaeological evidence for presence of a burial). One probable burial site consists of three adjacent platforms that are consistent with Hawaiian burial platforms. Most other probable burials are located within portions of lava tubes that have been systematically and formally sealed off. These areas often involve small spaces that have been blocked with upright slabs or tightly packed cobbles. In the lower elevation portion of the project area, filled crevices on top of tumuli represent a similar type of construction that are considered probable burials.

Burials are usually located in isolated areas, and many burial sites have burial as the sole primary function. However, more than half of the burials in the project area are also associated with another primary function, most often with habitation and water collection. This association suggests either interment of the burial after the other portions of the tube were no longer used, or, less likely, contemporaneous usage of a tube for dual purposes.

Ceremonial

While ceremonial sites make up less than 2% of the total historic properties within the project area, there are several portions of the Kaloko Makai project area that utilized sites in whole or in part as a ceremonial place. Most often this is evidenced by the placement of branch coral, petroglyphs, and/or the style of construction. While these sites were certainly ceremonial areas, there are only a few that are possible *heiau*. The following is a discussion of the diagnostic attributed used to identify *heiau* and other ceremonial structures.

The general consensus regarding *heiau* (e.g. Bennett 1930, Kolb 1991, and Stokes and Dye 1991) is that they are "extraordinarily diverse" (Kolb 1991:108) and "found in a bewildering variety of forms, sizes, and locations throughout the islands" (Kirch 1985:257). W.C. Bennett's 1930 dissertation continues to be "the most comprehensive survey of heiau to date" (Kolb 1991:108). Bennett, among others, attempted to provide diagnostic attributes from which *heiau* could be identified and classified. These include size, uprights, depressions, altar, paving, tiers/terraces, coral, historical reference, location, and function.

Size refers to the surface area (i.e. square meters) of the structure. Initially, W. C. Bennett designated two size classifications for *heiau*, small and large. The dividing line between them was arbitrarily set at 50 feet "though this figure is not absolutely fixed" (Bennett 1930:4). Over the years this has been refined to include three general size ranges, small being less than 200 m², "mid-sized" (Kirch 1985:261) ranging from 200 to 400 m² and large being greater than 400 m². Based on these specifications, site -26424 (225 m²) fits into the lower end of the mid-size range. In general, mid-size structures and larger have been interpreted as religious structures (Hammatt et al 1997:181).

Attributes including altars and paving, generally refer to internal features of the structures (Hammatt et al 1997:176-177). Altar in this case is employed to describe a slightly elevated or raised stone foundation within the structure. Bennett designated altars as one of the *heiau* features focusing primarily on ethnographic evidence related to "*lele*" which he described a "a sort of scaffolding supported by posts on which offerings were laid and left to moulder away" (Bennett 1930:39). According to David Malo (1903), "In front of the lele was a pavement of pebbles (or framework) on which offerings were deposited until they were offered up, when they were laid on the lele" (Malo 1990:213-214). The term paving is employed referring to well constructed surface layer(s) of a specific structure. Although a common structural component, paving is suggestive of a "greater construction effort" (Hammatt et al 1997:185). Formal paving of two different types (slabs and *'a'ā* cobble) is evident within site -26424, as are various internal features, including a placed head branch coral.

Location refers to our perception of prominent placement of specific structures in terms of view planes from and to the particular structures (Hammatt et al 1997:189). The importance of *heiau* location has been well documented (Bennett 1930:341; Buck 1964:516; Stokes and Dye 1991:21; and Kolb 1991:80-83). When considering location (Kolb 1991):

> ...local topography of a temple was intimately tied to the concept of religious "sanctity". Large heiau were generally situated upon prominent locations such as hill tops, bluffs, or knolls. This higher ground affirms the divine and inaccessible nature of high-ranking *ali'i*, while affording an excellent view of the surrounding countryside and coast. Smaller *heiau*, on the other hand were usually placed within villages, upon mountain slopes, in upland valleys, along the coast, or in any other location that would best serve the people (Bennett 1931:35).
>
> The incorporation of the local topography makes any cursory analysis of *heiau* form suspect in two ways (Hommon 1987:24-5). First, the placement of *heiau* architectural elements tends to be influenced more by the contour of the landscape than by the abstract plan imposed upon the site by the architect. This suggests that the location of a *heiau* played a much more important role in its design than previously thought, and may partially explain the large amount of variability present in *heiau* form. Each promontory varies in its size, shape, and orientation of natural rock outcrops....
>
> Second, some platforms and terraces that appear to be solid architectural elements are actually masonry veneers, and thus are deceptive as to the amount of labor used in their construction. (Kolb 1991:82-83).

Although there are several platforms and other smaller structures in the project area that were likely shrines or had a ceremonial aspect, and some of the are possible *heiau*, there is one structure in particular that is a probable *heiau* (in TMK 28). This structure (an enclosure) has a fair amount of internal construction, formally paved floors, a placed head of branch coral, and a very formal *pāhoehoe* slab trail that leads to it. This combination of features suggests that this historic property functioned as a *heiau*. Other ceremonial features in the project area consist of platforms with some branch coral and/or multi-tiered formal construction, petroglyphs in lava tubes, and small agricultural shrines.

Habitation

Habitation sites are the most common type of historic property in the project area, and range from small lava tube shelters to multi-component complexes. The temporary and permanent habitation designation for the sites within the project area fit the models of type of habitation expected within the Intermediate and Upland Zones as well as meeting a set of criteria for interpreting modes of habitation (i.e. Cordy et al. 1991:529 and Clark 1986:198). Two specific types of habitation types – temporary (which includes shelters) and permanent - are used in the present analysis of these sites. Permanent habitation tends to increase upslope, where there are more lava tubes and better soil development for agriculture, but both temporary and permanent habitation sites are present throughout all four parcels in the project area.

The distinction between the two habitation modes is posited based on the following set of criteria, which have been developed by CSH over years doing archaeological research within the Hawaiian Islands. This includes locales where other researchers have developed models for distinguishing temporary and permanent habitation (Cordy 1981, Cordy et al. 1991 and Jensen 1988). Thus, models for distinguishing temporary versus permanent (Cordy et al. 1991, Clark 1986, Weisler and Kirch 1982, Green 1980) are available for comparative analyses.

CSH incorporates aspects of these models into the set of criteria that we then apply to the range of sites within a project area. The process of interpretation involves: 1) in field site recordation and tentative interpretations; 2) laboratory analysis that includes a) reevaluation based on inventory of all sites; b) incorporation of subsurface testing data; c) correlation to previous studies; and d) review of historic background data. In field interpretations can thus be altered based on compilation of full inventory survey data and correlations to previous studies.

The primary criteria utilized for in field interpretations include size, architecture type (e.g. lava tube, c-shape, platform, terrace, etc.) and substantiveness of architecture (i.e. substantial versus insubstantial). These three primary criteria provide essential determining factors that are found in the existing habitation models (e.g., Cordy et al. 1991:527-536, Clark 1987:105-214, Green 1980:54-63), and are discussed in detail below, with a brief summary of the correlation to sites within the project area included.

Size

While there is no set size determination to differentiate temporary and permanent habitation, structures can be roughly categorized as small (<20 m^2) or large (>20 m^2), with larger structures having a tendency to be permanent habitation. Though size can be a key determining factor there are variables which can affect its diagnostic value. These variables include differences in field and recordation methodology related to measuring and reporting on sites or features size. Examples include utilization of interior versus exterior measurements, defining natural areas or surfaces utilized for habitation (e.g. cave floor areas, modified outcrop surface area) and personal perception(s) of site or feature limits (e.g. exterior perimeters of enclosures, platforms, c-shapes, etc.). CSH utilizes maximum exterior measurements as the basis for calculating area. Thus, based on the documented size range differences and the regional variations in habitation models, as well as the above-mentioned variables Cultural Surveys Hawai'i utilizes structure size of ca. 20 m^2 as a general dividing line between large and small. The implication here is that large is suggestive of permanent habitations with small indicative of temporary habitations. However, additional criteria are necessary to affix these differing modes of habitation, especially because of variability in architecture or structure type and substantiveness of structures which size (m^2) does not address.

Architectural type

1) Temporary Habitation - lava tubes & blisters, irregular shapes, standard C- and L-shapes platforms enclosures, terraces, alignments

2) Permanent Habitation - platforms, enclosures (rectangular, square),terraces

Based on the previous habitation models as well as Cultural Surveys Hawaii's research (Hammatt et al. 1997), certain architectural or structural types tend to be more often associated with one mode of habitation or the other. Types such as C- and L-shaped enclosures, isolated hearths, caves, and modified outcrops, for example, are more often associated with temporary habitations. Platforms, rectangular enclosures and terraces are more often associated with permanent habitations. However, these architectural types are not necessarily mutually exclusive and therefore besides size, and type, substantiveness of architecture is essential in the interpretations.

Substantiveness of sites/features

1) Substantial - Well paved, bifaced, (thick) sturdy walls, volume (though no specific m^3), defined areas by alignments

2) Unsubstantial - Minimally or unmodified tubes/blisters, rough, loose paving (or none), uniface (piled versus stacked) walls, incorporated natural features.

Substantiveness of structures refers to quality of construction which in part infers amount of labor invested. Permanent habitations are expected to have more substantial architecture; such as well-paved surfaces; bi-faced, thick, sturdy walls; and in the cases of platforms and terraces, significant rock fill. In contrast, temporary habitations are expected to have less substantial architecture; such as minimally or unmodified lava tubes or blisters; rough, loose pavings; incorporation of natural features (e.g. large boulders, bedrock ledges, outcrops); and unfaced or unifaced walls. Thus the substantiveness criterion suggests mode of habitation based on perceived labor investment as an indicator of the pre-determined use of the structure. In other words, greater investment would be put into permanent habitations to provide stable and comfortable structures versus little effort invested in structures that were pre-determined for short-term or temporary use.

These three criteria: size, architecture type, and substantiveness provide the basis of CSH mode of habitation interpretations. However other criteria are viewed as necessary in supporting these interpretation. These additional criteria include: single versus multi-component site layout; internal features; functional associations and; geographic location.

Single versus Multiple Components

1) Temporary Habitation - generally single featured but multiple not all that unusual

2) Permanent Habitation - either single or multiple component but usually other feature associations.

Habitation sites are described as either single-structure site or as a complex of related multiple structures. Typically, but not exclusively, temporary habitation sites are single-structure sites or they contain only one habitation structure in a complex layout. In contrast, permanent habitation residences, although commonly containing one primary habitation structure (i.e. sleeping house), often include other function-specific structures (e.g., men's house, sleeping house and cooking house), in addition to other functional feature types that supplement a permanent household (e.g. garden areas, storage or special-use caves, and family temples).

The variation between single-structure and multiple-structure permanent residences have been described, by several 19th-century Hawaiian scholars (summarized in Cordy 1981:73-76), as being dependent on the inhabitants' social rank. The larger, multiple-structure permanent residences (containing "men's houses, sleeping houses, heiau houses, women's eating houses, houses for the storage of provisions, houses for cooking, and many other houses" [Kamakau 1976:96]) were occupied by the *ali'i* or wealthy commoners, and the single-house residences were occupied by other commoners (*maka'āinana*). Hawaiian scholar, David Malo, described a *maka'āinana* house as a "little shanty" in which all residential activities took place, "the fireplace was close to their head, and the poi dish conveniently at hand" (ibid.). Ethnographers E.S. Craighill Handy and Mary Kawena Pukui also noted the presence of single-structure households and multi-structure households, although they emphasized the multi-structure pattern (Handy and Pukui 1972:7, 112). The supposition that a multiple-house (structure) design was

common among both social classes has been demonstrated in the archaeological record (e.g. Cordy 1981; Weisler and Kirch 1982). Cultural Surveys Hawai'i's work in inland settlements, in Waiohinu, Ka'u, and Honokohau, North Kona (Robins et al. 1992 and 1995 respectively), documented that multiple-structure households were common, accounting for approximately 50% of all permanent habitation sites.

Internal features

1) Temporary Habitation - few, if any, from just survey level observation, cupboards (excavation observations, e.g. multiple hearths)

2) Permanent Habitation - cupboards, single, well-defined hearth, constructed entrances or pathways, internal alignments (indicating segregation for multiple purposes)

The presence of internal features in habitation structures tend to indicate longer or permanent use of the structure. The more common internal features associated with permanent habitation are: solitary inlaid hearths, entry ways (including constructed pathways and doorways), and alternating surfaces (tiers) or internal alignments defining different living areas. Internal features that may occur in both temporary and permanent habitation structures include cupboards, post-holes, alignments, and less substantially constructed hearths.
Observations of cultural material (midden, artifacts, manuports, etc.) at sites provide additional supportive data, however the presence or absence of such material was not a key determining criterion.

If extensive excavation of habitation sites has occurred then thickness of a site's or feature's cultural deposit and the type of associated artifacts may assist in distinguishing between temporary and permanent habitation. For example, thicker cultural deposits that contain a variety of domestic-related tools could be an indicator of permanent habitation activities (Clark 1986: 207), while sparser cultural deposits with a limited variety of tool types may be an indicator of temporary habitation activities (op.cit. 199-200). However, the density of a cultural deposit or artifact types alone does not necessarily distinguish between temporary and permanent use, since similar domestic activities - revealed by similar artifact types - may be found at both temporary and permanent habitation sites (Cordy et al. 1991:528, 533-534). In addition, a dense and thick cultural deposit may be produced at a temporary habitation site that was used frequently over a long period of time (i.e., recurrent habitation). Regardless of whether or not intact cultural deposits can indicate temporary or permanent use, not enough subsurface data was obtained, during the inventory survey of this project, to facilitate this type of comparative analysis.

Functional Associations

1) Temporary Habitation - agricultural, natural resources (lithics, mining, sources) fish/shell fish

2) Permanent Habitation - other permanent habitation, burials, religious features/sites (uprights, i.e. heiau), shrines; potable water source(s)

The functional association of other features, sites, or complexes can assist in mode of habitation interpretations. Based on previous research temporary habitations in the central Kona region tend to be associated with *mauka/makai* trails, intensive agriculture, specific resource procurement (e.g. lithics, birds, timber, etc.) and natural features such as lava tubes and/or blisters. Permanent habitations may be associated with other permanent habitations in a cluster or "village" setting, burials, religious sites/features, potable water, and ocean access (Clark 1986, Jensen 1988, Cordy

et al. 1991, Robins et al. 1995, Colin et al. 1996). Additionally, historic records related to Land Commission Awards (LCAs) are evaluated when applicable, as providing functional interpretations, possibly related to mode of habitation and thus is included in the column on "other functional associations."

Geographic location

1) Temporary Habitation - coast to inland, but more prevalent inland, amongst intensive agriculture, along trails, edges and/or interfaces of lava flows

2) Permanent Habitation - mainly coastal but scattered inland, shoreline access

Similar to other criteria previous research has documented trends pertaining to geographic location of temporary and permanent habitations. This category should be considered in regards to the topography/geology of the specific project area. The trends pertinent to the Kona region for temporary habitations indicate that sites may be found from the coast to inland, but that they are more commonly found inland, especially within an intensive agricultural context (Hammatt and Clark 1980, Robins et al. 1995). Permanent habitations are more commonly documented historically and archaeologically as being coastal with scattered inland sites. The predominance of permanent habitations being coastal is especially true for clustered housing, or "village"-like settings.

Interpretation Summary

The interpretations of habitation sites into temporary or permanent can be an uncomplicated process depending on survey area, number of sites, and type of sites present. However as can be seen in large studies, like the present survey, the quantity, variety and varying conditions of habitation sites necessitates utilization of a wide range of interpretive criteria. As explained, CSH makes in-field interpretation based on observable criteria, particular size, architectural type, and substantiveness of architecture. Other criteria are then applied as supportive data of one mode or the other. The following is a summary discussion of temporary and permanent habitations within the present project area.

Temporary and Permanent Habitation within the Project Area

Within the current project area, the majority of sites discussed as temporary habitations (or as in the case of many lava tubes, as shelters), have a floor area less than 20 m^2. In some cases where the floor area is larger, the overall site is overall informally constructed and considered temporary habitation for that reason. Specifically, lava tubes tend to be temporary habitation sites rather than permanent, but often have rather large floor spaces. Permanent habitation structures tend to be larger, often with multiple living surfaces that increase the total habitation space.

A full range of architectural types is present within the project area, including both temporary and permanent habitation platforms, enclosures, terraces, and lava tubes. Temporary habitations tended to consist of only one or just a few structures of fairly informal construction, while permanent habitation complexes often involved multiple architectural types and/or at least one formally constructed primary structure. The substantiveness of permanent habitation structures tended to be an important factor in determining the type of habitation, and is the main reason that the less formally modified lava tubes (as opposed to formally constructed surface structures) are generally considered temporary habitation.

Many of the larger habitation site complexes within the project area have internal features, in the form of hearths, storage areas, or internal alignments that suggest permanent rather than temporary habitation. Formal construction style, internal features, and multiple component features do seem to occur concurrently at permanent habitation sites within the project area, while temporary habitation tends consist of fewer features with little or no internal construction.

Finally, the distribution of the temporary habitation sites within the project does tend to be near activity areas and minor agricultural areas, whereas permanent habitation is more likely to be associated with shrines, lava tubes, and more intense agricultural modification.

Lava Tubes

Lava tubes and blisters are numerous throughout the region and - depending on a wide range of factors such as size, accessibility, and interior environmental conditions - were utilized for various functions. In the present project area these tubes are denser on the *mauka* slopes, but are present throughout all four individual TMKs. Some blisters and small tubes, inspected during the present survey, showed no evidence of utilization, but a surprisingly large number do have at least minor modification, and some lava tubes were extensively utilized for recurrent habitation. The range of functions for tubes and blisters within the project area include burial, habitation, and activity areas (specifically water collection and tool production).

While some modified lava tubes consisted of only a small blister opening and less than 5-10 square meters of usable space, other lava tubes are very large and run for hundreds of meters, often interconnecting in complex ways. Both small and large tubes were utilized, with some modification and cultural material located surprisingly far inside long lava tube systems.

Habitation-related modification in lava tubes generally consisted of floor clearing, constructed entrances, midden deposits, and signs of tool manufacture (lithic debitage, portions of fishing implements such as octopus lures, etc.). Other habitation related items include several *papamū* game boards, as well as a tapa beater and poi pounder. Habitation of lava tubes ranged from a few cleared rocks and a small amount of midden to large subsurface complexes including platforms, pavements, walls, and petroglyphs.

Other than habitation, the two other primary functions for lava tubes in the project area are burial and water collection. A large percentage of the burials in the project area are located inside lava tubes, and are interred utilizing various styles. Some lava tube burials within the project area are historic (associated with historic goods and/or coffins) but most have no associated grave goods and are assumed to be pre-contact. It is notable that many of the burials located during the inventory survey were far from entrances and/or in difficult to reach locations, sometimes due to the main entrance to the burial chamber being intentionally blocked.

Water collection in lava tubes is also quite frequent, especially in the *mauka* regions of the project area. Small informal concentrations of cobbles and small boulders in lava tubes are indicative of water collection activity areas. Generally water catchment features consist of small to medium sized cobbles placed in rough circles or stacked against outcrops in tubes to create a stable area for some sort of container (gourds or carved wood). Some sites in the project area have more formal water collection features, which are often rectangular in shape and larger than the less obvious informal water catchments. Many water catchment lava tubes have a fair amount of internal construction, such as formally modified entrances which appear to constrict the tube entrances (possibly for moisture retention) as well as making movement through the tube easier.

Other associated features include small cairns in the lava tube, which appear to direct a person to tube exits.

While no gourds were found in place in the project area - or any other containers such as wooden bowls or carved logs - occasionally gourd fragments were found. In more intensive water collection lava tubes, there is often charcoal associated with water collection features, which can sometimes be identified as charred *kukui* nut; the *kukui* nuts (also known as candle nut) were almost certainly used as a light source during collection of water vessels. Both gourd fragments and charcoal associated with water collection are good candidates for radiocarbon dating during data recovery.

The story of Ko'amokumokuohe'eia and historic newspaper articles translated by Kepa Maly (see above Background Research section) suggest that water collection was very important in the Kekaha region, and the two formal water collection sites mentioned above appear to fit very closely with the type of activity described in these accounts. Differences in the size and formality of water collection features may be attributable to varying sizes of containers used, i.e., gourds versus carved trees.

Lava tubes also generally offer a greater degree of midden and artifact preservation compared to surface sites. Of the more than fifty indigenous artifacts found during the inventory survey (including lithics, abraders, bone awls, manuports, a poi pounder, a tapa beater, *papamū* boards, etc.), the vast majority were observed in lava tubes. Although most lava tubes in the project area contain a minimal amount of soil deposition, there is high potential for data recovery of the surface midden present, as well as recovering datable charcoal and wood/gourd fragments associated with water collection features. Overall, lava tube utilization within the project area was likely an important factor in settlement patterns and site distribution.

Trails

Trails are a common site type within the Kekaha region in general and one of the more prevalent types specific to the Intermediate Zone. Although some of the trails in the project area were little more than remnants, several run many hundreds of meters and are in good to excellent condition. The most common type of trail consists of *pāhoehoe* slabs placed stepping distance apart on *'a'ā*; these trails range from remnants (only a few slabs) to a trail that consists of immediately adjacent *pāhoehoe* slabs for several hundred meters. *Pāhoehoe* slab trails are generally considered to be pre-contact. Historic trails, of which there are a few in the project area, tend to be wider and have curbing and causeways (typical of historic horse trails).

The intersection of three of the trails in TMK 28 (one very formal *pāhoehoe* slab trail, one informal slab and crushed *'a'ā* trail, and a historic curbed horse trail) is especially of interest, as it appears to represent trail use during subsequent periods of time. The construction type also is indicative of changing needs in transportation, specifically the creation of trails more amenable to travel by horse or other pack animal.

Another long historic trail is located in the north east portion of the project area (TMK 26). Site -10714 is a wide, curbstone trail over *pāhoehoe* that utilizes constructed causeways to cross low-lying areas in the flow. This trail matched well with "Kohanaiki Road" seen on Emerson's maps dating to around 1888, and was also found in the Wolforth (2005) study area directly *mauka* of the current project area. This trail is associated with several large habitation sites, as well as the Kona Field System.

The large number of trails within the project area reveal that the residents of Kaloko and Kohanaiki (both pre- and post-contact) had a significant network of travel routes that provided access to resources and exchange of resources over the *'a'ā* (especially in TMK 17 and TMK 25). The presence of several different types of trails as well as intersecting/overlapping trails suggests use of this area over various periods of time. The trail network includes both *mauka/makai* and cross slope-oriented trails, and the trails thus provide fairly direct coast-to-uplands routes via the project area and access to activity areas within the project area. The activity areas include: agricultural pursuits, ceremonial sites, and temporary and recurrent habitation sites, as well as animal husbandry areas. Overall the trails suggest a high level of energy investment in constructing paths for traversing the *'a'ā* flow, both in pre-contact times as well as historically.

Attempts were made with all trails in the project area to follow them to their full extent and where possible make relevant correlations. It proved impossible to follow some trails on the grass-covered *pāhoehoe* adjacent to the *'a'ā* lava where the trails were still visible. The uniformity of the terrain (usually consisting of undulating *pāhoehoe*) surrounding the *'a'ā* flows negates the necessity of extensive trail construction and suggests that while the trails followed a single route over the *'a'ā* flows, once the trail exited the *'a'ā* more than one path may have been traversed by travelers. Additionally, grass and *koa haole* growth is thickest on the *pāhoehoe* terrain; this, in combination with the lack of trail structure, makes identifying specific trail alignments on the *pāhoehoe* lava essentially impossible.

Site Distribution

Overall, the site/feature types and functions observed during the inventory survey correlate with the anticipated finds for the Intermediate and Upland Zone of the Kekaha region in which the project area lies. Historic properties within the project area include agricultural modification, permanent and temporary habitation complexes, a large number of lava tube sites (including tubes used for habitation, water collection, burial, and ceremonial activity), historic animal husbandry, and several intact trail systems. Most habitation sites have been interpreted as temporary in nature, with permanent habitation sites increasing in density significantly in the *mauka* portions of the project area. Agricultural sites/features are present in increasing density on the *mauka* slopes where the Kona Field System begins in earnest; lower elevation agricultural modifications represent opportunistic productivity versus the type of full scale land modification for intensive productivity at higher elevations. Several long trails traverse various portions of the project area and are both historic and pre-contact in style. Finally, burials are most commonly found in lava tubes and the majority are located within the northeastern parcel, TMK 26. Overall, the majority of the recorded sites in the project area are presumed to be pre-contact, with some historic period activity. Based on historic information, goat and cattle and grazing was the main form of land use during the historic to modern era, although there are a few historic homestead sites present, as well as historic burials.

Site distribution clearly indicates a preference for permanent habitation in the *mauka* portion of the project area, most notably in the northeastern parcel (TMK 26). There are fairly distinct differences between Kaloko and Kohanaiki Ahupua'a site density; very possibly due to ranching activity and bulldozing disturbing much of the Kaloko portions of the *ahupua'a*. The site density in Kohanaiki is especially high in TMK 25 and 26. Probably most surprising is the large number of sites in TMK 25, and large amount of widespread temporary habitation in what is generally

thought of as a "barren" land. The increased amount of habitation on the *mauka* slopes (eastern portion of TMK 26) is less surprising, as this is a common pattern for this area, although this makes the numerous site complexes no less impressive. The lava tube density in TMK 26 is also quite impressive, with nearly every lava tube encountered having at least minor cultural modification, and lava tube sites ranging from small shelters to high energy-investment permanent habitation complexes. Water collection in this parcel is also quite remarkable, with the number of total water catchment features numbering in the hundreds, if not thousands for the entire Kaloko Makai project area, with the majority located in TMK 26.

Geologically, the large south parcel (TMK 28) is largely barren *'a'ā* with very low site density (approximately 0.11 sites/acre); relatively level pāhoehoe areas in the *mauka* section of the parcel were more heavily utilized in the past but there does appear to be disturbance of older sites from historic and modern ranching activity. It is notable that the majority of sites in this parcel 28 (and within the Kaloko Ahupua'a portions of the project area in general) are either lava tubes or located on high outcrops/tumuli. This undoubtedly is in part due to the advantages of these locations for habitation (shade, cool breeze, good views, etc.), but it is also hypothesized that bulldozing and ranching activity could also be responsible for the lack of intact surface structures in this area. In TMK 28, the most notable sites include a more than 500 meter long formally constructed *pāhoehoe* slab trail that leads to a ceremonial enclosure (probable *heiau*) at the edge of the *'a'ā* flow. There is also a series of three large burial platforms in the northeastern corner of this parcel.

The northern *makai* parcel, TMK 17, also has fairly low site density relative to the *mauka* parcels (0.26 aites/acre). This is not unexpected given the rough *pāhoehoe* and *'a'ā* that dominate this area, with little access to water and generally very rough conditions. About 20% of the sites in this parcel consist of *mauka/makai* trails (mostly *pāhoehoe* slab stepping stone trails) running across *'a'ā* flows. An unusual aspect of this set of trails is their proximity to the *ahupua'a* boundary, suggesting that there was substantive traffic between Kohanaiki and Kaloko Ahupua'a in this area. There is a noticeable concentration of surface sites that runs from the center of the project area up a moderate *pāhoehoe* ridge that ends at a foot of a very prominent, tall *'a'ā* flow near the *mauka* boundary of the project area. Due to the height of this *'a'ā* flow, there are many sites here, including some over the boundary of the project area.This parcel also has a fairly large number of modified outcrops and enclosures, which mainly function as intermittent (temporary) places for habitation. Most temporary habitation sites are located near identifiable or inferred transportation routes, and sites generally are most frequent on ridges and tumuli, or in lava tubes. In this way, the dense sites along the 120 foot contour and the other distinct ridges are expected. Lava tubes are relatively rare in this parcel, adding to the difficulty of water procurement, and this portion of the project area fits the model for the Intermediate Zone (Cordy 1991) very well.

Immediately *mauka* of parcel 17, site density begins to increase in TMK 25, with 0.34 sites/acre. Habitation (both temporary and permanent) site density increases, with more formal and larger habitation complexes in the east portion of the parcel. Notably, there was considerably more habitation sites than was expected given that most of the parcel is within the "Intermediate Zone" (Cordy 1991). In general, there is a clear preference of *pāhoehoe* terrain over *'a'ā* terrain in terms of site location. The *'a'ā* tends to display features such as trails, habitation, and storage sites and generally the elevated flows likely create separation and distinction for certain ceremonial sites. Because many of the sites are close together, it seems reasonable to conclude that many, though probably not all, the structures were in use contemporaneously. If not used

contemporaneously in this area, it is difficult to understand why so many enclosures were constructed, instead of modifying existing structures. Interestingly, the number of enclosures in Kohanaiki is in sharp contrast to Kaloko, with several permanent habitation sites and the relatively dense area of habitation around the top of Huliko'a Drive (in Kohanaiki). Though there are few lava tubes to collect water in, the intensive agricultural site near the northern edge of the project area is the best evidence that many of these Kohanaiki habitations were well populated. It stands to reason that it is likely that several families lived seasonally in the area, perhaps more often. It also seems likely that survivors of disease epidemics after contact made the shortest move possible, to the Kohanaiki Homesteads established along the government road (Māmalahoa Highway) 2.4 kilometers or 1.4 miles directly upslope.

The northeastern (*mauka*) parcel, TMK 26, has by far the highest site density (0.62 sites/acre). This area is characterized by large expanses of *pāhoehoe*, an increased amount of soil development and rain fall, and an increase in the size and number of lava tubes. While the west portion of the parcel is similar in site density and in character to TMK 25, the eastern upland portion has a very steep increase in site density and the number of large site complexes. The site complexes tend to have multiple features (note that 43% of all features from the entire project area are located within this parcel, despite it being the smallest in acreage) and sites are more commonly formal than in the other three parcels. There is an increase in the number and size of permanent habitation complexes and an increase in intensity of lava tube utilization. Water collection within lava tubes is ubiquitous, as is low-intensity agriculture throughout the parcel. On the *mauka* slopes of the project area agriculture increases greatly in intensity and becomes more formal; this area is considered a portion of the Kona Field System and was recorded as a portion of that large agricultural complex. This parcel also has a fairly formal trail running *mauka/makai*; this trail appears to match Emerson's historic maps that refer to it as "Kohanaiki Road" (see trails discussion above). Other notable sites include several ceremonial structures and petroglyph panels; some of the ceremonial structures are probable *heiau*. Finally, burials are also very common within this parcel, most often located within lava tubes, although several surface structures have also been determined to be burial platforms. Burials are often single individuals, but some tubes were clearly being utilized as burial tombs, and burials range from pre-contact to historic. Many burials are located far from any tube entrance, and this issue will need to be fully addressed in preservation and burial treatment plans.

Conclusions

Kohanaiki and Kaloko, based on the present research, had fairly different in resources at the elevation of the project area, and varied significantly in the types of resources as elevation increased. Rainfall, eroded *pāhoehoe* preferable for agriculture, and barren *'a'ā* all created distinct landscapes for these *ahupua'a* in the project area. Both had numerous lava tubes a great resource in this arid region. In Kohanaiki the *mauka* regions had greater potential for agriculture and had very dense lava tubes, attracting habitation to this area.

As a whole, inhabitants of Kohanaiki and Kaloko were fairly spread out, but were more concentrated along the upper half of the project area. Pre-contact times there could have been as many as a dozen households living in this more *mauka* area. As has been demonstrated elsewhere in Kona, strong preference was given to ridges, small rises and proximity to lava tubes in the case of most of these habitations. This habitation area in the project area was most likely the *makai* edge of an inland population center, that likely extended *mauka* of the Kohanaiki

Homesteads. In post-contact times, it is likely that many of those who remained resettled near the new government road, at the Kohanaiki Homesteads or in the land claims awarded in this vicinity. Still, findings show that the area continued to be an important resource and habitation area evidenced by a notable number of historic sites including a habitation, platforms, two curb stone trails, a historic habitation and numerous historic burials. In these post-contact times, the mauka project area probably served as an informal extension to the Kohanaiki Homesteads to the *makai*.

Residents of these areas were industrious and opportunistic use of the natural terrain and natural resources is evident. The lack of readily available freshwater led to a number of adjustments in living practices. Agricultural areas are concentrated higher up the slope where rainfall is more prevalent. Lava tubes were utilized to capture dripping ground water almost without exception, even when the labor required to do so would have been very significant. Habitation was also somewhat intensive, with dense complexes of structures located further *makai* than might have been expected by previous work in the area. These areas were interdependent with other portions of the *ahupua'a*. Presence of significant marine food remains in *mauka* agricultural areas and habitations reinforce the importance of coastal resources here. The *makai* project area was probably frequently traversed on *mauka-makai* trails, which were identified to some degree in the project area and have been identified in Kaloko-Honōkohau National Historic Park to the west. Interestingly, evidence was found that Kaloko and Kohanaiki may have been interdependent upon eachother at these elevations, perhaps more than with other neighboring *ahupua'a*. Dense clusters of trails crossing *'a'ā* flows in both the *makai* project area (TMK 17) and the middle project area (the center of TMK 25) virtually straddle the presently known *ahupua'a* boundary. Also, historic maps show that the major *mauka-makai* trail, Site -10714, crossed from Kohanaiki into Kaloko in the middle project area, though this was not definitively confirmed with archaeological findings. At least one possible crossing preserved as a gap in the post-contact *ahupua'a* wall was also located near the *mauka* end of the project area.

Until the construction of Queen Ka'ahumanu Highway, the use of some of these trails likely continued for access to the coast. Other historic use, in particular ranching, played a major role in a continually evolving landscape. Huehue ranch provided jobs for paniolo who continued utilize the area, introduced fodder flora have overtaken much of the landscape and grazing and mechanical clearing have likely negatively impacted many sites. Modern use has continued to affect the area and disturbance in the form of bulldozing, dumping and camp sites along Hina Lani Street have had the greatest impact.

Nevertheless, these numerous stages of land use have had a large area to share, and much of the earliest land use in pre-contact times is still in good condition. Further research on these cultural resources through a comprehensive data recovery program will add considerably to this knowledge. Preservation will also be a major consideration especially in the northeast project area with emphasis on trails, burials and sites of high interpretive value.

PROJECT EFFECT AND MITIGATION RECOMMENDATIONS

Project Effect

The proposed project will affect historic properties recommended eligible to the Hawai'i Register. CSH's project specific effect recommendation is "effect, with agreed upon mitigation measures."

Historic properties outside of the project area do have the potential to be affected by the current development. The proximity of the project area to Kaloko-Honokōhau National Historical Park to the east is the primary concern. Historic properties north and south of the project area are of less concern due to the extensive industrial/commercial developments separating the project area from the potential sites there. Also of some concern are the remaining Kohanaiki Homsteads in the next parcel east of the project area. Three of these homesteads were recommended for preservation by previous archaeological work there (Wolforth 2005) and if not directly affected by development of that parcel, their viewplane has the potential to be affected by development of the project area.

In the case of the National Historical Park, there is potential visual impact by further development of the slopes of Hualālai and potential auditory impact due to increased use and/or expansion of Queen Ka'ahumanu Highway and/or Hina-Lani Street. In both cases, significant impact has already been made by large industrial/commercial developments *mauka* of Queen Ka'ahumanu Highway. However, due to the situation of the project area on the slope immediately overlooking the park, there is a potential cumulative effect.

Mitigation Recommendations

Overall, the project area contains a large number of significant sites that are recommended for preservation and/or data recovery. It is recommended that of the 341 sites in the project area, a total of eighty (80) sites be subjected to a program of data recovery to address scientific and informational concerns and a total of seventy-two (72) sites be preserved (Table 11). Preservation sites should be considered for some amount of data recovery effort as part of the preservation plan, to include further photographic documentation, dating, etc. as appropriate. It is believed that continued documentation in some cases could help mitigate possible vandalism or looting of preserve areas.

The remaining 189 sites are not recommended to undergo further research, as the documentation and plotting of location during the current study has addressed the limited information available at these sites. These sites are classified under Criterion D significance only and are generally characterized as sites in poor structural condition, or sites such as minimally modified lava tubes, trail remnants, agricultural features, or animal husbandry walls that lack excavation potential.

Mitigation for impact on historic properties outside the project area is best addressed by architectural and landscaping measures to minimize visual impact on the environment in Kaloko-Honokōhau National Historical Park. Based on previous development of the vicinity, tall buildings directly adjacent to the highway, bright or light colored paint, heavy use of corrugated metal and landscaping using non-native plants would have the greatest visual impact on those properties in the park. Use of low-rise architecture, local stone, muted colors and native plants

would be preferable from a mitigation perspective and would minimize the urban feel of the land most immediately visible from, and historically tied to, that preserved in the park.

Table 11. Mitigation measures recommended for each parcel

Recommendation	TMK 17		TMK 25		TMK 26		TMK 28		All 4 TMKs	
	No.	%	No.	%	No.	%	No.	%	No.	%
Preservation	3	5.1	18	14.9	38	30.8	13	31.7	**72**	**21**
Data Recovery	19	32.2	29	24.0	23	19.2	8	19.5	**80**	**23**
No Further Work	37	62.7	74	61.2	60	50.0	20	48.8	**189**	**56**
Total (total %)	**59 (17%)**		**121 (36%)**		**120 (35%)**		**41 (12%)**		**341 (100%)**	

Data Recovery

A total of eighty (80) sites are slated for data recovery and should be subjected to further documentation and, if feasible, excavation to address scientific and information interests. Data recovery should proceed in accordance with a data recovery plan that is to be submitted to DLNR State Historic Preservation Division for review and approval.

The sites selected for data recovery include a variety of site and function types attributable to traditional Hawaiian use. Functional types include habitation (temporary and permanent), agricultural areas, trails, activity areas (i.e., water collection in lava tubes), and sites deemed to have good excavation potential. The majority of sites slated for data recovery are those sites with the most formal construction and/or the largest cultural deposits. In this project area this results in a close focus on habitation (both temporary and permanent), both in lava tubes and on the surface.

Potential research topics that further documentation could answer should be explored in the data recovery plan. At this time it is recommended that further consideration be given to research topics such as those listed below, as well as any pertinent questions raised by contemporary research on the island, or in comparable environments elsewhere in the Pacific region. One lava tube within the project area contains some potentially significant paleoenvironmental remains that should also be considered during data recovery. Further, the plan should consider numerous new technologies entering the field of archaeology that could answer new types of questions.

Possible Data Recovery Topics:

(1) An evaluation of historic property distribution as it compares to common settlement models (e.g., Schilt 1984; Kirch 1985; and Cordy et al. 1991). That is, were Kohanaiki and Kaloko exceptions to these models or do they confirm their veracity? In addition, historic versus pre-contact settlement patterns could be addressed.

(2) Further study of the use of permanent and temporary habitation sites in the upland zone to include further functional interpretation and analysis of greater quantities of

midden for subsistence patterns in the area. Results could be compared with other habitation models (e.g. Cordy et al. 1991; Mitchell and Kolb 1992; and Hammatt et al. 1995).

(3) To a limited degree, habitation research may collect data with potential to provide some insight into social dynamics in both *ahupua'a* through a comparison with Dr. Ross Cordy's 1991 model of social rank determinants in coastal Kaloko and Honokōhau I and II *ahupua'a*. There are several large habitation complexes within the project area that include ceremonial components, and these aspects could be more thoroughly addressed.

(4) Water collection within lava tubes is a frequent activity throughout the project area, and site distribution appears to be partially dependent on this resource. Thus, a focus on the distribution and chronology of this particular resource and its relationship to habitation is recommended.

(5) Assessment of the suitability of non-radiometric dating of structures and/or trails, such as TL/OSL.

(6) Higher quality digital photographic documentation.

Although the eighty sites designated for data recovery can be wholly or partially mitigated through this measure, these historic properties may have a valuable aspect for the proposed residential neighborhood, and interim preservation is an alternate consideration. These sites speak to the history of the locale, creating a uniqueness that cannot be engineered into an urban area. One option is to voluntarily preserve these habitation sites on lots that would appeal to home owners who are interested in history and would perceive this as value added to their property. The recommendation would thus be interim preservation with an option to pursue data recovery at the landowner's discretion.

Site Preservation

There are a total of seventy-two (72) sites in the project area that are recommended for preservation in whole or in part. A large percentage of these sites are recommended for preservation based on the presence of a burial (confirmed or probable) and/or association with a burial. Burials are especially common in lava tubes within the project area and special consideration will need to be given to the preservation in place of burials, especially when remains are located far from the lava tube entrances. Thus, the preservation plan will need to address the logistics of preservation boundaries in terms of accurate locational information as well as how to preserve/seal entrances associated with burials. Several of the non-burial preserve sites are major intact trail systems that run for several hundred meters, and two sites are *ahupua'a* walls that are recommended for preservation with breaches allowed. Other preserve sites include ceremonial enclosures and platforms (possible *heiau*), excellent examples of habitation complexes (some of which utilize both surface and sub-surface areas), and a few petroglyph panels.

It is recommended that considerations for the preservation of these sites be detailed in a burial treatment plan and preservation plan to be approved by the State Historic Preservation Division.

Disposition of Materials

The complete collection of artifacts associated with this archaeological inventory survey was collected from private lands; accordingly, this material belongs to the landowner. While a relatively small number of artifacts were collected given the size of the project, some items were retrieved during the inventory survey due to concern over possible looting. Some artifacts and midden were collected as part of the test excavations conducted. The artifacts associated with this archaeological inventory survey will be temporarily housed at a CSH storage facility. CSH will make arrangements with the landowner regarding the disposition of the project's collection. Should the landowner request archiving of material, then the archive location will be determined in consultation with SHPD.

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Appendix J

Cultural Impact Assessment for Kaloko Makai
Cultural Surveys Hawaii, Inc.
May 2008

Draft

Cultural Impact Assessment for a 1,150-Acre Parcel within portions of Kohanaiki and Kaloko Ahupua'a, North Kona District, Hawai'i Island TMK: [3] 7-3-009:017, 025, 026, 028

Prepared for

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(Job Code: KOHANAIKI 1)

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Management Summary

Reference	Cultural Impact Assessment for a 1,150-Acre Parcel within Portions of Kaloko and Kohanaiki Ahupua'a, North Kona District, Island of Hawai'i, TMK: [3] 7-3-009:017, 025, 026, 028 (Magat et al. 2008)
Date	May 2008
Project Number (s)	Cultural Surveys Hawai'i Inc. (CSH) Job Code: KOHANAIKI 1
Agencies	State of Hawai'i Department of Land and Natural Resources / State Historic Preservation Division (SHPD)
Project Location	The project area is comprised of TMK: [3] 7-3-009:017, 025, 026, 028. The project area is located in portions of Kaloko Ahupua'a and Kohanaiki Ahupua'a, and the west boundary is approximately 1300 meters east from the western coast of Hawai'i. The project area is bound by Queen Ka'ahumanu Highway to the west, by undeveloped parcels to the east, 'O'oma 2nd Ahupua'a to the north with Huliko'a Drive north of the *makai* portion, and "Kaloko Industrial" or "New Industrial" south of the *makai* portion. The surrounding parcels are largely undeveloped. Hina Lani Street runs *mauka/makai* through the project area. This area is depicted on the 1996 USGS 7.5-Minute Series Topographic Map, Keahole Point and Kailua Quadrangles (Figure 1).
Land Ownership	Private, Stanford Carr Development Kaloko Makai, LLC
Project Description	The proposed project comprises the development of a residential subdivision with limited retail establishments near Queen Ka'ahumanu Highway. Associated ground disturbance will include grading and excavation related to the project area's development, to include engineering topography, placement of structural footings, utility installation, roadway, parking area installation, and landscaping. Importation of substantial construction gravel and fill dirt will also likely accompany much of the construction.
Project Acreage	The CSH project area consists of approximately 1,150 acres.
Area of Potential Effect (APE)	For the purposes of this cultural impact assessment (CIA), the APE is defined as the approximately 1,150-acre project area footprint. While this investigation focused on the project APE, the study area also included portions of the *ahupua'a* of Kohanaiki and Kaloko.
Document Purpose	The project requires compliance with the State of Hawai'i environmental review process [Hawai'i Revised Statutes (HRS) Chapter 343], which requires consideration of a proposed project's effect on cultural practices. At the request of Stanford Carr Development, LLC, CSH undertook this CIA. Through document

	research and cultural consultation efforts, this document provides information pertinent to the assessment of the proposed project's impacts to cultural practices (per the OEQC's Guidelines for Assessing Cultural Impacts). The document is intended to support the project's environmental review and may also serve to support the project's historic preservation review under HRS Chapter 6E-42 and Hawai'i Administrative Rules (HAR) Chapter 13-284.
Consultation Effort	Hawaiian organizations, agencies and community members were contacted in order to identify potentially knowledgeable individuals with cultural expertise and/or knowledge of the project area and the vicinity. The organizations consulted included the State Historic Preservation Division (SHPD), the Office of Hawaiian Affairs (OHA), the Hawai'i Island Burial Council (HIBC), and community and cultural organizations in the North Kona area. A total of twenty-five people were contacted for the purposes of this CIA; 18 people responded; and 12 *kūpuna* and/or *kama'āina* were interviewed for more in-depth contributions. At this writing, a total of nine of these individuals have consented to have their testimonies included in this report. Efforts to obtain permission to include the testimonies of the remaining three individuals who were interviewed for this CIA are ongoing.
Results	Background research conducted for this project yields the following results: 1. The project area is part of the traditional region known as Kekaha, extending from Honokōhau to 'Anaeho'omalu in North Kona. Despite being a dry place, the project area contains many unique resources—including dozens of subterranean lava tubes and caverns used to collect water; the project area included an extensive pre-Contact Hawaiian settlement that continued to support a subsistence-based lifestyle into the early historic era. 2. Archaeological research shows the project area contains hundreds of culturally and historically significant sites and thousands of individual features within these sites. Sites in the project area include permanent and temporary habitation structures—many of which incorporate natural features of subterranean lava tubes into their design, agricultural features (including extensive rock mounds used to plant sweet potatoes), at least 65 burials located in approximately two dozen burial sites, *ahu* (stone markers), trails, petroglyphs, *ahupua'a* boundary walls, *papamū* (traditional gaming site), and others. 3. Radiocarbon dating from nearby sites definitively shows the general area has been utilized by humans for at least 1,000 years.

	4. The project area is likely to contain substantial additional subsurface deposits—as yet undiscovered and undocumented—associated with lava tubes and subterranean chambers, including burials and other highly sacred materials. 5. The project area is also associated with the unique history of Hawaiian-style ranching and *paniolo* ("Hawaiian cowboys"), including the well-documented Hu'ehu'e Ranch. 6. The project area is associated with specific *mo'olelo* (oral history) about (a) the sixteenth or seventeenth century ruler of Hawai'i Island, Lono-i-ka-makahiki, who was involved in several famous battles with the chiefs of Maui (including Kama-lala-walu) and other parts of Hawai'i, (b) Kamehameha I, whose remains were reportedly interred near Kaloko Fishpond, (c) 'Umi-a-Liloa, who frequented the famous fisheries of Kaloko and Kohanaiki, and (d) the Nahulu chiefs (including Ka-me'e-ia-moku and Ka-manawa). The project area is also associated with legendary references to Ka-Miki, various *mo'o* (water spirits) that resided at fishponds at and near the seashore, and Hualālai; and more general references to water-collection lava tubes and the unique environmental conditions of the region. Community consultation conducted for this project yields the following results: 1. Several participants voiced negative feelings and opinions about the overall cumulative impacts of ongoing and future developments in Kona District and the project area environs pointing out such factors as a diminished quality of life for locals, dwindling resources, prices beyond the reach of most kama'āina and overtaxed infrastructure as contributing to a loss of what is authentic and traditional about Kona. 2. Several participants talked about subsistence resources that were previously available to, and enjoyed by, locals—such as various *limu* (seaweeds), crabs and fish—but that are no longer available or easily accessed due to the cumulative impacts of development in Kona. 3. Most participants talked about the presence of burials and *iwi kūpuna* (ancestral remains) throughout the project area. It is clear from some of the interviews that there are many lineal and/or cultural descendents to some of these burials that should be consulted during the proposed development, since some historic-era family burial sites, in particular, may be impacted by the subject project. 4. A few participants talked specifically about changing patterns of vegetation and plant life, highlighting the loss of native and

	Polynesian-introduced species as well as useful historic introductions such as mango trees. In particular, there is a remnant area of lowland forest in the project area containing several endangered and threatened native species, including *ko'oko'olau* (*Bidens spp.*). It is important to understand that such natural resources are significant cultural and historical resources to many native Hawaiians. 5. A few participants talked about drinking from water collection caves in historic times, as they moved around the landscape (e.g., as ranchers), and of brackish pools used by their animals (e.g., cattle and horses). 6. Several individuals discussed trails in the project area, including a historic trail running from the ocean to the mountains (this is the so-called "Road to the Sea") along the *ahupua'a* boundary between Kaloko and Kohanaiki, that were used in the recent memories of some participants to gather resources from the sea and the uplands. Given many changes and modern developments, most of the trails in the project area have not been used by many people for several decades.
Recommendations	The following recommendations are based on a synthesis of all the information gathered during preparation of this CIA. Faithful attention to these recommendations, and efforts to develop appropriate measures to address these concerns, will help mitigate the adverse impacts of the proposed action on Hawaiian cultural beliefs, practices and resources by the project: 1. Most of the people who voiced negative feelings and opinions about the overall cumulative impacts of ongoing and future developments in Kona District stopped short of saying they were entirely opposed to the proposed project; however, some participants recommended the project proponent prepare a draft Master Plan for review and comment by the public so that the various short- and long-term cumulative impacts, both negative and positive (e.g., the construction of recreational facilities and/or parks and other "green spaces"), can be assessed by the community. 2. Several participants, including the Office of Hawaiian Affairs (OHA), recommend the project proponents work together with the local community in order to develop plans that are *pono* (i.e., harmonious with the local environment), culturally sensitive and fair and balanced with respect to the *'āina* and its natural and cultural resources. 3. Efforts should be made to protect and preserve brackish water pools and water collection lava tubes.

	4. Most participants strongly urged that no burials or *iwi kūpuna* (ancestral remains) should be relocated or moved to make way for the proposed project. 5. One participant who worked as a *paniolo* for many years recommended preservation and protection of "holding corrals" (*puakini*) in order to educate present and future generations about the unique Hawaiian-style "cowboys" that flourished in and around the subject project area in historic times. 6. Efforts should be made to preserve and protect all trails in the project area, including designing around trails to maintain an authentic sense of place that is unique to Kona. 7. Efforts should be made to preserve and protect the remnant lowland forest and any other native and Polynesian-introduced plants species in the project area, including *ko'oko'olau* plants and other endangered and threatened species. Preparation of a "vegetation master plan," which could be combined with the next item (below), would help guide plans and commitments to preserve and protect these unique resources. 8. Several participants stated that, if the proposed development goes forward, it should use environmentally-appropriate landscaping that enhances the sense of place, including native and Polynesian-introduced species. Preparation of a "vegetation master plan," which could be combined with the previous item (above), would help guide plans and commitments to preserve and protect these unique resources. 9. OHA, in particular, recommends the project proponents faithfully follow all applicable laws with respect to the treatment of all historic properties located within the subject project area. 10. Cultural monitoring should be conducted during all phases of development, including all significant ground disturbances, to ensure that significant cultural and historical resources are protected and preserved in accordance with appropriate mitigation plans. 11. Community members and groups responsible for the long-term care of the Kohanaiki and Kaloko Ahupua'a, as well as cultural practitioners who utilize the area for gathering and for cultural and educational activities, should be further consulted regarding the above issues and other concerns throughout the planning, development and operation of the proposed housing development. This consultation should include all interested community groups and individuals who have a stake in the project area.

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Section 1 Introduction

1.1 Project Background

At the request of Stanford Carr Development, LLC, Cultural Surveys Hawai'i, Inc. (CSH) conducted a cultural impact assessment (CIA) of a 1,150-acre parcel within portions of Kaloko Ahupua'a and Kohanaiki Ahupua'a, North Kona District, Hawai'i Island, TMK: [3] 7-3-009:017, 025, 026, 028. The project area's west boundary is 1300 m east of the western coastline of Hawai'i. The project area is bound by Queen Ka'ahumanu Highway to the west, by undeveloped parcels to the east, 'O'oma 2nd Ahupua'a to the north with Huliko'a Drive north of the *makai* portion, and "Kaloko Industrial" or "New Industrial" south of the *makai* portion (Figures 1-4).

The 1,150-acre is privately owned by Stanford Carr Development Kaloko Makai, LLC. The proposed project comprises the development of a residential subdivision. Associated ground disturbance will include excavation related to the project area's development, to include structural footings, utility installation, roadway, parking area installation, and landscaping.

The purpose of the CIA is to consider the effects that the proposed project may have on the culture of Hawai'i, and traditional and customary rights. 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." Act 50 (SLH 2000) was passed as an attempt to balance the scale between traditional lifestyles and development and economic growth. Act 50 provides that environmental impact statements: (1) Include the disclosure of the effects of a proposed action on the cultural practices of the community and State; and (2) Amend the definition of "significant effect" to include adverse effects on cultural practices.

The scope of work was designed to meet the Guidelines For Assessing Cultural Impacts as adopted by the Office of Environmental and Quality Control (OEQC) (1997), as well as the requirement of any other State and County agencies involved in the review process for the proposed project. The "Guidelines for Assessing Cultural Impacts" issued by the OEQC discuss the types of cultural resources, practices and beliefs that might be assessed. The Guidelines state:

> The type of cultural practices and beliefs subject to assessment may include 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.

The assessment also considers cultural resources, practices and beliefs within the broader context of Kaloko Ahupua'a and Kohanaiki Ahupua'a that are relevant to assessing the role of the project area.

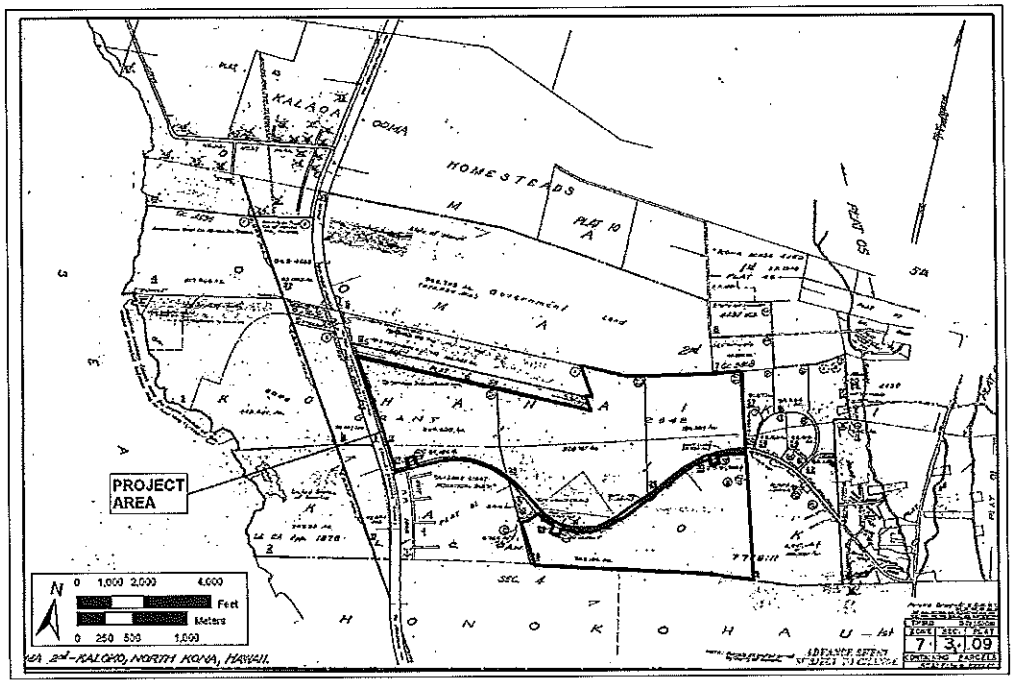

Figure 2. Tax Map Key (TMK) showing project area

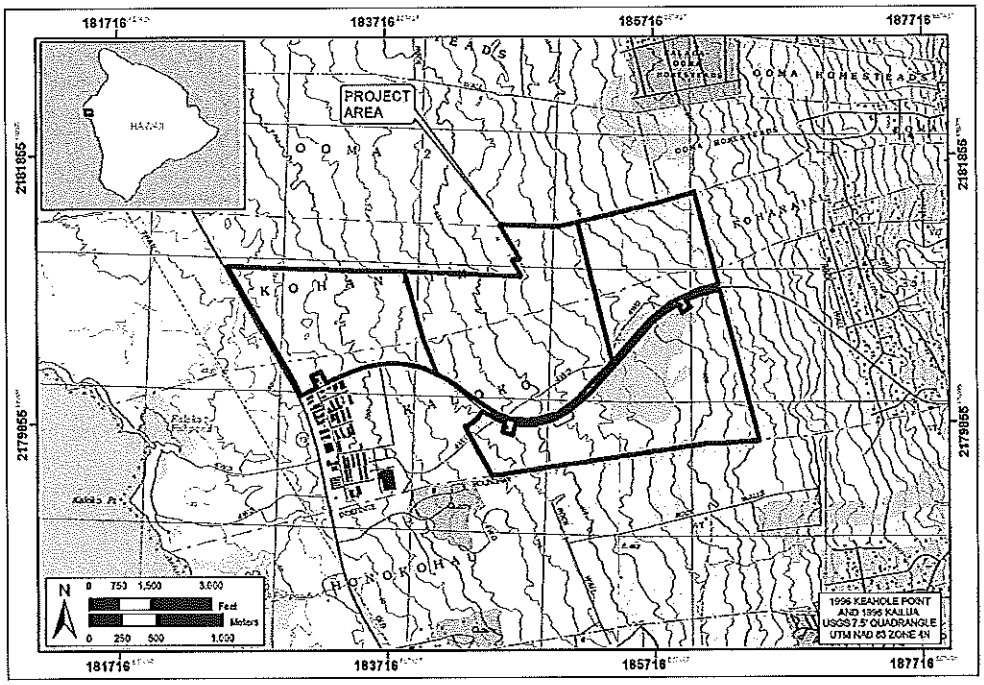

Figure 1. U. S. Geological Survey Quad Map showing project area

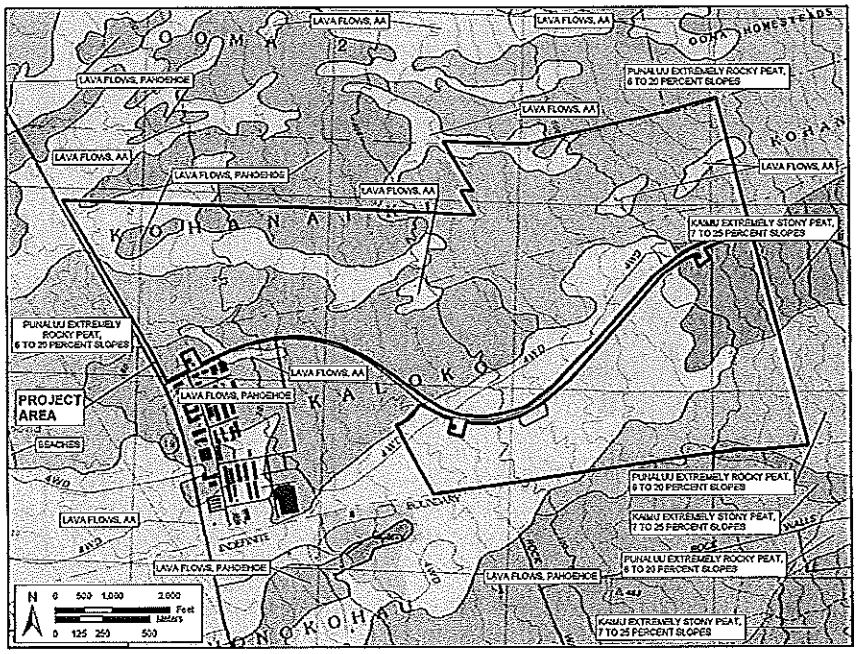

Figure 4. Soil map of the project area and vicinity

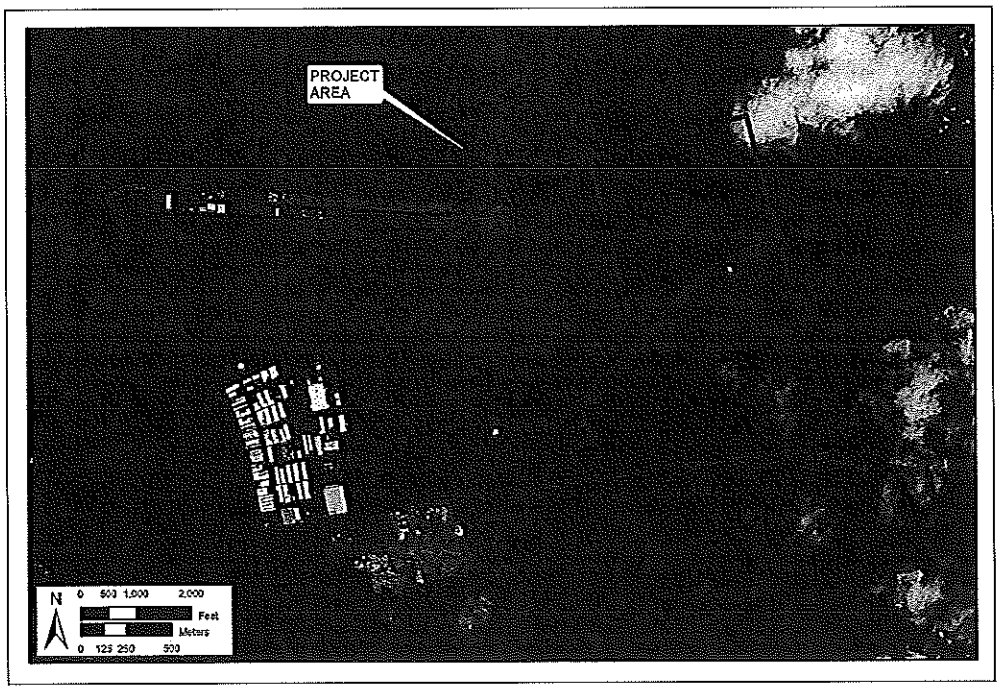

Figure 3. Aerial view of project area (source: USGS Orthoimagery 2005)

1.1.1 Archaeological Inventory Survey

An archaeological inventory survey including a surface survey, subsurface testing, and laboratory analysis of cultural and radiocarbon-dating materials was conducted for the project area. Given the large size of the project area, a decision was made to split the archaeological inventory survey reports by individual TMK parcel, producing a total of four reports.

1.2 Scope of Work

The scope of work for the CIA includes:

1. Examination of historical documents, Land Commission Awards, and 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.
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.

1.3 Environmental Setting

1.3.1 Natural Environment

The project area comprises approximately 1,150 acres in the *ahupua'a* of Kaloko and Kohanaiki. The lands are located on the leeward coast of Hawai'i Island within the district of North Kona on the lower west slope of Hualālai Volcano. The project area is bounded by Queen Ka'ahumanu Highway to the west, Hina Lani Street to the south, TMK [3] 7-3-009:032 to the east, and 'O'oma 2nd Ahupua'a to the north. Elevation within the project area ranges from 80 ft. above mean annual sea level (a.m.s.l.) at the western boundary to 760 ft. a.m.s.l. along the eastern boundary.

Kona weather is typified by afternoon showers brought on by warm air that has been moved inland by light sea breezes. The humid air gradually condenses over higher altitudes throughout the day. At night, the land cools resulting in breezes which send warm air back out to sea. Rainfall in the project area averages 10 inches per year (Cordy et al. 1991). There are no natural springs or perennial streams within the project area, but dozens of subterranean water-collection lava tubes have been identified during archaeological survey by CSH.

The land surface is comprised of a large *'a'ā* flow running *mauka/makai* through the project area with several smaller flows to the northeast and a large flow in the northwest portion of the

project area (see Figure 4). The surface of the *'a'ā* lava ranges from roughly level expanses to rough fractured ridges.

Pāhoehoe lava covers the west-central and north-central sections of the project area. The surface ranges from level expanses to highly fractured tumultuous areas and is characterized by numerous tumuli and pressure ridges with depressions or undulations in the *pāhoehoe* containing thin soil pockets. Collapsed portions of lava tubes also contribute to the uneven surface of the *pāhoehoe* flows.

Punaluu extremely rocky peat is the dominant soil type in the project area (see Figure 4). Punaluu soils consist of well-drained, thin organic soils over *pāhoehoe* lava bedrock. The soils are gently sloping to moderately steep. The natural vegetation associated with this soil type consists of *koa haole* (*Leucanena glauca*), Christmasberry (*Schinus terebinthifolius*), guinea grass (*Panicum maximum*), natal redtop (*Rhynchelytrum repens*), and sand bur (*Cenchrus echinatus*). These soils are used for pasture (Sato et al. 1973). Both slope and soil development increase considerably with elevation.

In general, vegetation (especially ground cover) is dense throughout most of the project area and obscures ground visibility. The non-native *koa haole* tree dominates the project area vegetation along with the non-native air plant (*Kalanchoe pinnata*), non-native Christmasberry trees and grasses (predominately non-native fountain grass, *Pennisetum sectacacum*). The native *pili* grass, *Heteropogon contortus*, may also be present. At higher elevations, Christmasberry becomes more dominant, often growing in dense thickets that seriously impede pedestrian passage and greatly decrease ground visibility. Other non-native plants observed include lantana (*Lantana camara*) and *liliko'i* (*Passiflora edulis*). Native plants present include: *'ilima* (*Sida fallax*) in scattered numbers, *noni* (*Morinda citrifolia*), *'ōhi'a* trees (*Metrosideros polymorpha*), *laua'e* (*Phymatosorus scolopendria*), *'ohe* trees (*Reynoldsia sandwicensis*), *alahe'e* (*Psydrax odorata*), *kukui* (*Aleurites moluccana*), *kī* (*Cordyline fruticosa*; also often referred to as *tī*) and *halapepe* (*Pleomele spp.*). Native plants observed at higher elevations include: *naio* (*Myoporum sandwicense*), *'a'ali'i* (*Dodonaea sp.*) and *'ūlei* (*Osteomeles anthyllidifolia*).

1.3.2 Built Environment

Although much of the land around the project area remains rural, the built environment is distinct on the north and west sides of the parcel (see Figure 3 above). The built environment is distinct near the Queen Ka'ahumanu Highway, *makai* of the project area. To the north of the project area is a light industrial area bordering Huliko'a Drive built after the Colin et al. (1996) study. This area is marked by the Matsuyama Market and Pine Tree Cafe near the intersection of Huliko'a Drive and the highway. The area is marked by a stone sign "Kohanaiki." Today the industrial area is nearly complete, although some construction continues.

Hina Lani Street, a major coastal/inland (*makai/mauka*) connector road, runs through the center of the project lands. Two 1-million-gallon water tanks and a fairly large base yard have been developed along Hina Lani Street and are convenient points of reference. South of the *makai* (west) portion of the project area is a large industrial area often referred to as "Kaloko Industrial" or "New Industrial" (in reference to an older industrial area near the old Kona airport). This area features numerous large warehouses, light industrial and commercial buildings

(Home Depot and Costco, among others). As of the writing of this report, construction has commenced on additions to this commercial/industrial area *mauka* of the existing warehouses.

The project lands themselves are generally undeveloped, and appear not to have been dramatically impacted by modern activity other than bulldozing. Some modern cattle ranching has apparently taken place intermittently within the project area, with some barbed-wire fencing and a wooden trough present; the historic *ahupua'a* wall that runs through portions of the project area is also a good indication that historic animal husbandry occurred in the area. Modern trash and occasional transient camps were found near some historic properties, but generally this type of modern disturbance is concentrated near Hina Lani Street. However, portions of the *'a'ā* and *pāhoehoe* flows throughout the project area have been bulldozed, and bulldozer roads and intermittent bulldozing activity are present. A large portion of the bulldozing on *pāhoehoe* areas is probably related to the ranching activities. There are additional swaths of bulldozing on the *'a'ā* around the water tanks located on Hina Lani Street and at the large base yard off of Hina Lani Street. Most bulldozer activity tends to be concentrated either near Hina Lani Street, near the southern *ahupua'a* wall, or near barbed-wire fences within the central portion of the project area. There are a few distinct bulldozer roads in the project area, but less distinct signs such as bulldozer tread scars on bedrock were also noted in various locations.

A jeep road present since mid-century runs more or less *mauka/makai* just north of Hina Lani Street and is visible on the aerial view (see Figure 3). A bulldozer road, also visible on the aerial view, extends from Hina Lani Street north to the end of Huliko'a Drive.

Section 2 Methods

Historical documents, maps and existing archaeological information pertaining to the sites in the vicinity of this project were researched at the State Historic Preservation Division library, CSH Library, the University of Hawai'i's Hamilton Library, the Hawai'i State Archives, the State Land Survey Division, the Mission Houses Museum Library, the Hawai'i Public Library, the Archives of the Bishop Museum, and the Kona Historical Society. Previous archaeological reports for the area were reviewed, as were historic maps and primary and secondary historical sources. Information on Land Commission Awards was accessed through Waihona 'Aina Corporation's Māhele Data Base (<www.waihona.com>)

The Office of Hawaiian Affairs, Hawai'i Island Burial Council, and members of other community organizations were contacted in order to identify potentially knowledgeable individuals with cultural expertise and/or knowledge of the study area and the surrounding vicinity. The names for potential community contacts were also provided by colleagues at CSH and from the researchers' familiarity of the families who frequent the area. Some of the prospective community contacts were not available to be interviewed as part of this project. A discussion of the consultation process can be found in Section 5 (Community Consultation Effort). Please refer to Table 2 for a complete list of individuals and organizations contacted.

2.1 Previous Cultural Impact Assessment

A CIA (Hammatt and Shideler 1996) was conducted for a portion of the project area in 1996 as a companion study to the Collin et al. (1996) study of TMK 7-3-009:017. Informants knowledgeable of the project area were interviewed. These consultations focused on identifying traditional cultural practices conducted within the project area as well as addressing community concerns regarding probable burial sites.

This summary of the CIA focuses on the probable burial sites located within that portion of the project area. The reader is referred to the CIA (Hammatt and Shideler 1996) for a detailed discussion and analysis of the traditional cultural practices documented within the project area.

On March 16, 1996, CSH staff interviewed the Reverend Norman Keanaaina, a *kama'āina* (native-born, one born in a place) of Kohanaiki since the 1940s. Reverend Keanaaina stated his belief that there were indeed burials within the TMK parcel 17 portion of the project area. He stated that interment within the TMK parcel 17 portion of the project area continued into the 1930s or 1940s, when his "grandmother's husband," the Kapaa family, was buried. Reverend Norman Keanaaina made a site visit with CSH personnel and was taken to three sites (SIHP No. -20702, -20717, and -20720) in the south central portion of TMK parcel 17, which had been previously identified by CSH as probable burials. The reverend agreed that the filled-in cracks at these sites were probable burials. He stated that the common practice was to wrap the body in a mat or a horse blanket, then inter it in a sufficiently large crack which would subsequently be filled with stones.

In 1996, eight possible burial sites (SIHP Nos. -20702, -20705, -20716, -20717, -20720, -20731, -20743, and -20749) had not been tested to determine the presence or absence of human skeletal remains, and testing was deferred to data recovery. Because the current CSH

archaeological inventory survey sought to re-evaluate and improve records for all of these sites, many of these sites were tested. The focus of this effort was to improve decision-making that now depends more heavily on findings of the archaeological inventory survey. The result of this testing was a reduction of eight possible burial sites to two probable burial sites. A third possible burial site (SIHP No. -20720) was determined to have been destroyed and is therefore no longer a current possible burial site.

Section 3 Traditional and Historic Background

3.1 Mythological and Traditional Accounts

3.1.1 Kekaha

The *ahupua'a* of Kohanaiki and Kaloko lie at the southern end of Kekaha, the portion of North Kona extending from Honokōhau to 'Anaeho'omalu. The character of Kekaha - as it had been established in the Hawaiian consciousness - is represented in a traditional saying recorded by Mary Kawena Pukui and in a brief description by John Papa 'Ī'ī. The saying, "*Kekaha wai 'ole na Kona*", translates to "waterless Kekaha of the Kona district." Pukui states that "Kekaha in Kona, Hawai'i, is known for its scarcity of water but is dearly loved by its inhabitants" (Pukui 1983:184).

Pukui (1983:271) also relates the importance of fishing in the following:

> *Ola aku la ka aina kaha, ua pua ka lehua I kai.*
>
> Life has come to the *kaha* lands for the *lehua* blooms are seen at sea.

Pukui (1983:271) further explains this saying: "Kaha lands refers to Kekaha. When the season for deep-sea fishing arrived, expert fishermen and their canoes headed for the ocean."

Samuel Kamakau, the native historian, relates that in the 15th century, High Chief 'Umi-a-Liloa fished for *aku* along the Kekaha coast, and around 1810, Kamehameha I also fished the shores of Kekaha (Kamakau 1961:20, 203).

Pukui et al. (1974:77-78) also relate that Kaloko is well known for the fishpond with the same name, and Kamehameha's bones are rumored to have been secretly buried here.

Kohanaiki means "small barrenness" (Pukui et al. 1974:115).

'Ī'ī describes the winds of Kekaha:

> ...a cold wind from Kekaha, the Hoolua. Because of the calm of that land, people often slept outside of [sic] the tapa drying sites at night. It is said to be a land that grows cold with a dew-laden breeze, but perhaps not so cold as in Hilo when the Alahonua blows. ('Ī'ī 1959:122)

These passages suggest that Kekaha was firmly identified with its austere physical environment. A legend told in Maguire (1966) reveals the importance of water resources in this general area (see also Wolforth 2005:8-9). The story takes place at the Cave of Mākālei, which is located outside of the current project area near 'Akahipu'u (a nearby mountain). The story focuses on a man named Ko'amokumokuohe'eia, who moved to this area and was told by the current residents that water was very scarce. Water, he was told, could be obtained in "celebrated" caves, but these caves were *kapu* (forbidden), and if caught, trespassers would be killed by the owner of the cave. However, Ko'amokumokuohe'eia discovered a very small cave entrance that no else knew about. The cave had water dripping from its roof (Maguire 1966:30). Ko'amokumokuohe'eia and his father used carved *'ōhi'a* and *wiliwili* trees to capture the dripping water, and his family was thus able to survive during dry spells. This legend clearly

demonstrates the importance of water as a resource that is difficult to procure, and it highlights the importance of water collection caves.

John Ka'elemakule Sr., a Kekaha native, wrote newspaper articles between 1928 and 1930 that provide details about life and customs in the last half of the nineteenth century. Kepā Maly (Maly and Maly 2003) translated these serial accounts that appeared in *Ka Hoku o Hawai'i*. The two following excerpts provide additional details related to water collection.

> ...There were not many water holes, and the water that accumulated from rain dried up quickly. Also there would be weeks in which no rain fell... The water which the people who lived in the uplands of Kekaha drank, was found in caves. There are many caves from which the people of the uplands got water... [September 17, 1929:3] (Maly and Maly 2003:42)

> ...The *kūpuna* had very strict *kapu* (restrictions) on these water caves. A woman who had her menstrual cycle could not enter the caves. The ancient people kept this as a sacred *kapu* from past generations. If a woman did not know that her time was coming and she entered the water cave, the water would die, that is, it would dry up. The water would stop dripping. This was a sign that the *kapu* of Kāne-of-the-water-of-life (Kaneikawaiola) had been desecrated. Through this, we learn that the ancient people of Kekaha believed that Kāne was the one who made the water drip from within the earth, even the water that entered the sea from the caves. This is what the ancient people of Kekaha wai 'ole believed, and there were people who were *kia'i* (guardians) who watched over and cleaned the caves, the house of Kāne... [September 24, 1929:3] (Maly and Maly 2003:42)

Kekaha was, however, "valued by ruling chiefs, inhabited by attendant chiefs, and upon occasion abused by warring chiefs" (Kamakau 1979:31). Describing the apportioning of land by the *ali'i* (royalty) before the ascendancy of Kamehameha, Kamakau records this information about the lands of Kekaha:

> Waimea [he is referring in this case to Waimea, O'ahu] was given to the Pa'ao kahuna class in perpetuity and was held by them up to the time of Kamehameha III when titles had to be obtained. But there was one land title held by the kahuna class for many years and that was Puuepa in Kohala. In the same way the land of Kekaha was held by the kahuna class of Ka-uahi and Nahulu. (Kamakau 1961:231)

Kamakau further records that during the 1770s, "Kekaha and the lands of that section" were held by descendants of the Nahulu line, the Ka-me'e-ia-moku and Ka-manawa, the twin half brothers of Ke'e-au-moku, the Hawai'i island chief (Kamakau 1961:310). The Great Seal of the State of Hawai'i depicts Kame'eiamoku and Kamanawa (Springer 1989:23).

Kamakau mentions Kaloko in an episode that suggests its significance within the pre-Contact Kekaha landscape. Kamakau recounts an extraordinary day's reconnaissance of the west coast of Hawai'i Island by the spy Ka-uhi-o-ka-lani, sent to the island by Kama-lala-walu, chief of Maui. Having reached Kawaihae by canoe at night, Ka-uhi-o-ka-lani "ran about that same evening [reaching as far south as Ka'awaloa] and returned before the canoes were dismantled..." Ka-uhi-o-ka-lani, describing his journey and the landmarks he observed, relates: "I went on to the long

stretch of sand, to the small bay with a point on that side and one on this side. There are large inland ponds." He is told that the "sandy stretch is 'Ohiki, and the walled-in ponds are Kaloko and Honokōhau" (Kamakau 1961:56). This event unfolds during the time of the sixteenth-century Hawai'i Island *ali'i* Lono-i-ka-makahiki, suggesting that by the 1500s, Kaloko and its fishpond were well-known features in the Kekaha landscape.

Intensive archaeological investigation during recent decades has clarified the picture of pre-Contact Hawaiian life within Kekaha and the two *ahupua'a* under study. An especially detailed study of Kaloko has resulted in the following analysis of the development of pre-Contact settlement throughout the *ahupua'a*:

> Throughout its span of occupation Kaloko was but part of a larger society. Kaloko was apparently a unified community after A.D. 1200-1300. When initially occupied (A.D. 1000-1500), it may have been an outlier of another community. Nevertheless, from its initial occupation, Kaloko had 1 or more internal local residence groups containing constituent households. By A.D. 1200-1300 at least 2 residential groups were present in the community, and by contact (circa A.D. 1778) at least 4 residential groups had dwelled in the area. Each residential group performed religious functions as well as being a leisure unit. Members of the group held use rights to adjacent farm lands and probably to areas where forest and marine resources were located. Within each residential group, 1 household seems to have been dominant, being the spatial focus for its group's religious activities. It is suggested that such dominance was a function of consanguineal seniority and/or wealth. (Cordy et al. 1993:45)

While exact population figures for Kaloko were not possible, the study suggested that the "community seems to have gradually grown in size but could never have been larger than 118 and most likely was about 60-100 in size" (Cordy et al. 1993:45). The general pattern of land use and settlement suggested for Kaloko may also have existed within the similar environment of neighboring Kohanaiki.

A detailed study of Kaloko by Cordy et al. (1991) for the National Parks Service has developed a model of pre-Contact settlement throughout the *ahupua'a*. The following is a summary of this model provided by the National Parks Service (2001):

> Permanent settlements in the leeward portions of Hawai'i Island began by the A.D. 900s to 1000s, and possibly earlier. These would have occurred near favorable water sources, Kaloko bay probably having been one of the most sheltered and inviting large inlets along the Kona Coast. Coastal habitations had expanded by the 1200s, utilizing inland fields as well as sea resources for subsistence. The Kekaha lands north of Kaloko and extending to Kohala are thought to have undergone initial permanent settlement beginning in the 1400s, with subsequent occupation of the coast north and south over the next few centuries.
>
> Sometime during the period of 1580 to 1600, Laeanuikaumanamana, the *kahuna-nui* of the ruling chief, Liloa, acquired the Kekaha region. It is thought that the construction of fishponds at Kaloko and Honokahau began during this time, with

Kaloko Fishpond dating from at least the 1400s to 1500s. During the 1600s to 1700s, as the Kona Coast population grew with the establishment of the royal residence of 'Umi-a-Liloa at Kona and the consequent increased demand for food production, Kaloko also increased to probably almost 200 residents. It continually supported a higher population than other Kekaha areas because of its fishpond and extensive inland field system. (National Parks Service 2001)

3.1.2 Kaloko Fishpond

Marion Kelly relates the legend of the *mo'o* or water spirit that resided in the Kaloko fishpond. The pond, as previously mentioned, dates to pre-Contact times.

> One informant explained that the pond was "Kupua" (spooky) and not like other ponds.
>
> Two informants declared that the pond at Kaloko was kapu and that there was a "Spirit" (Mo'o) of the pond which, if treated badly, would retaliate, bringing bad luck to those responsible, but if this spirit was properly cared for (malama) she would be cooperative.
>
> An illustration of how appropriate care was taken of the mo'o of Kaloko is provided by the story of Ahuna, a Chinese man married to a Hawaiian woman (Apa) and living at Kohana-Iki. Ahuna had leased the pond from Maguire (J.A. Maguire owned Hu'ehu'e Ranch and the project area lands), but before he removed any fish from the pond, he asked his friend Henry Ha'o to roast a suckling pig, specially prepared, which he took to the pond and laid on one of the two rocks which can still be seen today near the remains of the old net shed. By this act, it was explained, he fed (hanai) the mo'o of the pond and could thereby expect its assistance in obtaining a substantial number of fish from the pond. One informant said directly, "That's why he has good luck."
>
> Ahuna's daughter, Atati, married Henry Akona, and the house that stands today at Kohana-Iki, not far from the Kaloko-Kohana-Iki boundary, is sometimes identified as Akona's house, although he no longer owns it (Kelly 1971:27-28).

Another account of the fishpond was translated by Kepā Maly (1993:23) and relates part of the Legend of Ka-Miki (see below for additional information). Ka-Miki caught many *'anae* or mullet in the pond that he prepared and distributed to his family members. Ka-uluhe, his guardian, questioned the source of the fish.

> ...Ka-Miki described the pond, and Ka-uluhe told him that the 'anae were from the fishpond of the ali'i Ahauahale, his wife Pukaki, and his young brother 'Owela-a-Lu'ukia. Ka-uluhe asked, "How is it that they did not see you?" Ka-Miki told her that he only saw a stout bulging-eyed man sleeping along the pond edge. Ka-uluhe told him, "That man was Kumakapu'u, a guardian of the pond who controlled the abundance of the fish, and the restrictions of their use, as well as the use of the surrounding fresh water springs. Kumakapu'u is not a real man, but is a god who also cared for the offerings to the chiefess deities of the fishpond. The goddesses were 'O'opu-po'owai-nui-a-niho, Ka-lama-i-nu'u-nui-a-

> noho, and Kiha-wahine-iki-a-nanea; and they were the ali'i kapu Lono i'a (royal ones who kept the fish of Lono class restrictions).
>
> Kapakolea is the site which divides the pond, and was the halau ali'i (royal compound) of the gods. If the pond guardians were away from Kapakolea (traveling), the fish pond water would turn blood red, thus hiding the fish; and when the gods returned, the water would become greenish and the fish could be seen, and so these signs remain to this day. (Maly 1993:23)

3.1.3 The Legend of Ka-Miki

Kepā Maly (1993) translated the "Kaao Hooniua Puuwai no Ka-Miki" (The Heart stirring Story of Ka-Miki) that appeared in the newspaper *Ka Hoku o Hawai'i* between 1914 and 1917. The legend provides details about life and the environment of Kekaha as well as for the entire island of Hawai'i. Ka-Miki, the quick or adept one, and his brother Maka-'iole, rat or squinting eyes, traveled around the island to participate in competitions circa the thirteenth century when Pili-a-Ka'aiea was the chief of Kona. The boy's parents were Pōhaku-o-Kāne (male) and Kapa'ihilani (female), the *ali'i* of Kaloko and Kohanaiki. The legend relates that the supernatural brothers "were empowered by their ancestress Ka-uluhe-nui-hihi-kolo-i-uka (the great entangled growth of *uluhe* fern which spreads across the uplands), a reincarnate form of the earth-mother goddess, creative force of nature Haumea (also called Papa) who dwelt at Kalama'ula on Hualālai, in the uplands of Kohana-iki, Kona" (Maly 1993:21-22). The twins were raised by Ka-uluhe, who taught them how to use their supernatural powers.

Portions of the legend that are relevant to the current study follow. The following excerpt discusses the division of property within Ka-loko (the pond).

> The wood carved for the makaha (fish pond gates) came from 'Iwa'awa'a (near a halau ali'i [royal compound] and kahua [contest arena] of the chief Pohaku-o-Kane, on the plains of Kohana-iki next to Kaloko [1/15/1914]). The lands of Kaloko and Kohana-iki were jointly governed by Pohaku-o-Kane, though the ponds were under guardianship of other god-chiefs and chiefesses (5/21/1914).

Several of the stories identify *heiau* of Kaloko and Kohanaiki. The first appeared between April 16 and 30, 1914.

> The ocean at 'Ohiki was named Kauahia or Kai o Kauahia. After an 'awa ceremony with Ka-uluhe ma, Ka-Miki went to the shore of 'Ohiki to fish, in the pond waters of the chief Ahauhale. 'Ohiki was the name given for several places, including: a heiau; a cove; and an 'ili of Kaloko. The 'ili land parcel came to be known as Ki'ikahala after the punishment of the dual formed priest-shark Kalua'olapauila.
>
> On the night of Kāne the priests, chiefs, and people were observing the kapu of silence and all was being made ready to dedicate the royal compound of Ka'aipu'a at Kohanaiki. Ka-Miki and Maka-'iole descended to the coastal region of Kaloko and Kohanaiki from Kalam'ula and beat the drums in the heiau of Pohakea, 'Ohiki, Kaukeano, 'O'unui, Honu'iwa, Pu'uho'olelelupe, Kauki'eki'e, and Hale-o-Lono. The sound of the pahu heiau (temple drums) greatly startled the

> people, and caused the priests and chiefs of Kaloko to grumble amongst themselves. The sequence of events which followed, led to the naming of Hi'iakanoholae.
>
> A spring in the land parcel was also named 'Ohiki. The ocean of this area was named Kauahia before 'Ohiki came about, and following the death of the shark-priest Kalua'olapauila, the land section and temple of 'Ohiki came to be called Ki'ikahala.

The following appeared between January 8 and 15, 1914 and describes Hale-o-Lono, or house of Lono, a *heiau* in Kohanaiki where prayers for rain and abundant growth were offered.

> Hale-o-Lono was the husband of Pipipi'apo'o, a daughter of the deified beings Kumua and Ka-uluhe. Hale-o-Lono excelled at farming, and had the plain of Nanawale, Kohaha-iki well cultivated. His plantation was marked by Nahiahu, also called Nawahiahu (the alignment of cairns) on the makai side of this feature.

Additional information about Na'wahi'ahu was published between January 8 and 29, 1914:

> Na-wahi-ahu (the place [of] cairns) [or] Mahiahu is identified as a line of cairns which marked the agricultural fields of Hale-o-Lono, and the sacred plantation of Ka'aipu'a at Kohana-iki. Before Hale-o-Lono established his fields in this area this portion of Kohanaiki was called Nanawale (to look about – because of the extensive fields).

Details about why this area of Kohanaiki became important appeared between January 8 and May 28, 1914 and December 6, 1917.

> Ka-uluhe-nui-hihi-kolo-i-uka a reincarnate form of Haumea (also called Papa) lived at Kalama'ula in the uplands of Kohana-iki, below Hainoa. Ka-uluhe was the wife of Kumua, and the hill site at which Kumua dwelt is also called Kumua; it is below Kalama'ula, a little above the hidden spring of Kapa'ihi. The reason that Kumua lived at this hill was because it allowed him clear view of the coastal lands of Kohana-iki, which is where his children and grand children lived. One of the children of Kumua ma was Pipipi'apo'o and she was married to Hale-o-Lono (an agriculturalist and temple type, coastal Kohana-iki) who was an exceptional farmer. Hale-o-Lono excelled in his trade, and the place upon which he farmed was called Nanawale, and because he marked the area with many cairns, it came to be called Nahiahu, also called Nawaiahu, the place of cairns.

Nawahi ahu appears on Emerson's RM 1449 and RM 1512, dating to 1888 and 1889 respectively. A discussion of the maps and roads that appear on the maps is presented in the "Mid- to late -1800s" section below.

A more recent translation of the legend of Ka-Miki by Maly and Maly (2003:15) includes the following additional information about Nāwahiahu.

> Pipipi'apo'o was another daughter of Kūmua and Ka-uluhe-nui-hihi-kolo-i-uka. She married Haleolono, one who cultivated sweet potatoes upon the *'ilima* covered flat lands of Nānāwale, also called Nāhiahu (Nāwahiahu), as it has been called from before and up to the present time. Cultivating the land was the skill of

> this youth Haleolono, and because he was so good at it, he was able to marry the beauty, Pipipi'apo'o. Pipipi'apo'o skill was that of weaving pandanus mats, and there grow there many pandanus trees to this day. The grove of pandanus trees and a nearby cave, is called Pipipi'apo'o…

Maly (1993:28) notes that Hale-o-Lono, Ki'ikahala, and 'Ohiki are associated with sites and/or place names that are shared by Kaloko and Kohanaiki.

Ka-Miki completed his journey around the Big Island and

> …became the foremost champion of Pili (7/26/1917). It was at this time that Ka-Miki learned about the sacred palama chiefess Paehala of Honokohau; lands also called Na-Hono-i-na-Hau-'Elua (the bays of the two dews). Pili gave Ka-Miki permission to wed Paehala if she and her family agreed, and Pachala was the foremost beauty of Kona.
>
> When the chiefess agreed to marry Ka-Miki, Pili told Ka-Miki, that he would also, "oversee the chiefs' sacred fishponds [at Kaloko and Pa'aiea]; the schools of kala, uhu, and palani; and all the lands of Kekaha from Hikuhia which is above Napu'u u (also called Napu'upo'alu); and lands between Keahualono at Kaniku to the plain of Kanoenoe, marked by the hill of Pu'uokaloa at Keahuolu" (10/18/1917). (Maly 1993:22)

The following passage is from Kihe and appeared in *Ka Hoku o Hawai'i* between January 31 and April 10, 1928. It relates the variety of agricultural crops that grew in Kohanaiki and Kaloko:

> Departing from O'ahu, Makalie and his family landed at Hale 'uki, Ka'upulehu and were greeted by Ke'awalena a chief and overseer of the Kekaha region. Ka'upulehu and all Kekaha were extensively cultivated at this time. Dependent on seasons, the uplands were used for residences and farming, and the coastal lands fro residence and fishing. Pao wai (dug out water catchments) on the pahoehoe and in upland fields were a means of water catchment. Crops grown here included: taro, sweet potatoes, sugar canes, bananas, and 'awa…(Maly 1993:25)

Maly (1993:29) explains that traditional accounts of Kaloko and Kohanaiki describe a lush environment that differs from its current state due to several factors. The Hualālai lava flow in 1801 covered the former agricultural and forested lands, residential areas, and fishponds. The loss of forests began the decrease in rainfall that was exacerbated by the introduction of livestock and ranching. Goats and cattle stripped the vegetation from the lands causing water resources to dry up. Thus, over the last 150 years, the environment has been significantly altered.

3.1.4 The Pool of Wawaloli

Eliza Maguire (1966:11-17) collected and translated ten legends in 1923. Her husband, John Maguire, established Hu'ehu'e Ranch. *Paniolo* ("cowboys") working the ranch told the stories and Maguire decided they were too important to allow to fade away. "The Pool of Wawaloli" was near the coast "between Ooma and Kaloko." Although this legend takes place on the coast, it is the only one that Maguire translated that is within the vicinity of the current study area.

Malumaluiki, a beautiful maiden, leaves her parents' home to travel to the coast for shellfish and seaweed. On her way she becomes thirsty and stops to drink from a pool, where she meets a handsome young man. The two are immediately infatuated with each other and spend several hours together. Before Malumauiki departs, the handsome man tells her to call him Wawa when they are together, but call him Loli when she approaches the pool. He also teaches Malulmaluiki a chant to summon him at the pool.

After departing from her home several days in a row to meet Wawa, Malumaluiki's parents become suspicious since she never brings home any shellfish or seaweed. Her father follows her one morning and discovers that his daughter's lover has a human form and a sea-slug form. After observing the two together, he memorizes the chant to Loli and departs.

Malumaluiki's father consults with a *kahuna* (priest) to see how he can save his daughter. The *kahuna* tells him to trap and destroy Wawaloli which will save all the young women in the area from the lecherous evil wizard. The father returns to the pond, repeats the chant, captures Wawaloli with a net, and buries him in an *imu* (earth oven). Malumaluiki is sad to lose Wawaloli but much wiser. All that remains of Wawaloli is the pool he once occupied and still retains his name (Maguire 1926:21-26.)

3.1.5 Stillman Family Song

The following is a family song written by Rose Simerson about life on Hu'ehu'e Ranch. The song was sang by the Kahauanu Lake Trio, "Ke Po'okela", Volume II Album. The Stillman family descends from Kipikane, the great granddaughter of Kamehameha I, who married John P. Parker, the founder of Parker Ranch (Kanoa-Martin 2007). This is their family song:

Keiki mai au no Hu'ehu'e 'eā 'eā	*I learned to throw a lasso and crack the whip*
Kīpuka 'ili a'o kani ka uwepa	*From childhood at Hu'ehu'e*
Ka waiho laulā ka'u aloha 'eā 'eā	*The broad open plains I love*
Ku'u lio puakea ha'a i ke kula	*My white horse goes prancing in the high pasture land*
Maika'i Hu'ehu'e e waiho nei 'eā 'eā	*Hu'ehu'e is a fine place, lying there below*
Ho'okahi no hewa he ulua 'ole	*Too bad there's not even one fish (cowboy)*
Ua ho'i ka ulua i Kahalu'u 'eā 'eā	*The cowboys went to Kahulu'u town*
I ke ani peahi lau o ka niu	*Where the palm leaves beckon*
A komo i ka malu lau kukui 'eā 'eā	*In the kukui leaf shade*
Ho'ola'i nā iwa oia uka	*The birds of the upland are made still*
Ha'ina 'ia mai ana ka puana 'eā 'eā	*The story is told*
Kipuka ili a'o kani ka uwepa	*Of learning to throw a lasso and crack the whip*

3.2 Early Historic Period

Kamakau (1961) reports that during the war between Alapa'inui of Hawai'i and Kekaulike of Maui, Kekaulike "abused the country people of Kekaha" by destroying all the coconut groves and slaughtering "the country people." The destruction of these valuable trees was devastating.

As previously mentioned, Kekaha lands were set aside for the priestly class:

> Waimea [O'ahu] was given to the Paao Kahuna class in perpetuity and was held by them up to the time of Kamehameha II when titles had to be obtained. But there was one land title held by the kahuna class of Paao for many years and that was Puuepa in Kohala. In the same way the land of Kekaha was held by the kahuna class of Ka-uahi and Nahulu. (Kamakau 1961:231)

During the last decades of the eighteenth century, following western contact, Kohanaiki and Kaloko - as elements of the larger Kekaha area - remained under the control of Ka-me'e-ia-moku, who resided to the north at Ka'upūlēhu (Kamakau 1961:147). Ka-me'e-ia-moku's son, Ulumaheihei Hoapili, "belonged to the priesthood of Nahulu and was an expert in priestly knowledge. He had been taught astronomy and all the ancient lore" (Kamakau 1961:354).

Archibald Menzies, the first foreigner to record his visit to Kekaha, accompanied Captain Vancouver in 1792. He described the land as "barren and rugged with volcanic dregs and fragments of black lava…in consequence of which the inhabitants were obliged to have recourse to fishing for their sustenance" (Menzies 1920:99).

On January 17, 1792, Menzies hiked to the top of Hualālai, and observed the following:

> We commenced our march with a slow pace, exposed to the scorching heat of the meridian sun, over a dreary barren track of a gradual ascent, consisting of little else than rugged porous lava and volcanic dregs, for about three miles, when we entered the bread fruit plantations whose spreading trees with beautiful foliage were scattered about that distance from the shore along the side of the mountain as far as we could see on both sides. Here the country began to assume a pleasant and fertile appearance through which we continued our ascent for about two miles further, surrounded by plantations of the esculent roots and vegetables of the country, industriously cultivated…From this place we had a delightful view of the scattered villages and shore underneath us, and of the luxuriant plantations around us…
>
> January 18th….We observed here and there on the path little maraes [shrines] pointed out by taboo sticks in the ground round a bush or under a tree. In passing these places the natives always muttered a prayer or hymn, and made some offering as they said, to their akua, by leaving them a little piece of fruit, vegetable or something or other at these consecrated spots. Even in this distant solitary hut, we found a corner of it consecrated by one of these taboo sticks which the natives earnestly requested us not to remove when we took possession of it, and we very strictly obeyed their injunction, conceiving that religious forms whatever they are, ought to be equally inviolable everywhere. (Menzies 1920:151-160)

Kamakau recorded that Kaloko is the site where Kamehameha's bones were cached by Hoapili after the king's death in 1819:

> Kamehameha had...entrusted his bones to Ulu-maheihei Hoa-pili with instructions to put them in a place which would never be pointed out to anyone. At midnight, therefore, when black darkness had fallen and no one was likely to be on the road and the rough lava plains of Pu'ukaloa lay hushed, Hoa-pili sent his man, Ho'olulu, to bring the container of wicker work in which the bones of Kamehameha were kept to Kaloko in Kekaha...The next morning Hoa-pili and Ke-opu-lani took canoe to Kaloko where Hoa-pili met the man who had charge of the secret cave and together they placed the bones there. (Kamakau 1961:215)

Kelly (1971:25) notes a February 16, 1887 letter to a person named Kapalu as the "overseer and keeper of the Royal Burial Ground at Kaloko, Kailua." The Interior Department of the Hawaiian Kingdom provided Kapalu with a $20 a month stipend, for seven months. A second letter reappoints Kapalu as a caretaker although there is no payment for his services. Kelly also relates that an informant's grandfather had disclosed the location of the burial cave, and he would move the remains to protect them. Another informant stated that women are not buried at Kaloko, only men of high rank. Other informants revealed that the burial caves were inland and not in the vicinity of Kaloko Pond (Kelly 1971:25).

Kamakau's account regarding the caching of Kamehameha's remains suggests that Kaloko's population, toward the end of the nineteenth century's second decade, had diminished to such an extent that the *ahupua'a* could provide the necessary isolation and secrecy for the burial.

By the early nineteenth century, the inhabitants of Kaloko and Kohanaiki had long experienced the social pressures and consequences of western contact. "As early as 1788, Hawaiians began enlisting as seamen on the foreign ships that stopped at Island ports, and their number increased rapidly with the growth of whaling in the Pacific" (Schmitt 1973:16). As harbor facilities were developed at Kailua and Kealakekua during the early 1800s, these ports became population centers drawn from increasingly isolated (economically and socially) areas like Kaloko and Kohanaiki. Newly-introduced diseases cut the population severely.

Missionary censuses of the 1830s chart the diminishing population of Kekaha and North Kona. In 1834, the total population of Kekaha is recorded as 1,244, comprising 21% of the total North Kona population of 5,957 (Schmitt 1973:31). The North Kona figure represents a population loss of 692 since the previous census of 1831 (during which no figure specific to Kekaha was noted), which recorded 6,649 persons in the district (Schmitt 1973:9). One factor - inter-island migration – which led to the diminishing population of Kona was specifically noted by missionaries in 1832: "We have been sensible for some time that the number of inhabitants in this island is on the decrease. There is an almost constant moving of the people to the leeward islands, especially since the removal of the governor (*Kuakini*) to Oahu. Some leave by order of the chiefs, and others go on their own responsibility" (cited in Schmitt 1973:16).

Land Commission documents of the 1840s and 1850s record the disposition of population and land use within Kohanaiki and Kaloko *ahupua'a* that had evolved since western contact. At the Māhele of 1848, Kaloko was claimed by and awarded [Land Commission Award (LCA) 7715] to Lot Kamehameha (who would become Kamehameha V). Kohanaiki was classified as

Government Land. Subsequently, 18 *kuleana* claims - by commoners claiming to occupy and/or cultivate land parcels - were made in Kaloko. Twelve of these claims were awarded. All claims were for *mauka* lands - between 1200 and 1700 ft. elevation - adjacent to or just *makai* of the Government Road. Only testimony for Kahiona's (unawarded) claim (LCA 9205/9237) mentions a fishpond; no claims were made for the coastal area. Farm lands claimed are *mala*, *kihapai*, and *mo'o*, i.e. forms of dry land agriculture; actual crops identified in the award testimonies are taro and sweet potato. Only five of the total 18 claims mention residence on or use of the Kaloko lands dating to the time of Kamehameha I, the first decades of the nineteenth century; the remaining claims testify to residence/use beginning in the 1830s and 1840s.

Parcels within Kohanaiki, having become Government Land, were subject to sale - designated grants - by the Hawaiian Kingdom government. Land sales began in the 1850s with Grant 2030 to Kaiakoili in 1856, awarding 102 acres adjacent to and *makai* of the Government Road. Also beginning in the 1850s, the first taxpayer rolls for Kohanaiki and Kaloko were documented: they indicate, within Kohanaiki, eight, 13 and 12 taxpayers during the years 1857, 1859 and 1860, respectively; within Kaloko, during the same years, 19, 21 and 23 taxpayers were recorded. Just past the middle of the nineteenth century, the populations of Kaloko and Kohanaiki had been drawn beyond the original subsistence-based economy into the western commercial paradigm.

As Cordy notes about Kaloko: "The historical documents suggest that by the 1840s-1850s, the Coastal Zone had been abandoned as a residential area, except probably for a house used by the fishpond's caretaker. This pattern would have been a stunning change from prehistoric and early historic times, when many coastal residences were present" (Cordy et al. 1991:288). This pattern likely also held for Kohanaiki.

3.2.1 Cultivation

Despite descriptions of the lava covered terrain, various crops were traditionally cultivated within the project area, and sweet potato is likely to have been the most abundantly grown crop because of its adaptability to stony, dry environments. It was commonly planted in mounds and in *pāhoehoe* excavations.

Henry J. Lyman, son of missionaries that first arrived in Hilo in 1831, describes features in Puna similar to *pāhoehoe* clearings in the project that were cultivated with sweet potatoes:

> Whereever the lava could be pounded into scoria, a plantation of sweet potatoes was laboriously formed by digging among the stones and filling in the holes with dried grass brought from the mountainside. Placed in the nest, the tuberous buds were covered with gravel, and there grew with astonishing luxuriance, yielding the largest and finest potatoes on the island (in Frierson 1991:167).

During the mid 1800s, Captain Charles Wilkes of the American Exploring Team comments on the agricultural use of *pāhoehoe* excavations (similar to the modification of *pāhoehoe* outcrop in the project) which he observed specifically in the Kona region:

> Cultivation is carried on in many places where it would be deemed almost impractible in any other country. The natives, during the rainy season, also plant, in excavations among the lava rocks, sweet potatoes, melons, and pine-apples, all of which produce a crop. (Wilkes 1845:91)

Sweet potatoes were also cultivated within walled fields or depressions in the walls themselves. E.S. Craighill Handy and Elizabeth Green Handy discuss this method from an account that appeared in the Hawaiian newspaper *Ka Nupepa Ku'oko'a* (March 24, 1922):

> Rocky lands in the olden days were walled up all around with the big and small stones of the patch until there was a wall (*kuaiwi*) about 2 feet high and in the enclosure were put weeds of every kind, *'ama'u* tree ferns and so on, and then topped well with soil taken from the patch itself, to enrich ti, or in other words to rot the rubbish and weeds to make soil.
>
> After several months, the rotted weeds were converted into soil of the best grade. The farmer waited for the time when he knew that the rains would fall, then he made the patch ready for planting. If for sweet potatoes, he made mounds for them and for taro too, on some places on Hawai'i. (Handy and Handy 1972:131)

3.2.2 Ranching

Ranching has its roots in this early historic period with the introduction of goats, cattle, and horses by sea captains who sought to develop these resources to replenish their ship holds during long journeys. Captain George Vancouver gave Ke'eaumoku, an *ali'i*, a pair of goats in 1792, and the following year, he brought Ke'eaumoku four sheep. Vancouver also brought the first cattle, California longhorns, to Kamehameha I in 1793. Kamehameha issued a *kapu* (in this case, a prohibition) that carried the death penalty to anyone harming cows or cattle thus ensuring that the first herds would proliferate. The *kapu* was enforced for 10 years. Due to the *kapu*, families constructed walls to protect their sweet potato and taro lands from the cattle. Kamehameha ordered the construction of a wall, *mauka* of the project area, that ran from north to south Kona, to prevent cattle from destroying populated areas (Bergen 2004:22-23). Historical research suggests that both goat and cattle grazing took place within the project area.

In 1803, horses were introduced, and they also ran free although no *kapu* protected them. Horses had difficulties acclimating to local grasses, and herds of feral horses were rare until the 1830s. At that time, Kamehameha III had California *vaqueros*, cowboys of Native Californian, Spanish, and Mexican descent, brought to Hawai'i to herd the cattle and teach Hawaiians to ride horses and tend the cattle. The *paniolo*, as they were called, were expert horsemen and able to chase down the wild cattle on horseback and capture them with a lasso. The hide and tallow trade proved to be successful and cattle were shipped from Kailua Bay to slaughterhouses on O'ahu (Figure 5 and Figure 6). In 1851, it was estimated that Hawai'i Island had 8,000 head of tame cattle and 12,000 head of wild cattle (Kelly 1983:79; Bergen 2004:23, 97).

Historic documents related to the Government Homestead Program of the late 1880s indicate officials determined that goats were the only animals that were adept at grazing within arid, rocky Kaloko and Kohanaiki (Maly and Maly 2003:76, 79). Goats were present in the area prior to the late 1880s and may have been present within the project area. Limited cattle ranching was practiced at the same time, although by 1900, cattle ranching had for the most part replaced the goats (Maly and Maly 2003:75).

Figure 5. Kailua Wharf on Steamer Day, circa 1890, Moku'aikaua Church in background (photograph by R. J. Baker)

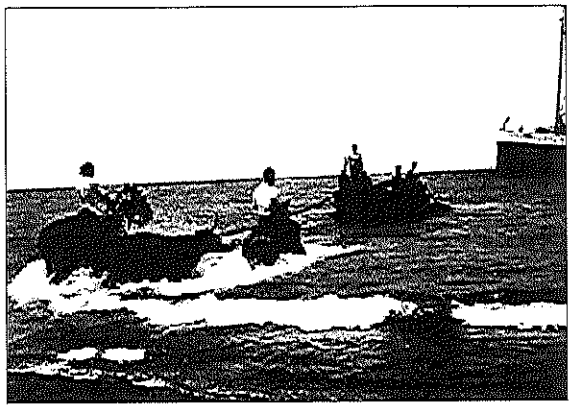

Figure 6. Loading cattle on the Kona Coast, Hawai'i (Faris 1929:296)

3.3 Mid- to Late -1800s

The division of Kohanaiki - through sales of Government lands -continued throughout the remainder of the nineteenth and into the twentieth century. Grant 2942 in 1864 awarded to Huliko'a 929.75 acres which included the width of the *ahupua'a*, extending *makai* from Kaiakoili's grant. In 1871, Grant 3086 awarded 154 acres to Kapena; this parcel extended *makai* from Huliko'a's grant to the shoreline.

At the time of the Māhele, Huliko'a was a resident of Kohanaiki (Maly and Maly 2003:4). Although Maly and Maly (2003:60) reviewed all Māhele claims, no additional references to Huliko'a were found. However, based on traditional patterns of residency in the region, it is "likely they had primary residences in the uplands, near sheltered *māla 'ai* (agricultural fields), and kept near shore residences for seasonal fishing, collection of salt, access to water in dry periods, and for access to other resources of the coastal zone" (Maly and Maly 2003:60). Maly and Maly (2003:66) also note that during their research "the original notes of survey and map accompanying Grants 2030 and 2942, are missing from the state collection, so the corresponding maps and surveys, and their relationship to Kapena's parcel could not be compared with the original records." These survey documents were also not found during the current study.

Kaloko is documented during the 1870s in testimonies by Hawaiians before the government's Boundary Commission. Testifying on August 12, 1873, Nahuina (who had earlier received LCA 10327 in Kaloko) describes himself as "born at Kaloko North Kona Hawai'i at the time of Keikepuipui, the building of the *heiau* at Kailua, and have always lived there" and states that the boundaries of Kaloko were shown to him by his father, the former *konohiki* of the *ahupua'a*. Identifying the mauka portions of the boundary, Nahuina notes bounds defined by vegetation and a wall (iwi aina), and recalls a former habitation site:

> ...From the makai side of Kaupulehu the boundary runs along said land, the koa being on Kaloko and the mamani and pukeawe [sic] on Kaupulehu to the corner of Lanihau 2nd Keahuolu and Honokohaunui...Ohiawela, a *pali*, on the road through the woods is a point on the boundary. This place is above Honokohaunui, thence turn makai to Kahua, a place in the fern where houses used to stand, from thence the boundary runs makai along an *iwi aina* to Kapokalani, at the Government road. Thence makai still following the *iwi aina* to Kiikii an ili aina, thence to Kaohe, a grove of trees thence to *aa*...

Nahuina adds that Kaloko has "ancient fishing rights extending out to sea." Testifying on the same date, Hoohia, who "moved to Honokohauiki when quite small and reside[s] there now", adds details that suggest the *mauka* Kaloko-Honokōhau boundary was defined by different vegetation that also reflected former traditional gathering rights: "Honokohaunui ends at Ohiawela, a *pali*. Kaloko takes the *koa*, and Honokohaunui, the *ohia*...The *olona* grows on Honokohaunui and Kealakehe and the *koa* on Kaloko."

During the 1880s, Kona lands - including Kaloko and Kohanaiki - were surveyed by J.S. Emerson for the Hawaiian government. A portion of his Registered Map (RM) 1449, Akapipu'u Section (Figure 7) shows a trail through the project area; the trail actually ran from the Kohanaiki Homesteads to the Kaloko fishpond. Emerson produced three maps corresponding to the project area during this time period: Registered Map (RM) 1280, RM 1449, and RM 1512. Emerson's

assistant, J. Perryman also produced sketches of the west slopes of Hualālai. Although other surveyors and historians have produced maps for the area, these maps are the most comprehensive. RM 1280 (Figure 8) is cited and reproduced with the most frequency. It is often dated to 1888, but the map does not indicate an original date; rather, the date the map was traced by another surveyor in 1952 for reproduction purposes. An independent attempt to verify its date during the present study was unsuccessful, as the original map is now retired and not available from the State Survey office. Circumstantial evidence dating the map includes the sketches of J. Perryman dated to 1882 that match the features of this map and a date range penciled on the back of the traced map on file - "1877-1903." RM 1449 and RM 1512, dating to 1888 and 1889 respectively, are essentially maps of the same series. RM 1449 is a broad overview map ranging from Kaloko to Kūki'o in the north, and RM 1512 is a detail of the land grants around the government road.

A portion of RM 1280 shows the locations of the three large Kohanaiki grants discussed earlier. Also indicated are "Kealiihelepa Hse" at the coast above the Kaloko fish pond and, near the government roads, "Kaloko Cath. Church" and "Kohanaiki Church," which is likely the Protestant church recorded as built by a minister, Kaanohimaka, and his congregation in the 1870s (Kelly 1971:14). As noted by Cordy et al. (1991:418), Emerson's map of the area including the Kohanaiki Church indicates "a set of about 16 stone house enclosures and a Protestant church, collectively called the Kohanaiki Homesteads;" Cordy et al. suggest a "late 1880s age for the formation of the Kohanaiki Homesteads." Kelly (1971) notes that the Kohanaiki Homesteads would draw people as other areas of North Kona were abandoned. Government records of Kohanaiki grants show 18 parcels ranging in size from 0.73 acres to 25.45 acres awarded between 1895 and 1904.

A composite of RM 1449 and RM 1512 (see Figure 7) shows an alternative view of both the country side and the detail in the area of the Kohanaiki Homesteads. Most visible are family claims in the Kohanaiki Homesteads and Kohanaiki Road running directly *makai* from the homesteads. The road ends abruptly on RM 1449, although it appears to come close to joining the prominent "Lower Government Road." The indication of the "Lower Government Road" also ends shortly into Kaloko.

While all three Emerson maps provide survey information for the area, there are inconsistencies that are difficult to interpret. All were surveyed within a short time period but RM 1280 does not indicate survey stations as the others do. The largest inconsistency is the route of the two roads extending *makai* from the homesteads – on RM 1280 crossing into Kaloko just outside of the homesteads and on RM 1449 crossing upslope of the project area. Since RM 1280 does not give a name to this road and the date of the map is somewhat uncertain, it is possible that there were two roads, one superseding the other. It is also likely that RM 1280 was simply a preliminary survey (if the dates for J. Perryman's sketches date the map) and was less accurate (since it did not use many survey markers).

Oral history interviews (Maly and Maly 2002) relate that in the mid-1800s only a few residences were on the coastal lands, in the uplands above 900 ft. elevation, and in the vicinity of Māmalahoa Highway (east of the project area). The land between 900 ft. and the coast was cattle, donkey, and goat pasturage. *Mauka/makai* trails through Kohanaiki, Kaloko, Kalaoa, and

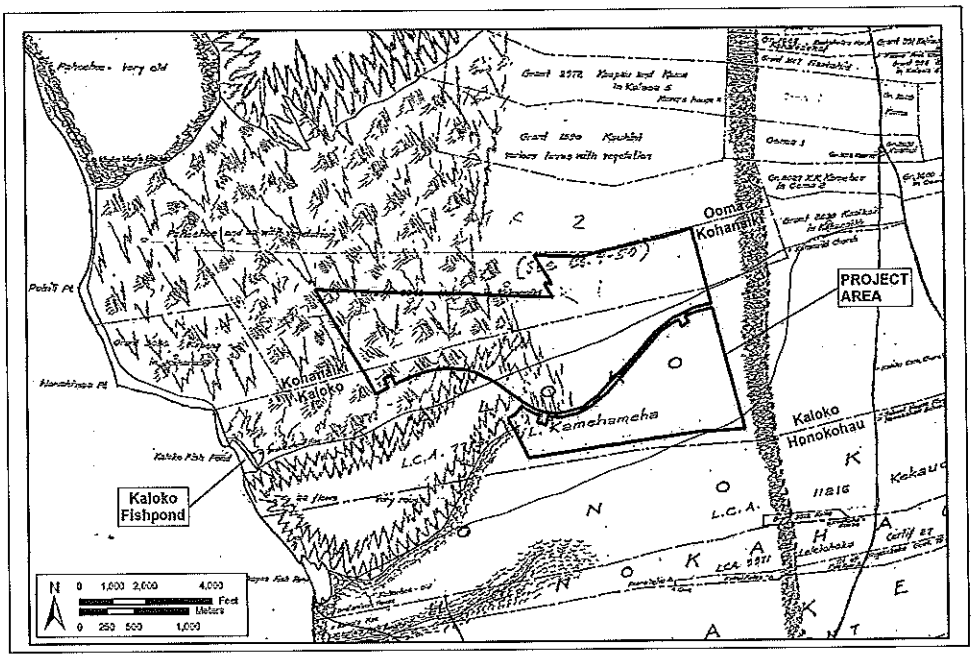

Figure 8. Portion of Registered Map 1280 by J. S. Emerson showing location of project area

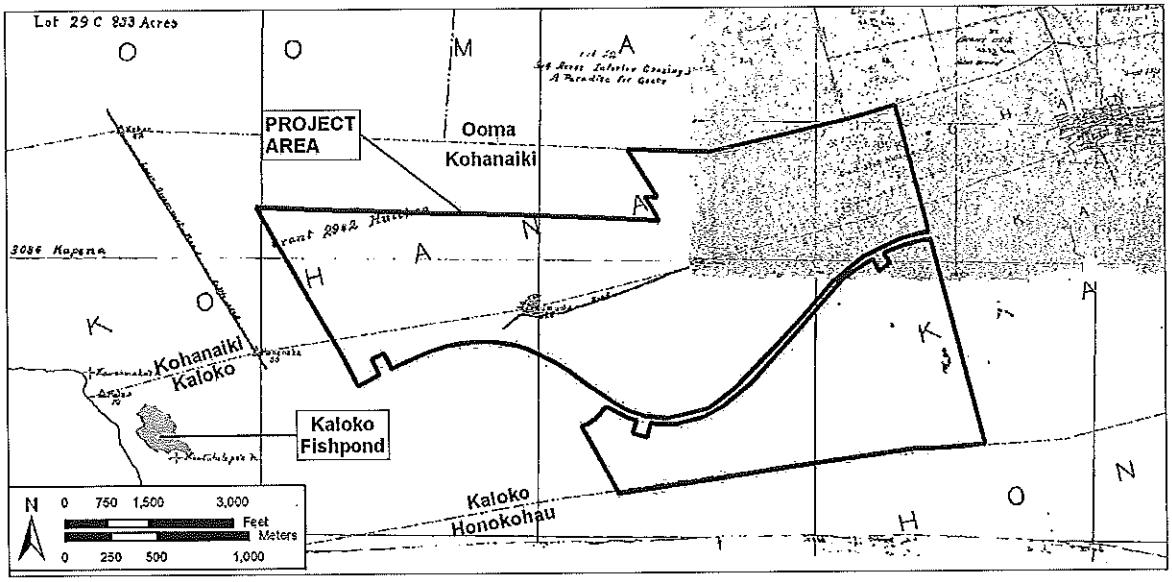

Figure 7. Portions of Emerson's RM 1449 (1888) and RM 1512 (1889) showing the road from Kohanaiki Homesteads

Honokōhau were utilized by upland families to access the coast to fish, and gather water during upland droughts.

Kaloko and most of Kohanaiki continued to be held by the *ali'i* throughout the remainder of the nineteenth century, passing, after the death of Lot Kamehameha, successively to Bernice Pauahi Bishop, Kalākaua and Kapi'olani.

Maly and Maly (2002:339) translated the following 1875 letter to the editor of *Ku Okoa*, the Hawaiian newspaper. The letter was written in response to another letter describing a drought in the Kekaha region and the subsequent famine. J.P. Pu'uokupa, the writer, lived in Kekaha:

> ...The people who live in the area around Kailua are not bothered by the famine. They all have food. There are sweet potatoes and taro. These are the foods of these lands. There are at this time, breadfruit bearing fruit at Honokohau on the side of Kailua, and at Kaloko, Kohanaiki, Ooma and the Kalaoas where lives J.P. [the author]. All of these lands are cultivated. There is land on which coffee is cultivated, where taro and sweet potatoes are cultivated, and land livestock is raised. All of us living from Kailua to Kalaoa are not in a famine, there is nothing we lack for the well being of our bodies. Mokuola (reference to a small island in Hilo Bay that is a sanctuary, and place of life and healing – indicates Kekaha is also) is seen clearly upon the ocean, like the featherless back of the ukeke (shore bird). So it is in the uplands where one may wander gathering what is needed, as far as Kiholo which opens like the mouth of a long house into the wind. It is there that the bow of the boats may safely land upon the shore. The livelihood of the people there is fishing and the raising of livestock. The people in the uplands of Napuu are farmers, and as is the custom of those people of the backlands, they all eat in the morning and then go to work. So it is with all of the native people of these lands, they are a people that are well off...
>
> ...As was said earlier, coffee is the plant of value on this land, and so is the raising of livestock. From the payments for those products, the people are well off and they have built wooden houses. If you come here you shall see that it is true. Fish are also something which benefits the people. The people who make the pai ai on Maui bring it to Kona and trade it. Some people also trade their poi for the coffee of the natives here... (J.P. Puuokupa, in Ku Okoa November 27, 1875; translated by Maly)

The following is excerpted from George Bowser's (1880) "Directory and Tourists Guide." Bowser traveled around the Hawaiian Islands and published his guide detailing places of interest. His observations during his journey along the west coast of the Big Island include:

> ...From Kiholo the road southwards is rough and laborious. Perpetual traveling over lava is very hard upon our horses, and it is impossible to travel faster than the slowest walk... Some twelve miles from Kiholo we began to cross the western shoulder of Mauna Hualālai, and the aspect of things changed, although the condition of the road did not. Here all around, for miles and miles, trees are growing thickly, on the otherwise almost bare surface of the lava. In numberless instances these trees, which are numerous enough in places to form a dense forest,

> grow out of lava pure and simple, without a semblance of soil of any kind to support them... Pursuing my way through this forest land, I enjoyed, in spite of the roughness of the road, one of the most delightful days experienced throughout my journey.... In this woodland I heard for the first time since I landed on the islands the notes of a pretty little bird about the size of a lark, called by the natives akakane. Its song is very sweet; nor is it the only songster of the woods. One especially I noticed, called iiwi, from its note. During the ride we saw numbers of native geese and sundry herds of goats skipping from ledge to ledge on the lava beds. Presently I reached the ridge of the mountain and had a fine view of the surrounding country...
>
> Fronting the sea...in North Kona there is a rich tract of bottom land which might be turned to good account. Large areas of the mountain land might also be cultivated for coffee...I was astonished to see in this district how bananas, mangoes, oranges, pineapples, in short all the fruits belonging to these islands, grow in profusion...
>
> At Kohanaike, a place about six miles short of my destination, I came upon a store kept by a Chinaman, who has Hawaiianized his name to Akao. Here the tourist, if he has no supplies with him, can get anything he wants, in the way of canned fish, milk, crackers, etc., and if night should overtake him here, a bed can always be had. I finished my day's journey at Kailua, passing on the way a small place called Kaloko, where there is a blacksmith shop kept by Mr. Philip Ryan...(Bowser 1880:547-549)

Bowser also included the following individuals as residents of Kohanaiki or Kaloko in 1880:

> Kaiakoili lived in Kohanaiki and was a coffee planter who owned 600 acres, 10 of which were cultivated (Bowser 1880:215, 339).
>
> Katy Ryan lived in Kaloko on Kailua Road and was also a coffee planter and owner with seven cultivated acres (Bowser 1880:262, 349).

3.4 1900s

During the twentieth century, major developments focused on Kaloko Ahupua'a, with continuing commercial use of the fishpond and increasing animal husbandry. The Kohanaiki Homesteads were apparently in decline during the early part of the century (Maly and Maly 2003), and are mentioned only in passing in H.W. Kinney's 1913 guide to the Big Island, which notes that it is an "inland settlement without much interest." However, "from Hu'ehu'e southward the road passes through fertile lands, dotted with prosperous homes of Hawaiians, and some Japanese, planters of coffee and other crops (Kinney 1913:53). It appears that lands closer to the coast were inhabited. It should also be noted that Hu'ehu'e likely refers to the town Hu'ehu'e and not the ranch that extended into the project area.

Ranching steadily increased. Once John Maguire purchased the former chiefly lands of Kaloko in 1906 after the deaths of Kalākaua and Kapi'olani (Kelly 1971:29), the *ahupua'a* uplands were developed into the Hu'ehu'e Ranch. Maly and Maly (2003) discuss the acquisition of these lands and the types of ranching that were common:

> In 1899, John A. Maguire, founder of Hu'ehu'e Ranch applied for a Patent Grant on... lots in 'O'oma 2nd, but he only secured Grant No. 4536.... Maguire's Hu'ehu'e Ranch did secure General Lease No.'s 1001 and 590 for grazing purposes on the remaining government lands in the Kohanaiki and 'O'oma vicinity. Thus, by the turn of the century, Hu'ehu'e Ranch, utilized both the upper forest lands and lower kula lands to the shore for ranching purposes. Oral history interviews with elder former ranch hands record that this use extended across the Kapena and Huliko'a grant lands of Kohanaiki, from the fee and leasehold lands of Kaloko and 'O'oma. Nineteenth century goat drives gave way to formalized cattle drives and round ups on these lands. (Maly and Maly 2003:78)

3.5 Hu'ehu'e Ranch

John Avery Maguire was the son of Charles and Hiilawe Maguire. He was born in Hamakua, Hawai'i in 1848 and began his ranching career as a foreman for the Pu'uhue Ranch. Maguire later became the ranch manager and then purchased Hu'ehu'e Ranch in 1888. His biography indicates that he did not live at the ranch until 1897, but this is contradicted by other sources, as is the date of purchase. He also bought Kahuā Ranch Company in 1890 and sold it in 1898 to J.F. Woods (Siddall 1917).

John Maguire and his first wife, Luka Hopula'au, had one child, Charles Ka-ulu-hei-malama Maguire, before Luka died in 1898. Maguire inherited his wife's lands in Kona that included Grants 926 and 2121 in Puaa and Kuki'o that were previously owned by Pupule (Kelly 1971:44-46).

Kelly (1971:41) notes that in 1914, J.A. Maguire leased the Kaloko fishpond for 15 years to the Mokuaiai fishing *hui* (group or collective), indicating that he owned the lands. Additionally, Kelly's research of manuscripts at the Bishop Museum includes a document by Lono Maguire on medical lore. This Maguire was identified as a *kahuna lapa'au*, or medicinal expert. Kelly (1971:41) was unable to determine if Lono and John A. Maguire were related.

According to Kelly (1971), the 1918 Polk Directory (p. 960) lists Mrs. John A. Maguire as the commissioner of public instruction for North Kona. Her husband is listed as the President of John A. Maguire Estate, Ltd., and manager of Hu'ehu'e Cattle Ranch at Hu'ehu'e, North Kona. This "Mrs. Maguire" was John Maguire's second wife, Eliza. She recorded some of the traditional accounts of tales she heard on the ranch; "The Pool of Wawaloli" was one of the legends she translated and it appears above in the Mythological and Traditional Accounts section.

Likely due to its location north of the most populated area on the Big Island, Hu'ehu'e Ranch received many guests over the years including Queen Lili'uokalani, Prince Jonah Kuhio Kalanianaole, Sanford Dole, first president of the Republic of Hawai'i, and Jack and Charmian London (HawaiiHistory.org 2008).

John A. Maguire's lands extended well beyond the current project area to the north into Waipi'o Valley according to research conducted by Lebo et al. (1999). Maguire, his wife Eliza and his son Charles, conducted multiple land transactions within Waipi'o Valley between 1898 and 1915.

The following information is from the Kona Historical Society's Archive, Hu'ehu'e Ranch Records for 1958-1987. Thelma Springer, the great-granddaughter of J. A. Maguire, and her husband, Philip Springer, and Carl A. Carlson, Jr., the ranch manager for many years until his recent retirement, provided the historical society with the information.

By the time J.A. Maguire died in 1919, Hu'ehu'e consisted of 40,000 acres of land, most of which was leased from the Bishop Estate. He owned 2,500 head of cattle and 500 sheep. His son, Charles, and daughter-in-law Mary Kiha-lani-nui, pre-deceased him, and their only child Aileen Ruth Kiha-lani Maguire lived with her grandfather and inherited Hu'ehu'e Ranch.

Aileen married Arthur Joseph Stillman at the St. John the Baptist Chapel in Kohanaiki on December 27, 1917. Stillman became the ranch's general manager following the death of his father-in-law in 1919. The couple had four children including:

> Thelma Kiha-lani who latter married Philip P. Springer. Their daughter is Hannah Kiha-lani Springer;
>
> Ruth Ka-papa-ku'i-ali'i, who died in infancy;
>
> Mary Ka-haili-o'pua, who later married James Allen Robinson. Their daughter is Aileen Ruth Robinson;
>
> Nancy Ka-hiwahiwa, who later married Carol A. Oliver. Their children are Carole, Richard, Myra, John Avery, and Luka.

The Maguire/Stillman family held thousands of acres of property on Hawai'i including lands outside of the project area that are part of Hu'ehu'e Ranch. Maguire initially leased lands from the Bishop Estate and inherited lands from his first wife, as mentioned above; he later added acreage acquired from Kapi'olani at Kaloko.

A livestock survey conducted by the University of Hawai'i in 1927 states that the total land holdings at the time were 40,000 acres, 25,000 acres were leased and the remaining 15,000 was owned fee simple. Hu'ehu'e was south of Pu'uwa'awa'a Ranch and extended from sea level to 1,600 ft. elevation.

Only 12,000 acres were suitable for grazing, since large areas were covered with lava flows, and dense vegetation including lantana and ferns. Hu'ehu'e Ranch contained some 2,000 grade Herefords, 20 purebred Hereford bulls, and 20 purebred cows. Annually, approximately 330 to 400 head of cattle was sold, loaded on steamers in Kailua-Kona, and shipped to Honolulu (University of Hawai'i 1927:28).

There are "seven miles of pipe line which lead from tanks near a natural spring to various parts of the ranch."Additionally, the ranch "is fairly well supplied with fences and paddocks (University of Hawai'i 1927:28).

The Maguire/Stillman family held Hu'ehu'e Ranch until they sold it on July 8, 1966. At that time, the Kona Coast Company, a partnership between the Kaloko Land Corporation, Mauna Loa Cattle Corporation (which later was separately held by members of the Karl B. Rodi family), and Foothill Land Corporation (which was later succeeded by the David Pacific Corporation and Davis family members) was established. The company owned and operated the ranch that was

managed by Roger T. Williams. In early 1970, Carl Carlson became the general manager, and as mentioned above, recently retired.

Kona Historical Society records indicate that cattle ranching continued on Hu'ehu'e Ranch although game bird hunting and residential and resort development of properties became more important business aspects (Figure 9).

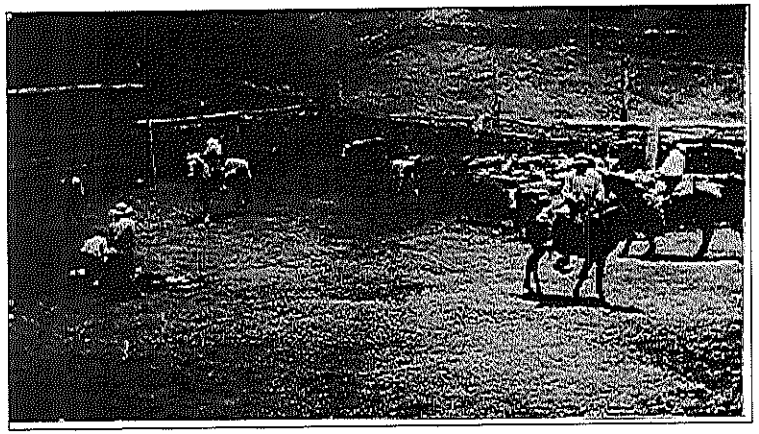

Figure 9. "Branding Pen", possibly at Hu'ehu'e Ranch; top of the photograph is *mauka* (Kona Historical Society, negative number: C 02284)

3.6 Modern Land Use

The boundary between Kohanaiki and Kaloko was until fairly recently only approximate. Kelly (1971:48) notes that when Emory and Soehren conducted their 1961 archaeological survey, the boundary was south of its current location. Additionally, one of her informants remembered that Kaloko Pond and the coast were within the *ahupua'a* of Kohanaiki, and Kaloko was "farther over, toward Huliko'a" (Kelly 1971:48). Kelly cites Beckley's (1887:256) statement that, "These fish ponds are sometimes owned, by the proprietors of two adjoining lands, the people of one owning the right to fish during the rise of the tide and the other during the ebb."

Until the construction of the Queen Ka'ahumanu Highway in the 1970s, access to the "kula kai (shoreward plains)" (Maly and Maly 2003:101) was limited to local residents. The 1924 USGS map (Figure 10) shows the *mauka/makai* road connecting the Kohanaiki Homesteads with the Kaloko fishpond, and crossing the project area at the *ahupua'a* boundary between Kohanaiki

and Kaloko. In the first half of the twentieth century, the primary method of travel was "by foot or on horse or donkey, and those who traveled the land, were almost always native residents of Kalaoa, 'O'oma, Kohanaiki, Kaloko and Honokōhau" (Maly and Maly 2003:99). Hu'ehu'e Ranch bulldozed a jeep road to the shore around 1955 (Figure 11) during the construction of the Kailua pier, and this was used primarily by the ranch employees for duties or for going fishing along the coast.

The Kaloko fishpond - leased from the Hu'ehu'e ranch - continued as a commercial fishing operation until the 1950s. During the 1970s, the pond was incorporated into the newly-established Kaloko-Honokōhau National Historic Park.

While the present project area is largely undeveloped, surrounding areas have seen increasing modern use. The Hu'ehu'e Ranch jeep road and other signs of animal husbandry activity can be seen on the 1959 USGS map (see Figure 11). More recent nearby development is largely industrial, and the Kaloko Industrial Area is just southwest of the project area, including large stores such as Home Depot and Costco. Huliko'a Road is also heavily developed, primarily as an industrial area, along a portion of the north border of the project area. Hina Lani Street runs along the south border of the project area, and leads *mauka* to a residential area (Kona Heavens) before the Palani junction (at Māmalahoa Highway), as well as leading *makai* to the modern Queen Ka'ahumanu Highway.

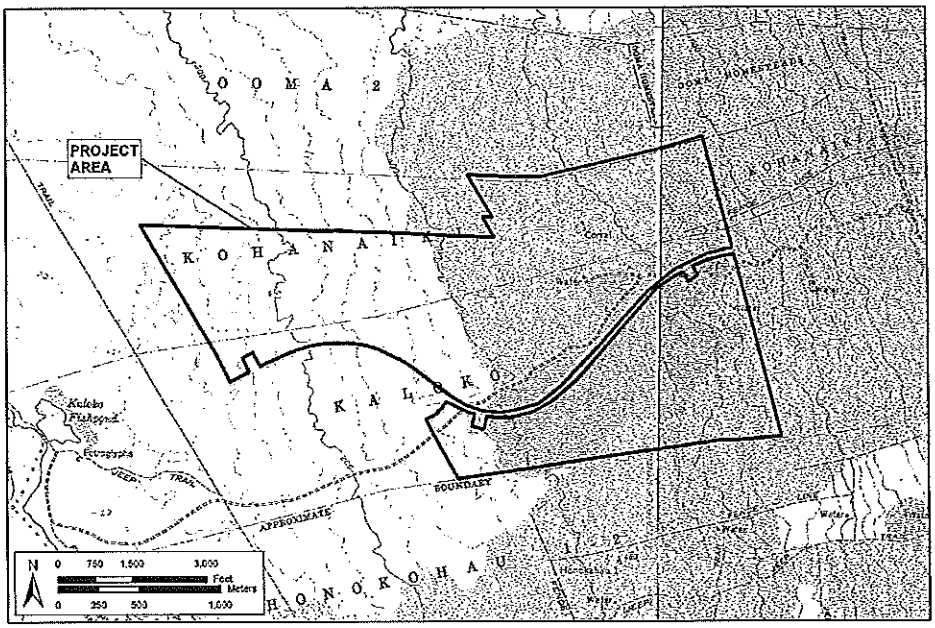

Figure 11. Portion of 1959 USGS map, Kailua and Keahole Point quadrangles, with overlay of project area showing jeep road and signs of historic/modern animal husbandry

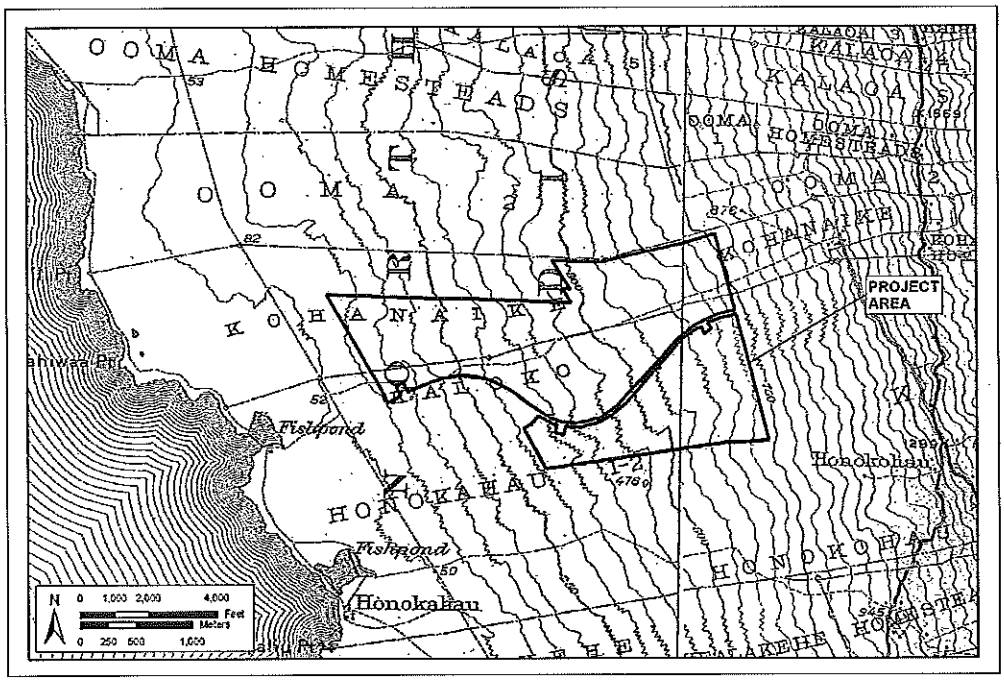

Figure 10. Portion of 1924 USGS map, Kailua and Keahole Point quadrangles, with overlay of project area

Section 4 Archaeological Research

4.1 Overview of Archaeological Studies Conducted within Kohanaiki and Kaloko

This section provides a general overview of archaeological studies in Kaloko and Kohanaiki Ahupua'a. Table 1 lists archaeological studies in this area with brief comments, while studies most relevant to the current project are discussed in additional detail in the text. The section following this discusses archaeological studies within the present project area in greater detail.

Archaeological work conducted within portions of Kohanaiki and Kaloko Ahupua'a (Figure 12) began with the early coastal survey performed by John Reinecke for the Bernice P. Bishop Museum in 1929-1930 (Reinecke 1930). This was a cursory survey in which approximate site locations and very brief site descriptions were recorded. Reinecke recorded eight sites at the coast of Kohanaiki; the sites - minimally documented and mapped - included habitation sites and a *heiau*. The next survey was undertaken by Kenneth Emory and Lloyd Soehren in 1961 (Emory and Soehren 1971). This was also a coastal survey, and focused specifically upon the coast of Kaloko, Honokōhau, and Keālakehe. In 1970 and 1971, Robert Renger and students from the University of California at Santa Barbara conducted an intensive survey of Kaloko and Honokōhau between present-day Queen Ka'ahumanu Highway and the coast (Cordy et al. 1991). This survey also included subsurface testing of selected sites. These three surveys identified a total of 94 sites within Kaloko between the coast and Queen Ka'ahumanu Highway as of 1971.

Additional archaeological work and historical research undertaken within or about Kaloko during the 1970s and 1980s include: an historical study by Marion Kelly (Kelly 1971); research relating to the establishment of the Kaloko-Honokōhau National Park (e.g. Honokōhau Study Advisory Commission 1974, National Park Service 1975); research stemming from the fieldwork conducted by Renger in 1970-71 (see the list presented in Cordy et al. 1991:2); and several reconnaissance-level studies (Ching 1980; Hammatt 1980; Soehren 1983).

Cordy (1981) conducted a survey of the coastal area (up to 1/2 mile inland) of Kohanaiki in 1975. Twelve sites were recorded including pavings, platforms, enclosures and a trail. Eleven of the sites were interpreted as habitation structures including sleeping houses, men's houses, special purpose, and a canoe house/men's house.

During the 1980s, PHRI began investigations of the entire *makai* portion of Kohanaiki Ahupua'a, bounded by its boundaries with 'O'oma 2 and Kaloko, and by the Pacific Ocean and the Māmalahoa Trail. During an inventory survey in 1986 (Donham 1986), "Fourteen previously recorded sites were relocated and 91 sites were newly identified...Habitation sites represented over half of the identified site total, and included habitation complexes, habitation/ceremonial and/or habitation/burial complexes, and temporary habitation sites" (Donham 1986:7-8). In 1991, PHRI performed data recovery of the project area (O'Hare and Goodfellow 1992). This work included: "detailed recording of (a) 31 sites (224 features) previously recorded in the project area, and (b) seven sites newly recorded during the Phase II work" (O'Hare and Goodfellow 1992:ii). Summarizing Kohanaiki settlement pattern within the zones represented by the project area, the report notes:

Table 1. Previous Archaeological Studies Within Kohanaiki and Kaloko Ahupua'a (Projects in Present Study Area are in Bold)

Source	Nature of Study	Area of Study	Finds	Comments
Reinecke 1930	Cursory survey	Coastal Survey	Briefly notes numerous sites	All sites *makai* of present project area
Emory & Soehren 1971	Cursory survey	Coastal Survey	Briefly notes numerous sites	All sites *makai* of present project area
Kelly 1971	Historical survey and background	Kaloko and Kuki'o Ahupua'a	Background study	Good background study
Renger 1971	"Field Notes" of "*Mauka* excavations"	"*Mauka* excavations"	"Field Notes" describe several sites	No site location map thus hard to be sure where sites are
Soehren 1979	Letter Report Reconnaissance Survey	Kaloko Access Road Corridor (Hina Lani Street)	No finds	-
Soehren 1980a	Letter Report Reconnaissance Survey	Kaloko lowlands	No finds	-
Soehren 1980b	Letter Report Reconnaissance Survey	Kaloko Access Road Corridor	Discusses 3 stepping stone trails, 2 *ahu* & a lava tube complex	Hina Lani Street Letter Report not actually seen
Hammatt 1980	Archaeological Reconnaissance	410 acre parcel	Identified 2 sites	*Mauka* of present project area
Barrera Jr. 1983	Archaeological Reconnaissance	TMK 7-3-9:19	No finds	No map
Soehren 1983	Archaeological Reconnaissance Letter Report	-	-	-
Kennedy 1983	**Archaeological Reconnaissance**	**Within present project area**	**Identifies 27 sites**	**Within present project area**
Kennedy 1984	**Intensive Archaeological Survey**	**Within present project area**	**Results of investigations of 25 sites**	**Within present project area**
Barrera Jr. 1985	**Archaeological Survey**	**409 acres 700 to 1080' elevation**	**58 sites**	**Within present project area**

Source	Nature of Study	Area of Study	Finds	Comments
Donham 1986	Archaeological Reconnaissance Survey	470-acres *makai* of Queen K Hwy	105 sites	Kohana-iki development
Rosendahl & Haun 1987	Archaeological Reconnaissance Survey	3 1-acre parcels, 2 in present project area	Their project area *mauka* of present project area had one site	Water tanks along Hina Lani Street
Barrera Jr. 1988	Archaeological Excavations	YO Project Area	60 sites	*Mauka* of present project area
Rosendahl, M 1989	Archaeological Inventory Survey	200 ft.-wide corridor along boundary separating O'oma 2 and Kohanaiki	Identified 4 sites; **site 5699 extends into current project area**	Adjacent to and north of present project area
Rosendahl 1989a	Letter Report Addendum to Archaeological Inventory Survey	Addl info re: site 13493 stepping stone trail by *makai* tank	Identified one *pāhoehoe* slab trail (site 13493)	Water tank *makai* of present project area
Rosendahl 1989b	Field Inspection	Kaloko Mauka Parcel # 1	Identified 4 sites	-
Rosendahl 1989c	Field Inspection	Kaloko Mauka Parcel # 2	No sites identified	-
Rosendahl & Walker 1990	Addendum to Archaeological Inventory Survey	Addl info re: site 13493 trail by *makai* tank	Addl info re: site 13493 trail by *makai* tank	Water tank *makai* of present project area
Rosendahl & Walker 1991	Archaeological Field Inspection	Industrial crusher site, 2 adjacent 10 acre parcels	Identified a trail with two cairns	South of present project area
Barrera Jr. 1991	Archaeological Inventory Survey & Data Recovery Report	800 to 1100'	Identified 61 sites	*Mauka* of present project area
Cordy et al 1991	An Ahupua'a Study: The 1971 Archaeological Work at Kaloko	Kaloko-Honokōhau National Park	94 sites identified	*Makai* of present project area
Kennedy 1991	Surface Reconnaissance	Long thin industrial development	No significant finds	*Makai* of present project area

Source	Nature of Study	Area of Study	Finds	Comments
Drolet & Schilz 1991	Archaeological Inventory Survey	8.8 acres in O'oma 2	29 sites identified Site -16103 extends into project area	Adjacent to and north of present project area
Barrera Jr. 1993	Archaeological Inventory Survey	5.7 acres; 1450 to 1630' elevation	Identified 40 features of Kona Field System	*Mauka* of present project area
Fager & Graves 1993	Archaeological Inventory Survey	Kaloko Industrial Park parcel	Identified 17 sites with 60 component features	*Makai* of present project area, south of Hina Lani Street
Fager & Rosendahl 1993	Interim Report Archaeological Inventory Survey	Kaloko Industrial Park parcel; 15+ acres	Identified 17 sites with 60 component features	Just *makai* of present project area, south of Hina Lani Street
Henry & Graves 1993	**Archaeological Inventory Survey**	**Transmission line project *mauka* side of Queen K Hwy.**	**Identified 10 sites within project area**	**Within present project area**
O'Hare & Rosendahl 1993	Report on burials	On coast	Report on burials	Kohana-iki Resort project
Rosendahl 1993	Archaeological Field Inspection	Kaloko Mauka Parcel	4 sites discussed	-
Nees & Williams 1995	Archaeological Investigations	110 acres, 2100 to 2900' elevation	Identified enclosure, lava tube, terrace, wall, mounds	*Mauka* of present project area
Walsh & Hammatt 1995	Archaeological Inventory Survey	Queen K Hwy Right-of-Way	Identified 9 sites adjacent to *makai* side of Hwy in Kohanaiki & Kaloko	*Makai* of present project area
Colin et al. 1996	**Archaeological Inventory Survey**	**224 acres *makai* of present project area**	**Identified 55 sites**	**Within present project area**
Rechtman 1998	Archaeological Field Inspection	2400-2500' elevation	No finds	*Mauka* of present project area
Rechtman & Henry 1999	Archaeological Inventory Survey	1450-1620' elevation	Identified 15 sites	*Mauka* of present project area

Source	Nature of Study	Area of Study	Finds	Comments
Wolforth 1999	Monitoring Report	HELCO Keāhole-Kailua Transmission line corridor	Describes one site 21258	Says Walsh & Hammatt previously id'd site as 19946 (on *makai* side of hwy)
Haun & Henry 2000	Archaeological Inventory Survey	Kaloko Industrial Park TMK: 7-3-51:60; 102-acre parcel	45 sites with 81 features	*Makai* of present project area south of Hina Lani Street
Rosendahl 2000	Archaeological Assessment	2435-2730' elevation	No finds	*Mauka* of present project area
Clark & Rechtman 2002	Archaeological Inventory Survey	1200' to 1600' elevation	Identified 5 sites	*Mauka* of present project area
Haun & Henry 2002	Data Recovery Plan	Kaloko Industrial Park TMK: 7-3-51:60; 102-acre	Data Recovery Plan addresses 8 specific sites	*Makai* of present project area south of Hina Lani Street
Rechtman & Rivera 2002	Archaeological Assessment	3-7-3-26:4; 3,100'	No finds	*Mauka* of present project area
Cobb et al. 2003	**Archaeological Assessment**	**TMK: 7-3-09:25, 26 & 28 at Kaloko and Kohanaiki (400 acres)**	**Briefly identifies 154 features**	**Descriptions quite brief; map hard to correlate with sites found in present survey**
Haun 2003	**Archaeological Assessment**	**400-Acre Portion of TMK 7-3-09:28 Kaloko**	**Identifies 8 sites (63 features) in present project area**	**Helicopter flight overhead led him to focus on open *'a'ā* area**
Haun et al. 2003	Data Recovery Report	Kaloko Industrial Park TMK: 7-3-51:60; 102-acre	Data Recovery Report addresses 8 specific sites	*Makai* of present project area south of Hina Lani Street
Moore & Kennedy 2003	Archaeological Inventory Survey	Roadway Corridor	Identified 1 site (23973) 2 mounds	South boundary of project area
Puette & Dye 2003	Archaeological Inventory Survey	22 acres 2100 to 2400' elevation	No finds	*Mauka* of present project area
Rechtman 2003	Archaeological Assessment	3-7-3-26:5; 3,100' elevation	No finds	*Mauka* of present project area

Source	Nature of Study	Area of Study	Finds	Comments
Elmore et al. 2004	Archaeological Inventory Survey	1400' elevation	Identified one historic site 24133	*Mauka* of present project area
Shideler & Hammatt 2005	**Archaeological Field Inspection and Literature Review**	**1,200+ Acres in Kaloko and Kohanaiki**	**Numerous pre-Contact sites observed, including: habitations, agricultural features, petroglyphs, boundary walls, and burials**	**Within present project area**
Wolforth et al. 2005	Archaeological Inventory Survey	TMK: [3] 7-3-09: 032	A total of 89 sites were identified, consisting of burials, perm. habitation, temp. habitations, religious sites, trails, boundary walls, and agricultural sites	*Mauka* of present project area
Nelson et al. 2006	Archaeological Inventory Survey	TMK:3-7-3-009:007	Re-recorded site 16103, which extends into project area	Adjacent to and north of present project area; **one site extends into project area**

> The data recovery work indicates that permanent habitation sites between Puhili and Wawahiwaa Points are concentrated in the coastal zone, near the shoreline. In the coastal area south of Wawahiwaa Point permanent habitation sites were near the shoreline and further inland. Temporary habitation sites were present in all areas of the coastal zone and in the barren rockland zones. The radiocarbon date ranges indicate that sites in the northern coastal zone might have been inhabited as early as A.D. 1020. Sites in the southern coastal zone may have been inhabited as early as A.D. 1370, and sites in the barren rockland zones may have been inhabited as early as A.D. 1180. In the barren rockland zones, use of the sites was terminated before the historic period, and in the coastal zone most of the sites were not used in the historic period. (O'Hare and Goodfellow 1992:ii)

In 1985, Barrera (1985) surveyed approximately 409 acres within Kaloko and Kohanaiki Ahupua'a; the 409-acre parcel is located between Māmalahoa Highway and Queen Ka'ahumanu Highway, 750 meters *mauka* of the present project area. Four sites were recorded in Kaloko,

including an enclosure, a lava tube cave, a wall and a platform (possible burial). Fifty-five sites were recorded within Kohanaiki and include mounds, platforms, habitation complexes, walls, and terraces. A portion of the study area included the historic period Kohanaiki Homestead. Barrera's site #59 comprises constructions associated with the homestead and is described as a "series of Habitation areas enclosed by large stone walls." No estimate is given of the ages of the other sites.

In 1987, Paul H. Rosendahl Inc. accomplished an archaeological reconnaissance survey of three one-acre parcels - proposed water tank sites - in Kaloko (TMK: 7-3-09:Por.1,17) (Rosendahl and Haun 1987), along the south side of the then "main access road between Queen Ka'ahumanu Highway and Kona Heavens Subdivision" - i.e. the present Hina Lani Road. The parcels were located at 350 ft. a.m.s.l., 630 ft. a.m.s.l., and 910 ft. a.m.s.l. Only one site (SIHP No. 10-28-10887) - an historic wall interpreted as a boundary or cattle wall - was recorded within the mauka-most parcel. Subsequently, in 1989, an additional water tank site parcel (TMK: 3-7-3-10:Por.17) - measuring 360 ft. north/south and east/west - was subject of an archaeological inventory survey (Rosendahl 1989). The parcel bordered the north side of the then "proposed Kamanu Street extension in the Kaloko Light Industrial Park" at the south boundary along Hina Lani Road. One site was recorded and designated SIHP No. 50-10-27-13493:

> a steppingstone trail segment measuring 7.5 m (24.6 ft.) long (E-W) by 0.6-0.7 m wide (1.97-2.30 ft.) (N-S)...located on a section of aa lava...The segment consists of approximately six flat and roughly round pahoehoe slab steppingstones set on worn aa gravel. The steppingstones measure c. 0.4 m (1.31 ft.) in diameter by 0.1 m (0.33 ft.) thick. The trail is oriented c. 159 degrees Az. (magnetic). No portable remains were present in association with the trail. The trail appears to be prehistoric, and appears to have been used as a secondary transportation route. (Rosendahl 1989:1)

In 1988, Cordy et al. (1991) began preparing a study of Kaloko Ahupua'a for the new Kaloko-Honokōhau National Park. The study was based on Renger's 1971 fieldwork conducted for planned development of coastal Kaloko for Hu'ehu'e Ranch. The fieldwork "included survey work in the intermediate and upland zones of Kaloko, which located additional sites, extensive excavation in the coastal area, and some excavation in the intermediate and upland sites" (Cordy et al. 1991:2). Renger identified, and in some cases re-identified, 94 sites that included 59 sites in the Coastal Zone, 30 sites in the Middle Zone, and five *mauka/makai* trails that crossed both zones and continued heading inland. As only "summary papers" had been previously written, the monograph published in 1991 includes the 1971 fieldwork data and resultant analyses, and additional fieldwork conducted by Cordy and Hitchcock in the 1970s and 1980s (Cordy et al. 1991:2, 44).

In 1991, Archaeological Consultants of Hawai'i (Kennedy 1991) performed a reconnaissance survey of a narrow corridor - 500 ft. north/south by 7260 ft. *mauka/makai* (TMK: 7-3-09:15) - in Kohanaiki extending *mauka* from Queen Ka'ahumanu Highway, located adjacent to the northern boundary of the present study area. No sites or features were observed; seven caves "were examined to term and were determined to be devoid of cultural materials" (Kennedy 1991:C-1).

In 1991 William Barrera produced an archaeological inventory survey and data recovery report of an extensive area just inland (*mauka*/east) of the present study area in which he identified 61 sites. These sites were rather clumped in the east central portion of his project area.

Rosendahl and Walker (1991) carried out an archaeological field inspection for proposed Kaloko Industrial crusher sites just south of Hina Lani Street at an elevation of approximately 450 ft a.m.s.l.. A trail and two associated cairns were identified.

In 1993, Paul H. Rosendahl Inc. conducted an inventory survey (Fager and Graves 1993) of an approximately 15-acre parcel adjacent to, and *mauka* of, the Kaloko Industrial Park, which includes a road corridor extended from the main project area to Kamanu Street. The survey recorded 17 sites incorporating 60 component features. The sites were judged

> ...in poor to good condition and comprised the following formal types: terraces, modified outcrops, mounds, walls, caves, pahoehoe excavations, cairns, filled cracks, enclosures, and a trail. The formal types comprised the following functional types: animal husbandry, temporary habitation, agriculture, marker, quarry, and transportation. (Fager and Graves 1993:ii)

A series of studies (Haun and Henry 2000, 2002; Haun et al. 2003) were carried out on a 102-acre Kaloko Industrial Park parcel south of Hina Lani Street. Of note are the fairly dense and widely distributed site concentration and also extensive areas of both *'a'ā* flow and bulldozing.

In recent years a number of studies have been undertaken in the Kaloko Mauka lands (east and upslope from the present project area) including studies by Barrera (1993), Nees and Williams (1995), Rechtman (1998), Rechtman and Henry (1999), Rosendahl (2000), Clark and Rechtman (2002), Rechtman and Rivera (2002), Puette and Dye (2003), Rechtman (2003), and Elmore et al. (2004).

In 2005, Wolforth et al. conducted an archaeological inventory survey of the northern portion of the Kaloko Heights Project (TMK [3] 7-3-09: 032), located approximately 1,000 m east of the current project area. A total of 89 sites were identified, consisting of burials, permanent habitations, temporary habitations, religious sites, trails, boundary walls, and agricultural sites. A historic wall that runs along the *ahupua'a* boundary between Kaloko and Kohanaiki extends from TMK parcel 32, adjoining the current project area to the east, into TMK parcel 25, within the current project area.

4.2 Archaeological Studies Conducted within the Present Project Area

The following is a summary of archaeological studies conducted within the current project area, discussed in chronological order. Table 1 lists in bold historic properties previously identified in the current project area

Survey work was undertaken in 1970-71 by Renger inland of the highway - i.e. that middle zone of Kaloko that includes a portion of the present study area. Although the findings of much of this fieldwork within the middle zone were written up in detail (Cordy et al. 1991), the findings from the survey sample conducted specifically within the project area (i.e. that portion of the middle zone situated on the inland side of the Queen Ka'ahumanu Highway) were not included because, "regrettably... it appears that the maps and survey records have been misplaced

since the end of the 1971 field season" (Cordy et al. 1991:340). Renger's summary of the findings from that part of the survey indicated that fifteen features were identified:

> Very few sites were discovered within the "transitional middle zone" ... between the coastal and upland exploitation zones ...Seven lava tube shelters, four trails (coast-upland), three platforms, two cairns ... two low-walled enclosures, and an L-shaped structure were recorded. (cited in Cordy et al. 1991:340)

These sites are presumably the subject of a set of Renger's (1971) "Kaloko Field Notes" that begins "*Mauka* Excavations" but in the apparent absence of any site location map it is difficult to relate these notes to specific sites in the field.

It is our understanding that Lloyd Soehren conducted a reconnaissance survey in 1979 of the Kaloko access road corridor, understood as the current alignment of present Hina Lani Street, but identified no sites.

In 1983, Joseph Kennedy conducted a reconnaissance and subsequent intensive survey (1984) of a parcel within the *makai* portion of the present project area. The 1983 reconnaissance located and briefly described 27 sites. These sites included 17 lava tubes, three *cairn* or cairns, two walls, two platforms, an enclosure, a modified outcrop, and a trail. The 1984 intensive survey identified:

> 45 separate cave openings and approximately 200 chambers in these caves. In addition there were 4 walls recorded, 5 enclosures, 13 platforms, 9 cairn, 2 trails and 2 sets of petroglyphs. Out of the 79 separate features on the property, 30 were judged to be worthy of re-investigation ... the remaining 49 sites that were not reinvestigated were comprised almost exclusively of relatively shallow caves with little or no evidence of cultural remains or associated modifications. (Kennedy 1984:18)

Many (but not all) of the sites identified in 1984 are described and some of these sites were not mapped. Excavations were carried out in three caves (Sites 11, 22 and 49 in the Kennedy 1984 numbering system). Of the 25 sites for which information is presented in the Kennedy 1984 study, 22 sites were recommended for no further work and three (Kennedy 1984 site #s 11, 22 and 32) were recommended for preservation.

In 1989, Margaret Rosendahl conducted an archaeological inventory survey of a 200 ft.-wide corridor along the boundary separating O'oma 2 and Kohanaiki, north of the project area, for a water system. Survey results included the identification of four sites that included quarrying pits, a ceremonial/habitation complex, a marker, and a historic wall. The wall, SIHP No. -5699, ran along "the inland boundary of the survey corridor" (Rosendahl 1989:13). During the current survey, 15 m of the wall's south end extends within the project area, and continues roughly north for at least 500 m. The rubble-fill method of construction indicates the wall is historic. No further work was originally recommended, although possible inclusion into landscaping was suggested for consideration (Rosendahl 1989:14).

In 1991, Drolet and Schilz conducted an archaeological inventory survey of 8.8 acres in O'oma 2, north of and adjacent to the current project area. Survey findings included the identification of 29 sites including two cave complexes, SIHP Nos. -16103 and -16104, that extend into the current project area. Nelson et al. (2006:66) found that the two caves connect and

actually consist of one subsurface complex. They referred to the sites as SIHP No. -16103. Drolet and Schilz (1991:27-28) determined that the sites were significant and their project, as planned, would avoid the sites and provide a "10 meter buffer zone" around them. Nelson et al. (2006:66) describe the site as containing "several architectural modifications, a plethora of cultural debris, and a single human burial." They determined that "site 16103 retains integrity of location and is in good condition for an archaeological ruin" (Nelson et al 2006:66).

In 1993, Henry and Graves carried out site identification along a Keāhole to Kailua 69 kV transmission line, which comprised a 50-100 ft wide alignment on the *mauka* (east) side of Queen Ka'ahumanu Highway. Nine sites were identified within the current project area. During the current inventory survey only three (SIHP Nos. -15324, -15325, and -15329) of the nine sites were relocated. It is believed that the seven sites not relocated were either situated outside of the current project area, within the *mauka* (eastern) road easement, or were destroyed (via bulldozing) during the installation of new powerlines along the eastern side of Queen Ka'ahumanu Highway.

In 1995, CSH conducted an archaeological inventory survey with limited subsurface testing within a narrow strip of land, averaging 300 ft wide, along Queen Ka'ahumanu Highway between Palani Road and the Keāhole Airport entrance road (Walsh and Hammatt 1995). Three sites were identified in Kohanaiki: two trails and a set of three cairns. One of the trails - a *mauka-makai* trail - had been previously identified and designated SIHP No. 50-10-27-15324. The site is described as consisting of:

> ...two converging trail segments designated Features A and B...Both trail segments extend in a roughly *mauka-makai* direction, but angle toward each other and converge into one trail that continues inland. The point where the two trails meet is located at the edge of the bulldozed portion of the present highway right of way, 164 feet (50 m.) from the *makai* edge of the highway pavement...On the *mauka* side of the highway, the trail was observed at the edge of the bulldozed portion of the power line (the new right-of-way boundary) and continuing inland at 65 degrees T.N. for at least another 100 feet (30 m.). (Walsh and Hammatt 1995:51)

This trail site is located within the present study area.

In 2003, Archaeological Consultants of the Pacific, Inc. (Cobb et al. 2003) conducted an archaeological assessment of TMK (3) 7-3-009: 025, 026, and 028. One hundred fifty-four (154) features were identified and included "caves, walls, mounds, platforms, enclosures, trails, *cairn*, "C"-shaped structures, possible *heiau*, terraces, alignments and modified outcrops" (Cobb et al. 2003:1). Each feature was identified with a number prefaced with "TF", and descriptions included feature type, a brief description, possible function and a preliminary significance evaluation. The report map does not show the location of particular sites found during the survey but has colored points for sites indicating "High Concern, Potential High Concern, and Minimal Concern" (Cobb et al. 2003:5). The *mauka* portion of the current project area was included in the survey and several site tags from the 2003 survey were found in sites recorded during the current project (see below). One site, TF142, a cave with a small entrance and indeterminate function, was thoroughly surveyed by CSH in 2007; no cultural materials or modifications were present.

Haun (2003) conducted an archaeological assessment of a portion of the current project area, largely via helicopter to cover the *'a'ā* terrain, but also by foot in the thicker vegetation. He identified eight sites, all of which correlate to sites presented in the CSH archaeological inventory survey for TMK 28 (Esh et al. 2008).

In 2005, CSH completed an archaeological field inspection of a 1200+ acre project area in Kaloko and Kohanaiki [TMK (3) 7-3-009:017, 025, 026, and 028] that included the current project area. Numerous pre-Contact sites including habitations, agricultural features, petroglyphs, boundary walls, and burials were observed (Shideler and Hammatt 2005).

In 2007 and 2008, CSH completed fieldwork for the four archaeological inventory surveys within Kaloko and Kohanaiki Ahupua'a (TMK: [3] 7-3-009:017, 025, 026, 028), that are the companion reports for this CIA. Given the large size of the total project area (over 1,100-acres), a decision was made to split the archaeological inventory survey reports by individual TMK parcel, producing a total of four reports.

In the 224+ acre project area in TMK [3] 7-3-009:017, a total of 59 historic properties were identified; 53 of the historic properties were previously identified and six were newly recorded during the inventory survey investigation. CSH had previously conducted an archaeological inventory survey (Colin et al. 1996) in the same project area in 1996 with limited subsurface testing for Kimura International; the project was terminated during the review process. Fifty-five sites were identified in 1996. All identified sites were of pre-Contact traditional Hawaiian origin and included the following site types: cairn, simple agricultural features, recurrent and temporary habitation sites, trails, enclosures, walls, and a quarry. During the 2007 inventory survey, two sites (SIHP Nos. -20706 and -20741) identified by Colin et al. were determined to be outside of the project area, likely due to the lack of GPS technology during the 1996 survey. One site, SIHP No. -20741, is within TMK parcel 25, another section of the current project area (Bell et al. 2008).

In the 360.131 acre parcel (TMK: [3] 7-3-009:025), a total of 121 historic properties were identified; two of the historic properties were previously identified and 119 were newly recorded during the inventory survey investigation (Bell et al. 2008).

In the 194.324-acre parcel (TMK: [3] 7-3-009:026), a total of 120 historic properties were identified; six of the historic properties were previously recorded and 114 were newly recorded as part of the inventory survey investigation (Bell et al. 2008).

In the 363.106-acre parcel (TMK: [3] 7-3-009:028), a total of 41 historic properties were identified. All sites were newly recorded as part of the inventory survey investigation; eight of the historic properties were previously noted in an archaeological assessment by Haun (2003), and some features were also noted by Cobb et al. (2003) (Esh et al. 2008).

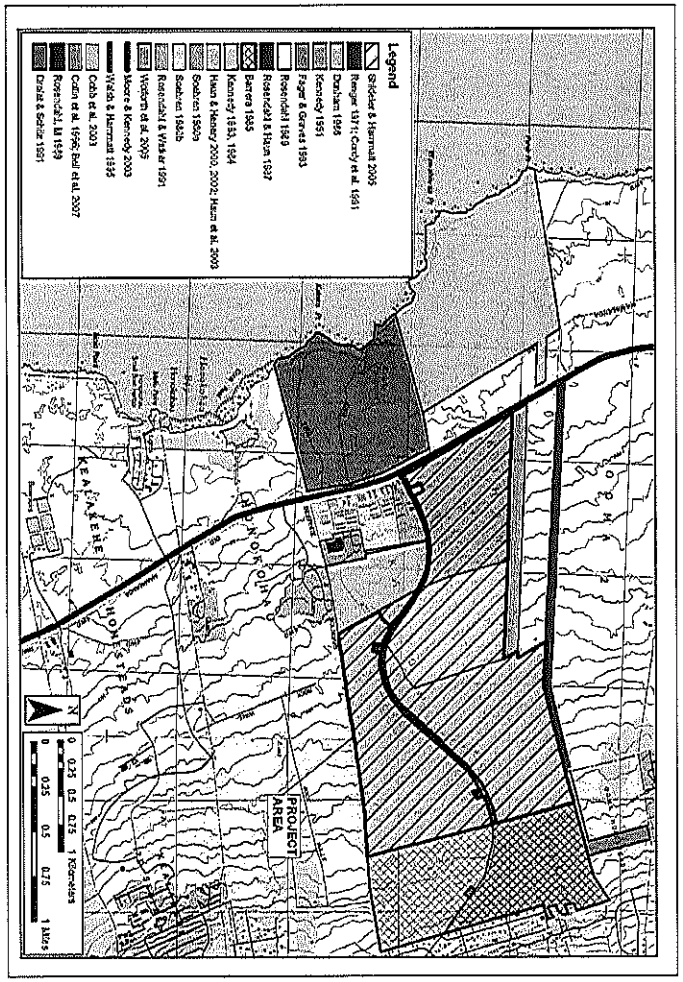

Figure 12. Map of previous archaeological studies in the project area and its vicinity

Section 5 Community Consultation Effort

Throughout the course of this CIA, 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 cultural resources and practices specifically related to the project area. A number of attempts (3-7) were made to contact individuals, organizations, and agencies apposite to the CIA for Kohanaiki. This effort was made by letter, e-mail, telephone and in person contact. In the majority of cases, letters along with a map and aerial photograph of the project area were mailed with the following text:

> At the request of Stanford Carr Development, Cultural Surveys Hawai'i, Inc. (CSH) is conducting a Cultural Impact Assessment (CIA) for a 1,150 acre project located in Kohanaiki and Kaloko Ahupua'a, North Kona District, on the Island of Hawai'i, Tax Map Key: [3] 7-3-009:17,25,26 and 28. The proposed project area is *mauka* (east) of Queen Ka'ahumanu Highway and is surrounded mostly by undeveloped land. The proposed project area extends *mauka* from the highway to within approximately 1/2 mile (900 meters) of existing residences in the Kona Heavens subdivision area (Anini Street, Manu Mele Street, Kohanaiki Road). The proposed project area is bisected by Hina Lani Street (*mauka/makai* road) and is nestled between the Kohanaiki Industrial Park and Kaloko Industrial Park (i.e. Costco and other big box retailers). See attached USGS map and aerial photograph of the project.
>
> The developers' proposed plans includes a residential community with construction of 5,000 new single- and multi-family residential units sizing at low, medium and high-densities, centralized commercial and neighborhood retail centers, an array of recreational facilities (e.g. parks, trails, open spaces), a new elementary school, a middle school, and associated infrastructure (e.g., new roadways, utilities, drainage, wastewater and potable and non-potable water distribution systems).
>
> The purpose of this cultural study is to assess potential impacts to cultural practices and resources as a result of proposed development in Kohanaiki Ahupua'a. We are seeking your kōkua and guidance regarding the following aspects of our study:
>
> - General history and present and past land use of the project area.
> - Knowledge of cultural sites which may be impacted by future development of the project area - for example, historic sites, archaeological sites, and burials.
> - Knowledge of traditional gathering practices in the project area, both past and ongoing.
> - Cultural associations of the project area, such as legends and traditional uses.
> - Referrals of *kūpuna* or elders and *kama'āina* who might be willing to share their cultural knowledge of the project area and the surrounding *ahupua'a* lands.
> - Any other cultural concerns the community might have related to Hawaiian cultural practices within or in the vicinity of the project area.

The results of the community consultation effort are presented in Table 2 below. Section 6 below presents the community responses to CSH.

Table 2. Community Contacts Summary

Name	Affiliation, Background	Comments
Ako, Mr. Val	Fisherman, lineal descendant	CSH sent letter and maps on Mar. 12, 2008. Mr. Ako shared his *mana'o* on March 27. See Section 6 below.
Carlson, Mr. Carl	Former general manager of Hu'ehu'e Ranch	CSH emailed letter and maps on Mar. 14, 2008. CSH spoke with Mr. Carlson the same day and he agreed to draw the borders of Hu'ehu'e Ranch on a TMK map, for the year 1955. CSH faxed the maps for Mr. Carlson to draw the borders on March 17. Mr. Carlson emailed CSH on Mar. 18, and said he would work on maps when he has time.
Davis, Ms. Morgan	State Historic Preservation Division, Hawai'i Office	CSH sent letter and maps on Feb. 26, 2008
Flores, Mr. E. Kalani	Lecturer, University of Hawai'i and trail expert	CSH sent email inquiry regarding historic trails on Feb. 24, 2008. Mr. Flores replied on Mar. 10, providing information about descendants and organizations. He requested to be notified of findings and of the report when it is done.
Haleamau, Mr. Karin	*Paniolo* for Hu'ehu'e Ranch and lineal descendant, as well as traditional fisherman	CSH sent letter and maps on Feb. 25, 2008. CSH called on Mar. 13, and interviewed Mr. Haleamau on March. 20. An additional statement was made by Mr. Haleamau on April 15. See Section 6 below.
Keanaaina, Mr. Duane	Lineal descendant	CSH sent letter and maps on Feb. 25, 2008. CSH interviewed Mr. Keanaaina on March 26. See Section 6 below.
Keanaaina, Rev. Norman	Lineal descendant	CSH sent letter and maps on Feb. 25, 2008. CSH interviewed Rev. Keanaaina on April 9. See Section 6 below.

Name	Affiliation, Background	Comments
Keka, Mr. Peter	Multi-generational ties to Kaloko-Honokōhau fishponds and surrounding lands with knowledge regarding traditional stonework and caring for fishponds	CSH sent letter and maps to Mr. Keka via Richard Boston, his supervisor at Kaloko-Honokōhau National Park, on Feb. 25, 2008. Mr. Keka shared his *mana'o* on March 21. See Section 6 below.
Kuali'i, Mr. Melvyn Kaleo	Lineal descendant and member, Hawai'i Island Burial Council	CSH sent letter and maps on Feb. 25, 2008. CSH telephoned on Mar. 18. CSH sent email on April 14.
Kunewa, Mr. Herman and Mrs. Iris	Lineal descendants and educators who grew up in Kohanaiki.	CSH sent letter and maps on Feb. 26, 2008. On Mar. 12, 2008, Mr. Kunewa supplied a statement. See Section 6 below.
Lamont, Ms. Joan	Vice President of Beautification, Kona Outdoor Circle	CSH contacted Ms. Lamont by phone on April 14, 2008 regarding proposed project area. CSH mailed letter and maps on April 15.
Lee, Mrs. Elizabeth	Master *lauhala* weaver, lineal descendant	CSH sent letter and maps on Feb. 26, 2008. CSH met Mrs. Lee on March 19. Interview pending approval.
Lee, Mr. Reggie	Lineal descendant; works with DNLR; son of Elizabeth Lee	CSH sent letter and maps on Feb. 26, 2008. Mr. Lee called on March 12, for his mother and brother Robert. CSH spoke to the Lees on Mar. 19, where they declined to make a cultural statement at that time and requested in-depth information regarding the proposed development.
Machado, Ms. Wendy	Cultural Historian, State Historic Preservation Division	CSH emailed Ms. Machado on March 14, 2008 to request a list of lineal descendants for Kaloko and Kohanaiki. Ms. Machado responded on March 25, saying she had a list of cultural descendants. Ms. Machado provided the list of cultural descendants for Kohanaiki on March 31. Ms. Machado emailed on April 1 to confirm she received project information and maps through Ms. Morgan Davis and to ask clarification of project TMK and provide several references.

Name	Affiliation, Background	Comments
Mahi, Mr. Arthur	*Paniolo* and Native Hawaiian cultural practitioner	CSH called Feb. 26 and sent letter and maps on Feb. 27, 2008. CSH interviewed Mr. Mahi on March 20. See Section 6 below.
McDonald, Mrs. Ruby Keanaaina	Lineal descendant and Office of Hawaiian Affairs community resource coordinator	CSH sent letter and maps on Feb. 25, 2008. CSH sent another letter and maps on March 25, 2008 to Mrs. McDonald's home address as she requested information as a lineal descendant. CSH interviewed Mrs. McDonald on April 15. Interview pending approval.
Nāmu'o, Mr. Clyde:	Administrator, Office of Hawaiian Affairs	CSH sent letter and maps on Feb. 25, 2008. See Section 6 below for OHA's response letter.
Nazara, Mrs. Cynthia	Lineal descendant and member of Hawai'i Island Burial Council	CSH sent letter and maps on Feb. 25, 2008. CSH interviewed Mrs. Nazara on March 24. See Section 6 below.
Paik, Ms. Linda Kaleo	Cultural Specialist, History and Culture, State Historic Preservation Division	CSH sent letter and maps on Feb. 25, 2008.
Punihaole, Mr. Robert	Hawaiian cultural practitioner with multi-generational ties to the Kekaha region and North Kona district	CSH sent letter and maps on March 25, 2008. CSH called on April 9. Mr. Punihaole declined to make statement as Kohanaiki is not his *ahupua'a*.
Springer, Ms. Hannah Kihalani	Former Office of Hawaiian Affairs trustee and a member of Kahu Ku Mauna, the cultural advisory group which advises the Mauna Kea Management Board. Her great-great grandmother, Luka Hopula'au, was the first wife of John Avery Maguire, the founder of Hu'ehu'e Ranch.	CSH mailed letter and maps on March 25, 2008. CSH reached Ms. Springer by telephone on April 22, and she shared the following: "Although my family is certainly connected to Hu'ehu'e Ranch and the surrounding lands, I don't know much about Kohanaiki and the project area. But you might check the development of the *makai* lands for additional information. My great-great grandmother, Luka Hopula'au Maguire, was born on Kohanaiki. I learned this from the Mormon church…There is much written on Kekaha lands and you could use that for information."

Name	Affiliation, Background	Comments
Soehren, Dr. Lloyd J.	Archaeologist, expert on place names	CSH called on Mar. 14, 2008, and emailed letter and maps the same day. Dr. Soehren replied on April 18 with the following statement via email: "...I once collected and propagated an *'ohe makai* seed from Kaloko, at about that elevation. The area contains a remnant dry land forest...Place names are scarce in that region, most being either at the shore or higher among the *kuleana*."
Van Gieson, Mr. George	*Hōlua* (sledding) expert for the island of Hawai'i and former member of Hōlua Project Incorporated, which sought to preserve *hōlua* throughout Hawai'i Island	CSH sent letter and maps on Feb. 26, 2008. CSH called on April 28 and Mr. Van Gieson supplied a cultural statement. See Section 6 below.
Ursua, Kumu Larry	Hawaiian cultural practitioner and Kumu kāne hula	CSH sent letter and maps on March 19, 2008. CSH called on April 9, and interviewed Kumu Larry on April 15. Interview pending appoval.
Young, Mr. Charles	Chair, Hawai'i Island Burial Council	Sent letter and maps on April 12, 2008. CSH called Mr. Young on April 28 and left message.

Section 6 Community Responses

Kama'āina and *kūpuna* with knowledge of Kohanaiki and Kaloko Ahupua'a and the proposed project area were contacted for participation in this assessment. The approach of CSH to cultural impact studies affords these community contacts an opportunity to review transcriptions and/or interview notes and to make any corrections, deletions or additions to the substance of their testimony.

Presented below are brief backgrounds of each participant, followed by their comments and concerns about the proposed project area. OHA's response letter follows the participants' comments and concerns.

6.1 Kama'āina Interviews

6.1.1 Mr. Herman Kunewa

CSH interviewed Mr. Herman Kunewa on March 12, 2008 by telephone. His statement represents his *mana'o* (thoughts, ideas, theories) as well as that of his wife Iris. They both have *'ohana* who hail from Kohanaiki. Mr. Kunewa was raised in Kohanaiki, and works as an educator along with Mrs. Kunewa.

When CSH inquired if Mr. and Mrs. Kunewa had any comments about the proposed project, Mr. Kunewa at first declined to make a statement. "We believe in taking a stand this time. You are not the first to approach us about cultural sites and practices, and it doesn't tell us how we can live," he said. "Hawaiians are having a hard time. We are just learning to get back our land."

Mr. Kunewa questions the validity of the proposed project. "The infrastructure in Kona is bad," he pointed out. "The resources are dwindling. When a development comes in, the bottom line is money. That's not what we want to see. Let them back off a bit and let Kona breathe. Let the *iwi kūpuna* (ancestral remains) rest in peace."

Mr. Kunewa emphasized that he is not blindly against development, but he is very much aware of the consequences of uncurtailed and ad hoc building.

> Specifically, we go through this apprehension. We are looking, reading about what is going on. We are very adamant about what is going on. We already work with the families of Kohanaiki, so that they are responsible for all the major sites on it. We are not totally against the development, but we are not for it.

Because he and Mrs. Kunewa are both teachers, they do their best to teach the young, both their children and their students. "We talk to them about the concept of the *ahupua'a*," he said. To understand the *ahupua'a* properly, one needs to also understand how it should look.

> When you go *makai*, and you look up and see development, or look down from *mauka*, and you see construction, the *ahupua'a* is already ruined. If you overdevelop it, aesthetically speaking, you also ruin it. It's all money, money, money. You talk to them, and they say it brings jobs. But I got friends in construction, and they are all laid off. How many families I know who have left Kona and moved away, because they cannot make a living.

Mr. Kunewa commented on the ongoing development in Kailua-Kona and throughout the state.

> No matter where development is happening, we need to go back to what is *pono*. These developments, they know if they don't do it right, they are going to pay for it. We are trying to survive and keep what is *pono*. Once it is gone, it is *pau*, and you will never know Kona. We all grew up in this area. We are the last generation, that generation that experienced what the *kūpuna* have left. To pass it to the next generation, that's what we're doing. But they're not going to experience it, because it is gone...I'm 54, and I grew up experiencing what is abundant. The *limu kohu* down the side of the cliff, the fish dancing all around you, and seeing the black crabs crawling all over, like a lava flow...I'd rather look at barren rock, than houses.

6.1.2 Uncle Karin Haleamau

CSH conducted an interview with retired *paniolo* Uncle Karin Haleamau on March 20, 2008, and he also participated in a site visit on May 22, 2008. Born in 1940, Mr. Haleamau worked for Hu'ehu'e Ranch from 1958 to 1993. He generously shared his *mana'o* on life as a Hawaiian cowboy. Mr. Haleamau is familiar with the trails of the project area and ranching history for both Hu'ehu'e and Palani Ranch. At 68 years old, he keeps fit by continuing to run cattle he owns as well as staying active in the community.

Mr. Haleamau grew up as a child in the 1940s, and when he was seven years old, he took a historic trip with his father on the last steamboat of Hawai'i. He is the third generation to work as a *paniolo*. His grandfather was also a cowboy, and so was his dad. In effect, Hu'ehu'e belongs to him, to his father, and grandfather as they all worked on the ranch. Ranches regularly reached out to the community in the form of parades and other events. They were an integral part of the community.

Life as a *paniolo* was hard, but also fun. As he recalls it, *paniolo* at the time did everything to make the land "go," not just taking care of the cattle. A typical work week was eight hours a day, sometimes 10 hours, six days a week. On Sundays, he would go to church, and then work. He got paid $170 a month. Each day, they would start work at 7 a.m.

> In the olden days, we did everything to make the land go. We fixed fences, ran cattle etc. Only four of us worked the land," said Mr. Haleamau. "We never grumbled, because when we needed help, the ranch gave help. When you are working for the ranch, you either survive or don't work at all because it was a rough life.

Although Hu'ehu'e Ranch was considerably bigger than Palani Ranch, the latter had more *paniolo* to care for its land and cattle. "Palani Ranch really took care of its land, they did manual work, cleared the land by hand. They had 8-10 guys, and it's a smaller ranch," he said.

Working at the ranch taught him how to appreciate the *'āina*, the abundant resources, and the rewards of hard work. "The ranch was very important to us—we can farm on the land, fish and hunt. There was enough for us," he remembered. "We didn't have to take for tomorrow. My dad told us, just take what you need." Mr. Haleamau noted that there were no luxuries, and

transportation was limited to horseback riding, or walking. Nature often determined the work, such as battling a huge fire in 1978, when a lightning storm touched off a fire which burned several thousand acres.

Mr. Haleamau is married to his wife Patricia for 45 years, and they have four children: Gary, Kalei, Kevin, and Conrad. They have seven grandchildren. Mr. Haleamau feels it is significant to share his lifestyle and experience as a *paniolo* to all of them.

> I tell my kids you have to learn what the land is about. I'm so concerned about the *'āina*. God gave us the land for one reason, to use it and to share it. I try to do this for the young generation.

Regarding the quality of the cattle, Mr. Haleamau reminisced about the strength and beauty of the *pipi*. One cow can weigh over 700 pounds, with horns ranging from two to three feet. "The Hereford and dairy cattle can handle going over the *'a'ā* (stony lava), beautiful cattle, they were strong...It was important to have a strong horse," he said. Once over the lava, the cows would refresh themselves by drinking the brackish water at the coast, which is high in minerals and good for the cows.

Due to the hot and challenging landscape of the *mauka* Kaloko and Kohanaiki Ahupua'a, water was an extremely precious resource. Mr. Haleamau is aware of only one cave for water collection, although he had heard of other caves that were also used to gather water drops that dripped into calabashes placed on the floor. He did not have to drink water from caves, as the ranch had its own well. "Water was so important here, we didn't waste water. It was so important to cattle."

Mr. Haleamau also discussed caves that held burials. He emphasized the importance of respecting burials and to ask permission from the *iwi kūpuna* if the need to enter the cave arises. He warned that people who do not ask for permission can fall sick if they disrespect the burials.

There are three trails in the project area that he is most familiar with, especially one that he calls "*Uluwini nui*," a secret trail. He describes the start of this trail as being close to a burial. All three trails he is aware of began *mauka* and close together before branching out, depending on their use. One trail led *makai*, so that one can access the sea while the other trails led to neighboring *ahupua'a* like Honokōhau. He believes old Hawaiians made the roads in order to gather such resources as fish. "Maybe this is what trails are for, for those who lived here," he said. Mr. Haleamau is saddened and upset because a lot of trails have been destroyed. "What I'm telling now, it's a dying thing. I'm the only one that can tell you...why are they destroying our land?"

While working the *'āina*, Mr. Haleamau grew familiar with the plants and crops that were available for use and consumption. For example, he used sisal (*Agave potatorum*) for rope. Fruit and plants in and around the project area included avocado, breadfruit, coffee trees, mangoes, Hawaiian lemon, navel oranges, purple *liliko'i* (*Passiflora edulis*) and banana *poka* (*Passiflora* spp.).

When asked if he observed any traditional practices, Mr. Haleamau noted the presence of numerous small pens, where goats were raised by old Hawaiians. But because he was always busy with ranching, he was not able to do anything but his work. "Once you get on a horse, *brah*, you get that cow, and you lose it," he laughed.

For him, the main area of concern regarding the proposed development is the preservation of holding corrals, known as *puakini*. "I would like them to preserve it, so we could show the people...This is very important. This is the one I'm concerned about," he stressed. "I feel this place and the old people who worked there. I feel *aloha* for that place. If they destroy it, they cannot build it again."

Speaking about the difference between the old *paniolo* life and the cowboy life today, Mr. Haleamau said:

> Ours was the way to survive, not to compete...we help others, that's what we did [with] our time. It wasn't a challenge; [it was] more of a responsibility and a life, but today it's so different. I can't be like that. I've seen a lot of good cowboys but also bad cowboys. They tested your skills. They would test you with a horse that can buck you. I had to show the *kūpuna* the habits they taught me, the hard way. Until today, I'm still learning. To me, we are all learning. Every day is a new thing, we learn.

Because Mr. Haleamau shared his memories of working on the ranch, his thoughts also turned to the people who crossed his path and influenced him in many ways.

> I walked with them, and I want to acknowledge them. If I miss anyone, please excuse me. I would like to acknowledge them. These men started the ranch and they made us who we are. The old *paniolo* days, they make sure everybody is *pono*, have *kaukau*...
>
> During my time of work at Hu'ehu'e, around October 1958 or 1959, I was part-time at the ranch that was run by Ed Johnson, who was manager at that time. There was another manager by the name of Roger Williams. After that, we had Dennis Hasarat, and our former and last manager was Carl Carlson. This is my time of work. Before these managers came in, I would like to acknowledge the people I worked with, including Uncle Kino George Kahananui, Jack Kau'i Ha'o, John Kapehe, John Apela Sr., Eddie Kalaū, Richard K. Punihaole, Carl Hose, Louis Kipano, Thomas K. Lindsey Jr., Gilbert Louwando, Clyde Bulū, my brother Herman K. Haleamau, Henry Ha'o Jr., Joe B. Keka Sr., mechanic Peter Cantor Sr., pasture herdsman Herbert Kono, Henry Sereon Sr., Simeon Tina Jr., William Gomes Sr., Kazui Matsumoto, Clifford Medeiros Sr. and Pek'e Bob Manuel Sr. They are all *paniolo* and employees of Hu'ehu'e Ranch before my time and after, who taught me most about the cattle and cultural work, how to live together and survive.

Mr. Haleamau recalled his childhood days when as a six-year-old, his father would take him riding horseback at night. As the horses slowly trotted up and down trails along Kohanaiki, his father would play music and both would drink in the soft sights and sounds of the night around them.

> My father always said take care of the land, it is not ours to fight, not ours to take, it's ours to be...it is for everyone. I want this to be *pono*, for every piece of land. I still remember the old Hawaiians when I used to ride with my father—their house

> was always open. The first thing you see is *kaukau*, and there are no signs telling you that you are trespassing.

He emphasized his need to share his *mo'olelo* about his *paniolo* life and experiences and the knowledge he gained working with people, animals and the land. It is knowledge that can inspire people to take care of the land.

> If I don't share it with you now, it will never be spoken anymore by anyone who has more experience than I have had, in this *'āina* of ours. Now is the time to share with the next generation; there's a lot of memories that I have. If they could feel the *mana*, and *mana'o* of what is true, then they could *mālama* the *'āina*. The *'āina* is going to be here forever more. I love this land. And don't forget to *mahalo* a Ke Akua [i.e., to thank God]. He loves us. That's what it is about...

I want to acknowledge whatever goes on now, and not to feel sorry later on, because this is for the next generation to be preserved. And I want everybody to understand that what we are doing is for all of us. And pls. support the whole community and let's do the right thing now.

6.1.3 Uncle Arthur Mahi

CSH interviewed former *paniolo* and pureblood Native Hawaiian culture practitioner Uncle Arthur Mahi on March 20, 2008. Mr. Mahi's *'ohana* lived in Kohanaiki. He worked for Hu'ehu'e Ranch in the 1930s to 1946, when he enlisted in the army. He was stationed in Korea, Lebanon, Philippines and Vietnam, among other places, and was a member of the military police. Married to his wife Theresa for 55 years, Mr. Mahi has 18 *hanai* children, including his own. He is knowledgeable about traditional fishing, trails, vegetation and other cultural resources and practices in and around the project area, particularly the middle section to the *mauka* portion of the proposed development.

Mr. Mahi is extremely concerned that the proposed development may negatively impact the *'āina*. He questions why trees such as the *wiliwili* (*Erythrina sandwicensis*) are dying, noting there are no more mango trees or native trees like *alahe'e* (*Canthium odoratum*) in the project area. During the 1930s to 1940s, these trees flourished in the project area and the surrounding land. Plants like banana, *uhi* or yam (*Dioscorea alata*), and *pia*, a Polynesian arrowroot (*Tacca leontopetaloides*) used as medicine and food by Hawaiians, were also widely distributed. "All kinds of plants were present, until these were choked by the bushes," said Mr. Mahi.

According to him, such plants were integral to Hawaiians not only for their use as a food and medicine resource but also for their connection to other aspects of life. For example, he cites a Hawaiian proverb that when the *alahe'e* tree blossoms, the *he'e* (squid, octopus) are *momona* (fat) and ready to harvest. Another saying involves the *lākana* (*Lantana camara*); when this plant blossoms, the *hā'uke'uke* (*Colobocentrotus atratus*), an edible variety of sea urchin, are also *momona*. If while harvesting the urchin, one was stung by the spikes of the *hā'uke'uke*, lemon or vinegar could be used to neutralize its sting.

Mr. Mahi remains steadfast in his insistence that plants must be respected. People need to be aware of giving back to the *'āina* whenever harvesting them. "When you plant, the plant is not just for you, but for everything and everyone," he said. "Everything that grows in the culture, you respect them. If you don't take care of them, they die." For Hawaiians, there is no such thing

as one "earth day" once a year; rather, it is every single day. "Our earth day is every day," Mr. Mahi noted. "You take care of the *'āina* and the *'āina* will take care of you."

This belief goes hand-in-hand with his conviction that no one can really own the land. "When people buy the land, you only buy the use of the land," he said. "Who owns the land? Ke Akua (God) and grandparents...When you die, you can't take the land with you. You don't own the land, the land owns you. What belongs to Hawai'i, belongs to Hawai'i."

As far as Mr. Mahi is concerned, "the *iwi* own the place." He recounted the traditional practice of Hawaiians burying their loved ones in the lava tubes or caves around the project area. Since there were hardly, if any, cemeteries before, Hawaiians used the places where they lived. They wrapped their loved ones with a *tapa* cloth and placed them in lava tubes or caves.

Caves were also used for other purposes, such as water collection. It was sometimes the case that water was collected in caves where *iwi* would also be present. Hence, Mr. Mahi stated that one must always ask permission from the *iwi*, before collecting the water. "You always say *mahalo* when entering, *aloha*, and *mahalo* when leaving." He frequently utilized the water collection in caves, noting that some water drips were fast, and some were slow. He brought his own calabash to collect the water, which tasted like "regular water."

Besides collecting water in caves, Mr. Mahi recounted diving in the deep sea with a gallon jug to collect water from the fresh water springs in the ocean, during the 1970s. Rain was also used for water. He also drank brackish water from the anchialine ponds in Kaloko and Honokōhau. "We got water all over the coast," said Mr. Mahi. He added that a *limu* (algae, seaweed), or moss was squeezed as a source of water and was found at the entrance of *ana* (caves).

An avid fisherman, Mr. Mahi shared some of the traditional ways of preserving fish. Using fish like *aku*, bonito or skipjack (*Katsuwonus pelamis*), he preserves them in Hawaiian sea salt, for up to 10 years. The fermentation yields a liquid condiment similar to *bagoong*, a Filipino fermented shrimp/fish condiment.

Besides the negative impact on plants, Mr. Mahi is concerned about the price of homes as well as the preservation of trails. When told that the price of homes may vary from an estimated $200,000 up to a million, he expressed doubts that the homes would really be affordable and wondered what kind of house it would be for $200,000. "That's not affordable houses, that's hanging our neck," he said.

According to Mr. Mahi, there are plenty of trails, *mauka-makai*, in the project area. He underscored the importance of preserving the trails. "Don't build houses on the trails," he warned. "Spirits are going to come, donkeys, people on the trail, through the house."

Mr. Mahi told of stories of people who complained about spirits that continue to pass through their house, as if they were still walking on a trail. He also advised against moving *iwi*, saying "Don't move the burials, because the artifacts are theirs."

Through his lifestyle, cultural practices and beliefs, Mr. Mahi expressed the value and the need to respect the Hawaiian worldview, where nature and people are interconnected and mingle with the past, present and future. "Everything you do is not for you. It is for the future, for the grandchildren, great-grandchildren etc. If you don't know now, it's too late."

6.1.4 Mr. Peter Keka

CSH interviewed Mr. Peter Keka on March 21, 2008, at the Kaloko- Honōkahau National Historical Park. Mr. Keka's *'ohana* has lived on Honōkahau for many years, and they also leased the fishponds in both Kaloko and Honōkahau. He grew up learning about the traditional ways to maintain and manage the enormous ponds, and is currently employed to restore the fishponds as well as other ancient Hawaiian sites in the park. Mr. Keka was born in 1940, and is 68 years old.

In response to the question if he has any concerns about the proposed development, Mr. Keka said:

> Let them come. Let them destroy it. Then they'll know what they did. You won't be able to stop it. You can slow it down but you can't stop it. Because greed is in everybody's blood...That's what's nature is about. It's people. To try is one thing, to stop it, is another. If you look at it, one is to be satisfied with what is, and the other is...(to be) in contempt.

Mr. Keka remembers vividly when his grandfather passed away 56 years ago. As a young boy, he was warned by his grandfather that change was coming. "It will destroy everything," Mr. Keka said, describing his grandfather's words. "I didn't know what he was talking about. Now I know. It's everybody, but look carefully. It's how you control things. You have development all over the place. You won't be able to stop it. No matter how you try, you can't stop it."

6.1.5 Mrs. Cynthia Nazara

CSH consulted Mrs. Nazara in person about the proposed development in Kohanaiki and Kaloko Ahupua'a on March 24, 2008. Mrs. Nazara's *'ohana* is from the project area and surrounding *ahupua'a*. Her great-great grandfather, William Keanaaina, was the caretaker of Kaloko pond. Her mother, Malaea Keanaaina, was born in Honokōhau junction, while her grandparents are from O'oma. Mrs. Nazara serves on the Hawai'i Island Burial Council and is an active member of the Kona Hawaiian Civic Club. She was born on O'ahu in 1947, and moved to Hawai'i when she was 13. She is the oldest of 10 siblings, and is the first cousin of Ruby McDonald.

Mrs. Nazara spoke of her extensive experience working as a cultural consultant to ensure that developments would not stray from what was promised to the community. In 1993, she worked on Four Seasons Hualālai.

> It was very different from what they promised. The first five years I was involved, it was low impact. And they always said they would build affordable. But to whom? They set it up so that they would build and it won't be seen from the road, but now you can see it from the road.

Although the experience made her wary of development, Mrs. Nazara believes that it is possible for cultural and lineal descendants to work with the developer.

> For me, I am never against progress. Progress is good. But people are angry because big companies come in and exploit us. They promise things, but when you look at the project, it's not the same. We want as a people to make sure the

> developer does what he wants to do, but we cannot help them if he doesn't tell us the truth.

According to Mrs. Nazara, developers in general are out to make money, and it is the responsibility of the descendants to be involved.

> Here in Hawai'i, whether we like it or not, developers are going to come in. As *keiki o ka 'āina* [children of the land], we want to be able to come to the table with these developers to ensure that things will be done right. And that's what everybody should strive for. There have been too many people living here that have been exploited. Developers come and suck all the "*hā*" out, all our breath and knowledge, and then they throw us out. We have to let people know. If we can get our foot in the door and work together with the developer, that's a good thing. Our goal is to not stir things up, but to work together. Don't exploit us.

6.1.6 Mr. Duane Keanaaina

CSH interviewed Mr. Keanaaina on March 26, 2008. Born in Kalaoa Kona, Hawai'i in 1952, Mr. Keanaaina's *'ohana* is from Kohanaiki as well as neighboring O'oma, Kalaoa, Ho'ona, Mahai'ula, Makalawena and Pu'uanahulu. The Keanaainas spent a lot of time in Kohanaiki *makai*. They also traversed the project area hunting feral goats, pigs, and gathered seasonal fruit. He mentioned that there were several trails traversing the project area. Additional information on the trails can be obtained from the Hao and Lee *'ohana*.

For Mr. Keanaaina, the size of the proposed development is not the question, but how it is developed. His main issues of concern focus on the areas of safety and ensuring the development is people-friendly:

> Development is inevitable, but how you do it, that's the question. If it is just high density, nobody wants that. But if it's community-friendly, you won't have too much opposition. Don't jam the lots too small, make it open so it's comfortable to walk around. If they are building a community, make it as safe as possible.

According to Mr. Keanaaina, the development should have careful landscaping:

> Landscaping is the key of the whole thing. You can soften the development if you have a bunch of houses, if trees are planted around it. If you use different types of landscaping, you can soften the visual impact for the neighbors above them…any opposition would come from neighbors above them.

In addition, he called attention to a section on the project area made up of a lowland forest. He also noted that although there are not too many endangered plants in the project area, there is at least one native plant called "*ko'oko'olau*" (*Bidens* spp.). When dried, it is taken as a tea or used medicinally as a tonic. It is often preferred over store-bought tea because of its pleasant taste. He suggested that the seeds of the plant should be collected and later re-planted as part of the landscaping:

> The *ko'oko'olau* plant is in the project area. The only place you'll find the plant. If they will develop it, please get the seeds, and use it as part of the landscaping when doing it. The plant is used for tea, better than Lipton and Earl Grey. You

> have to watch for this plant, because this is the only area that has it and collect the seeds.

The following is a list expanding Mr. Keanaaina's concerns and questions:

1. Children can get hurt if the multifamily complex is across the street from a shopping center and convenience stores. Consider installing an underground tunnel for ease and safe pedestrian access.
2. Regarding project density, sidewalk has to be no less than 4 feet, even wider if possible. This is because there are more people walking in the morning and the evening. "If you make it neighborhood friendly, are they going to install a walking trail that would allow them to go around the area and back to their residence?" he asked.
3. Pointing out that the development will be right next to a busy and steep road going uphill, Mr. Keanaaina suggests the inclusion of a runaway truck ramp. With all the heavy equipment on trucks going uphill, the ramp could keep people safe in case brakes fail.
4. No master plan has been provided for review and consideration.
5. Does the developer plan to build a shopping center or market?
6. On what side of Hina Lani Street will the multiple housing project be built, north or south? How many stories will the multiple family housing have?
7. Will the developer construct a highway to Kealakehe school, to help with traffic problems on Queen Ka'ahumanu Highway?
8. Are open areas being considered, such as a community center, parks, walking paths, soccer and baseball fields?
9. How will the community traverse Hina Lani Street, overpass or underground tunnel?
10. Does the developer plan to keep the lowland forest within the project area?

As mentioned above, the *ko'oko'olau* plant used medicinally as a tonic or dried and drank as a tea is found within the project area. But there are other native plants, some endangered, which also thrive within the project area. Seeds from these plants should be collected and replanted within the project area as part of the landscape design plan.

Mr. Keanaaina also made referrals to several individuals, including Kelly Greenwell whose family operated a cattle ranch in the *ahupua'a*. Clarence Rapoza now operates Palani Ranch and may have information on the proposed project.

6.1.7 Uncle Valentine K. Ako

CSH interviewed Mr. Valentine K. Ako on Mar. 27, 2008. Mr. Ako was born in 1926 in Hōlualoa. He comes from a long line of family that has resided in North Kona for generations. As a young boy, he learned from *kūpuna* how to fish and gather salt, as well as other vital Hawaiian traditions. At 17, he enlisted in the Merchant Marine and travelled around the world for eight years, during a period he calls "some of the best years of my life." He is knowledgeable

about the fishing practices and resources up and down the coast of Kona, and about the people who lived in the project area and beyond.

When asked about his concerns regarding the proposed project, Mr. Ako said: "That's a big area." He mentioned several trails in Kohanaiki, with some trails taken by *kūpuna* in order to go fishing. Mr. Ako also confirmed the presence of burials in lava tubes in the project area, saying:

> During the old days, prior to Westerners coming over, our *kūpuna* buried their loved ones in the lava tubes in that particular area. As generations went by, they didn't notify the heirs where their loved ones are buried. My dad before he passed away, took me up Palani and Māmalahoa, it was just barren at that time, so you could see down to Kohanaiki. And he said, "Our ancestors are buried there, these are all our ancestors buried there."

He expressed strong feelings against the removal of any of the burials that may be found during the course of development.

> My concern is this: Do not relocate these ancestors to another *ahupua'a*. If you find these graves, do not make it so that people can find them. This is where all our Hawaiian ancestors are buried. Leave the lava tubes alone, and seal it up. Don't make it so that people can come and see the graves and desecrate them. It's so important for developers to realize where our ancestors lived. You have to tell developers that this issue is important to us. My ancestors are all from this area. When they find these lava tubes, seal it up and do not expose it. Do not relocate them to another *ahupua'a*.

Besides lava tubes, cinder hills were easiest place to bury the *kūpuna*, because there were no metal implements. An *'ō'ō* (digging stick) was used in sandy beaches, but most of the time, Hawaiians dug by hand. Mr. Ako warned that it is when graves are moved or disturbed that the tribulation begins.

> When people come from all over the parts of the world and they have different ideas and no respect for our ancestors, and they try to implant their lifestyle, that's when trouble starts. As an elderly person today, we should make it a point to respect our *kūpuna*'s burials.

He stressed the importance of listening to *kūpuna* and their words to learn about the rich history and culture of Hawai'i. From 1992 to 2000, Mr. Ako worked with Kepā Maly to helped locate *kūpuna* around 80 years or older in order to record their knowledge. The interviews span North Kona history from Kohanaiki and other *ahupua'a* up to Kawaihae, and are stored with the Kona Historical Society. He also recommended two works in particular that would assist in appreciation and understanding of Hawaiian culture. One is a book by Mona Kahele, *Clouds of Memories*. The other is a book featuring maps and trails of the *ahupua'a* of Hawai'i, by Walter E. Wall, Dec. 1928 edition.

Mr. Ako shared some interesting insights into preserving fish and making fish sauce. For example, he takes *'ōpelu*, adds a lot of salt, and then mixes it in a blender. He then puts the salted fish pieces in a dish with a towel over it, leaving it under the hot sun for two months. After it becomes grey, he strains the liquid and uses it for cooking as well as the fish. He also discussed the different kinds of *poi*. Not everyone was allowed to mix *poi*, as one's body

chemicals could turn it sour or sweet. "Our *kūpuna* were conscious of who made the *poi*," he said. "The same goes for turtle meat. If you have lousy hands, the meat will turn bad."

6.1.8 Kahu Norman Keanaaina

Cultural Surveys Hawai'i interviewed Rev. Keanaaina by phone on April 9, 2008. He comes from a family of 14 children and was born in Kona on Nov. 4, 1940. Rev. Keanaaina's *ohana* has lived in the lands of Kaloko and Kohanaiki, as well Honokōhau and Kalaoa, for generations. Rev. Keanaaina's great-great grandfather Kea'naina, or Kea'naaina Nuuanu, is buried at the Kohanaiki point. According to the reverend, Kohanaiki is also known as Kohaneiki and Kahaneiiki.

When asked what he thinks of the proposed project, Rev. Keanaaina said:

> The project is not in Kohanaiki, I've seen the deed, it is for Kohana'iki, which is located in the *ahupua'a* of Honokōhau-iki. My grandfather owned all of this, Kohanaiki. Kohanaiki is still with the Kingdom of Hawai'i. Kohana'iki is noted as a nudist area, while Kohanaiki is a place of discipline.

Rev. Keanaaina feels very strongly against the proposed development, stating several times that the deed is not for the proposed area. He maintains he has filed a notice at the Bureau of Conveyances on O'ahu and at the Recordation office of the Aupuni Hawaii, an organization which seeks recognition for the Kingdom of Hawai'i. Rev. Keanaaina also states that notices have already been served to the developers of Kohanaiki over a year ago.

He cautions against what he called "lies and false filing."

> ....They said my grandpa was just an agent. No, my grandpa has the deed and now I have it. Mayor Kim and Angel Pilago is another problem. When they found out what was happening in Kohanaiki (*makai* of the project area), they ran away. I'm not blaming the developers, rather, I'm blaming them. And Linda Lingle. They're the cause of all this, the problems of Kohanaiki. They're playing a political game. But...they should stop and listen.

Rev. Keanaaina also discussed his plans of constructing a center to bring together various cultures present in Hawai'i. He would want to construct the center on the *ahupua'a* of Kohanaiki.

> I have plans for an international cultural center, because in Hawai'i, there are a lot of cultures today. In order to please everybody, we are going to have this center. There are 190 nations that I have contacted to bring their culture to Hawai'i. They are a part of my family, because of so many intermarriages.

6.1.9 Mr. George Van Gieson

CSH interviewed Mr. Van Gieson by telephone on April 28, 2008. Mr. Van Gieson is the Fire Captain of the Volcano Fire Station, and was active in helping preserve the *hōlua* or slides around Hawai'i. In 1976, he was one of the members of the non-profit Hōlua Project Information whose mission was to record and safeguard *hōlua*. Mr. Van Gieson stated that all of the slides the organization found were on the Makahiki trail, which goes around the coastline of the island.

When asked if he is aware of any slides in the project area, Mr. Van Gieson mentioned the *hōlua* in the Kaloko-Honokōhau national park.

> That one has always been a mystery to us, because it's so short and only 300 ft. long. And also it's really, really wide. The other thing is, that might have been to move logs down for canoes. It has the classic shape of a *hōlua* but it's so short and wide. But some people say it might have been a practice *hōlua* as several people can fit in it.

Another issue about the *hōlua* is that, between it and the highway, there are a lot of burials found, according to Mr. Van Gieson. His father had been with a select group of people who had seen a cave filled with many *iwi* that is located *mauka* of the *hōlua*. It is believed that they are the remains of hundreds who died in a flu epidemic which swept the island sometime in the mid-to-late nineteenth century.

6.1.10 Kumu Larry Ursua

CSH interviewed Kumu Larry Ursua on April 15, 2008. He is a Hawaiian cultural practitioner and an active community participant. Married to his wife Laurie for many years, Mr. Ursua is a 48-year-old father of six children. He works as a Father Coach at the West Hawai'i Family Support Services. Trained by the highly respected John Kaimikaua who was his mentor and teacher, Mr. Ursua continues to teach *kāne hula* (men's hula) in West Hawai'i and also previously taught Hawaiian Language and Culture as part of the community college.

When asked if he knew of any specific cultural practices and resources in Kohanaiki and Kaloko Ahupua'a, Mr. Ursua stated that he is not versed in the *mo'olelo* and referred to two individuals in particular, Mahealani Pai and Uncle Black Ho'ohuli, who are descendants from the Kohanaiki Ahupua'a. He said simply, "this is not my *kua 'āina*" (countryside).

Mr. Ursua shared his particular concern about the proposed project by expressing a wide-ranging prophecy from the ninth century that was taught to him by the *kūpuna*. Called the *Wānana*, (lit. "prophecy"), it foretells the consequences that happen when land is used for one's personal gain and how it is of the utmost importance to give back and respect its resources.

> I know that our ancestors began with a prophecy. The prophecy is called *Wānana*. The prophecy was the inevitable would come, that the land would be inhabited by many natives and people. The *Wānana* also said we would lose the ideas, religious and beliefs of our culture and we would struggle with a western lifestyle but later with time, we will adapt to it. This is the *Wānana* that I share...
>
> The *Wānana* concerns the forthcoming of a new age of life of the people of Hawai'i. These people that will come, will come from many nations trying to utilize the lands and to gain their own personal and their own nations' gain. The *Wānana* was spoken by the prophets, the prophets of old, going back all the way to the time of the ninth century. This *Wānana* was not only spoken on each island but was spoken by powerful prophets, leaders and *kahunas*. Like Kohanaiki, it is another land being developed. Like the prophecy, it entails the using, producing and manufacturing of lands, to serve not those *koko* to the *'a'ina*, *koko* as in bloodline to the *'a'ina*, but those from the outside. This prophecy helps us to

> understand that when these things occur, either we will stand as a nation of people that are raised from the sands of Hawai'i or we will stand separate. It spoke even about the lessons, tribulations that will be brought about by new generations of Hawaiians which would become aware of how important the western education would be in being able to utilize their system and law and government because the land would be taken.
>
> The land was taken and it was genocide. Later in 1993, an apology was made to the people of Hawai'i for the genocide of the islands and the Kingdom of Hawai'i. That separating many Hawaiians to stand for the reasons they stand today, creating many types of programs and other types of governments. At least small governments that help them to stand and build more Hawaiians to come to help them in their endeavors, to regain their kingdom, regain their government and regain their land. That would all fail. That would all fail because of the small uniqueness of the land and its people, now divided in this 21st century.
>
> So the *Wānana* as we were talking about...to better understand why Hawaiians will have difficulties coming together from families, from different districts concerning Kohanaiki. Kohanaiki in their first motion to do what they needed to do, affected Hawaiians, a very small (number) of families, to step forth in protecting and giving voice to that land...

Mr. Ursua discussed his belief that development is "inevitable," but what is essential is to work together with developers to ensure that the land is protected. He mentioned the Kohanaiki *makai* development that involved community members, including him, to assist in conducting the proper protocols in taking care of the cultural resources that were found on the land.

> However, the *Wānana* says that no matter what, the inevitable would be the land would have development and would be used for some gain and goals for other developers to come unto the land. As a person, as a Hawaiian myself, looking at the land and watching it being developed, I realize the prophecy is coming to pass; that this place must be built like many places from the past. And they are built out of different types of minerals, resources and structure. Our land will be built out of other things not from this land. Our ancestors will not be able to recognize the structure and building but they are also aware of it even though they are behind the veil and have passed on from this life. They have an idea and it echoes in their ears that the prophecy, the inevitable, would come. These things can be of great benefit to the people of Hawai'i, and these things can be a great downfall to many people who tried to look at opposition and looked at it as conflict.
>
> This is the inevitable, things will be built on the land, but as developers come, if we can gain their support, gain their trust, we can work civilly towards protecting the land still and providing the land with what it needs. The culture of Hawai'i is an important part of our children and those who come to learn the culture of Hawai'i. With that, we need to provide the kind of guidance for our generation to come so that they will be able to act accordingly, properly, in a way that they can meet certain things and communicate well with the developers. Rutledge came in

> and they allowed a team to investigate one of the caves that was breached and I was one of those members who were part of the team. That in itself says that some developers will want to be culturally sensitive to things that are culturally here. And that would be a great step as business and developers come to the land. That cultural consultants and people who have sentiment to the land communicate and work together with them to provide proper burial sites and proper protocols for where certain parts of the land were sacred in the past, sacred now, and will be sacred in the future. This is the Wānana that was spoken. Many things will fall, the sky, the heavens, the sun, the stars, the moon. The heavens will fall, and all that shall be left is the *maka'āinana*, which is the common people. *Maka* the eyes, *nana* is to watch. The watchers and keepers of the land. And I am one of them, hoping that the land would produce properly for the future.
>
> This was the *Wānana*. It is now, it is happening. This is the present time...

For Mr. Ursua, at the heart of any development of the land is the proper or *pono* way that one must approach it. He believes that to conduct oneself with arrogance and self-centeredness at the cost of gouging others and resources of the land is setting up one's self for later punishment.

> This is just my personal *mana'o*. If I preach this to many, they would follow. They would want to follow what their ancestors said. I don't preach this enough, but if I did, I think more people will have respect for peoples of the past and the generations unborn. If we all remain sensitive as people in general, not just Hawaiians, the land will be welcoming to all kinds of people whether you build your home here or not. But when we come for self-gain and self glorification, whatever you build on the foundation of the land, Hawaiians know in the past, our ancestors, (that) the land is alive. It is the mother and the womb of the Hawaiian people and if our mouth, our lips, and our voice as Hawaiians is not heard, not just any Hawaiian voice, but a voice of a Hawaiian person who is *pono*, submissive, humble, the mouth of Mother Earth will consume developers, and all those who build on her land for self gain. It may not happen tomorrow or next year, but she will consume it on her own time. Tūtū Pele is awake and her breath, the volcanic vog is an indication as she covers the state of Hawai'i to remind all her fires have no boundaries. That she will creep into any crack or crevice even onto developers' land and turn any haughty or self-gained development into ash. These are the words spoken from our prophets.

Discussing the contemporary events such as the high rise in gas prices, the sudden end of long-term airlines such as Aloha Airlines, and the cost of war, Mr. Ursua links all these events as part of the prophecy and illuminates what it means for the future of Hawai'i if people do not change how they live.

> We are in a depression mode, because we cannot build Aloha Airlines and ATA airlines. It can't be realized because of billions of billions of dollars are spent to conduct peace, but at the price of human life. Very shortly, for Hawaiians and all kinds of people, the crime rates will soar because people don't have jobs...

> We live on four major islands of Hawai'i and we live right smack in the middle of the Pacific. Our islands will not be on the priority list for products to be brought here. Because of what is important, crude oil, all things are run by those particular minerals. So we are heavily stocked by shipment, not be airway. Already the airways are shutting down. The airways that we fly to and from will be so expensive that it will be actually a luxury to travel and see family members. Now they will open the waterways, and it's still the same kind of product that we run our planes with, fuel. It has to cut across the ocean but those things will be cut off. Not only that, all of the products that come to Hawai'i will be cut off...

According to Mr. Ursua, caring for the land and turning back to the traditional methods of giving to it, not just taking from it, can help Hawai'i survive the steep costs of being dependent on oil. Those with the knowledge of caring for the land will suddenly be the most integral in a chaotic world where wars are caused over oil. Hand-in-hand with taking care of the land is the essential need to turn back to God or Ke Akua and to be mindful of the evils caused by greed and selfishness.

> A dependent land has to become independent and their people on it and Hawai'i will be challenge by that. With independence, you can do as you need but it will be how we have taken care of the land. Now we will have to go back to the very basic things our people did, to care for the land, to plant on the land, to fish on the land, all those practices will come back into play, and we will see how the land and the ocean will respond. And the resources of these things that were once in the land have already vanished. The land will be in chaos, the people will be confused. The *pono* within them will be lost. It will become a dog-eat-dog world.
>
> But there will be a few that will have power. Not just to suggest or to speak words, but the power to bring together the very few who are called "*Hoale Kalepopolo*." These are the kinds of people who come from the fields, from the mudflats, from the ocean. They will not be filled with education; they will be filled with understanding and the spirit of the land. And to those few, the land will yield. Bananas will grow, taros shall foot forth from its waters, the mountain will flourish for them and they will provide a "*pu'uhonua*" for the modern-day families. *Pu'uhonua* are used as a safe zone for those who broke the laws of the land. But the modern day *pu'uhonua* will be a person, will be a group of people who shall have wisdom, they shall have knowledge, they will be one with the land and the heavens. When they *pule* and pray and command the land to yield forth its fruits, the heavens will be one with them and the land will produce. People will understand that all we have today that technology can provide, it will be the spiritual foundation of the people of Hawai'i and the land to promote and provide the things that will care for the people here. And they will turn back to their past and turn back to their *kūpuna* and they will become a prayerful people, a submissive people, and Ke Akua will look upon that and we pray that He might be merciful. That in His response, we can start to rebuild the kind of heaven that is needed on earth. This is only a piece, a short version of the *Wānana*.

These things actually continue to exist, but if we continue to build, to develop down the coastline thinking that it is a good type of building and a good type of selling, then think about where you are building and where you are selling. You are not selling just any land, you are selling a land where people believe and live to know that the land itself is alive with spirit. And that spirit, that *'uhane* of the land, when you drive pillars, when you drive wood, when you drive metal to her and she is not willing to receive it. Many lands have to be blessed and consecrated by *kahus*, and sometimes not just the whole project, but in the project if there is 50 feet or if there is 47 acres, one prayer would not encompass the entire 47 acres, because what you blessed the land to take place for that moment, it might have changed on the blueprint of what they were going to do in a particular location of the property which was not part of the deal. When you changed that, the *pule*, or the blessing is voided. Therefore it re-opens itself to all kinds of things. And just be mindful that like any child, or any person, when we need to be reprimanded, we first get a warning. And our little warning was a 6.3 earthquake recently. That is just a shake, and now we are going into a rattle. Now the rattle is, although we don't say much, we are rattled by the vapors that when we look on the land, we can see the vapors, the *hā*, or the breath of Pele, travelling throughout the land. She is swelling, she is expanding beneath us, and she will make herself known. And there will be no mountains, no hills that you can run or hide from, because every hill and every mountain was created by her and at her command. Four of her mountaintops that lie on the island of Hawai'i are only dormant; they are not dead. She can travel to any of them...I'm not trying to be scary about this but when you tell people stuff like this---

...If we are in the image and likeness of our Creator, and he is looking at us right now, then he is saying "well for some of you, but woe onto many of you who have not been mindful of the things and place that I have given you." Of course, this is not the Garden of Eden anymore, but that place once in the very beginning existed. We left that garden, that we might till and care for the land. But instead, we have ripped and stripped and tore the land. For those who go about with Greenpeace, those who go about preserving the land and caring the ocean, blessed are those who do that because you are caring for the very earth that produces for you. But those who go into the sea, to the mountain and strip it of its resources, and tear it and make things extinct, your time will come. You don't have to die, but you will be afflicted by the things what others feel, you should be able to taste it. If we are the image of our Creator, then we have the potential to become like Him...If we have the opportunity to be like our Father, and have our own work to govern, give our only begotten Son, and watch the world as it produce and the nations and generations produce upon the earth and watch it develop, we are going to know exactly how those people are going to take care it. If we do what we do unto our father's planet, our children would do the same. But how are we going to respond to that? We have so much potential. And that was part of the prophecies of Hawaiians. We are not just a vapor of time; we are not a vapor like the vog you see in the sky that when the winds come, it shall blow away and is no more. We go from our mortality and our existence and our learning, our

probation, our trials and tribulations, our joys and happiness, all of that which our emotion can stand... And then it is followed by immortality. When we are in the immortality stages, and we separate our body from our spirit, we do not not continue to exist, we just exist on a higher plane. And we can look down and help our descendants like our *kūpunas* in the past have helped us. But we need to acknowledge them now more than ever, because they come with a righteous and ancient past, and righteousness that will provide us the wisdom and the strength to carry on in this last dispensation.

This is the last dispensation and our people knew that Lono wasn't just Lono. They knew Lono to be Ke Akua, he was Jesus Christ, and Jesus Christ came here and he taught the consecrated law. How can they bow down to Captain Cook, because he looked like someone they saw before his time? The only description he fits is the description of Jesus Christ, with eyes that are bluish green, fair skin and hair long and brown. And he wore his red robe. Our people were very clear about who that person was, and that person sat and showed them who he was and told them he would come again. And the reason why he's going to come is that he is going to cleanse the earth with his entity. Under the command of his word, Tūtū Pele would burn the land. At the command of his word, he would call his prophets to call upon the ocean to cleanse the lands with its high waves. Upon his words, he will call those who will command the winds that come and strip down everything that stands. What will be left is a pure form of the land itself, and then we will start again and that is what is meant to be. But all that we have, that we take advantage of—I am one of them, I like roads, I like stores, I like this and that---if we don't ration properly, we are going to lose more than what we have. That again goes back to the prophecy. I don't live just by that, but I understand that when it was prophesized 900 years ago, why would they say that about our time? Because they could foresee what people and how greedy people were going to be. And all the simple laws of the land were going to be forgotten, the simplicity of life, the basics of life were going to be put on the back burner and they were going to put up new things and it's not bad. I'm not saying that it's bad, but it is the intent and purposes in how they are using it, that makes it bad.

6.2 OHA Response Letter

In a response letter dated April 24, 2008, the Office of Hawaiian Affairs (OHA) conveyed several specific concerns and requests regarding the proposed project (see Appendix A for the letter). First, OHA requested CSH "conduct a thorough review of all archaeological reports and cultural studies related to the larger area which will be subject to the cultural impact assessment," and "a comprehensive archaeological inventory survey" pursuant to applicable statutes.

Second, OHA requested the opportunity to comment on all significance criteria assigned to historic properties identified during archaeological inventory survey in accordance with HAR 13-13-284-6(c).

Third, OHA raised the issue of consulting with individuals regarding their rights to access the project area "for constitutionally protected traditional and customary purposes."

Fourth, OHA recommended consultation with cultural descendents to burials within the "Kaloko Heights" project area, as recognized by the Hawai'i Island Burial Council, regarding cultural sites and resources that may be present in the subject project area; this consultation should also include community groups such as "Kahu o Kahiko."

Fifth, OHA discussed the cultural significance of the "Road to the Sea" trail, and stressed it should "be preserved in perpetuity," in accordance with applicable statutes and legal decisions protecting traditional and customary practices and the landscapes that support or supported these (in this case, subsistence activities taking place at both the seashore and the uplands).

Finally, OHA requested the opportunity to review the final CIA for this project.

Section 7 Traditional Practices and Properties

Discussions of specific aspects of traditional Hawaiian culture as they may relate to the project area are presented below. This section examines resources and practices identified within the project area in the broader context of the encompassing Kohanaiki and Kaloko Ahupua'a landscape. Excerpts from *kama'āina* interviews are incorporated throughout this section where applicable.

7.1 Hawaiian Habitation and Agriculture

According to the CSH archaeological inventory surveys of the project area (Bell et. al 2008a, b, c; Esh et al. 2008), of the total fifteen (15) habitation sites in the project area, thirteen (13) sites fit the characteristics of temporary habitation and two (2) are categorized as permanent habitation.

The majority of the temporary habitation sites within the project area are located on the *pāhoehoe* flow on the east and southeast side of the project area. Both permanent habitation sites are located on or near the edge of the large *'a'ā* flow that dominates the project area. In terms of elevation, all of the habitation sites are located above approximately 500 ft a.m.s.l., and generally the sites are scattered across the eastern portion of the project area. It is notable that nearly all non-lava tube habitation features are located on a naturally elevated area (either tumuli, outcrops, or *'a'ā* edge).

The terrain throughout the majority of the project area severely limits agricultural productivity, since large portions of the project area are barren *'a'ā* lava or rough *pāhoehoe* with no soil development. However, some of the *pāhoehoe* areas do have soil development, although these tend to be fairly small and shallow everywhere except for the far *mauka* extent of the project area. The agriculture-related features throughout most of the lower elevations of the project area represent more of an opportunistic approach versus the more expansive/intensive approach practiced at higher, more productive elevations.

Despite the lava covered terrain, various crops were traditionally and in historic times cultivated within the project area; and sweet potato is likely to have been the most abundantly grown crop because of its adaptability to stony, dry environments. It was commonly planted in mounds and in *pāhoehoe* excavations. It is notable that the most intensive areas of agricultural modification are located where there are older (highly eroded) *'a'ā* flows, ideal for building planting mounds. Besides sweet potato, gourds, mulberry, and taro are the most likely crops to have been grown in this area. Both taro and sweet potato were named as actual crops during the Land Commission documents for Kaloko lands during the Māhele of 1848.

7.2 Gathering of Plant Resources

In ancient Hawai'i, upland forest regions provided various woods needed for canoes, tools and more, as well as cordage, food and herbs (Abbott 1992). Several of the plants within the project area have past and present ethnobotanical uses for native Hawaiians (e.g., as medicinal, building, weaving). Many of these plants are (possible) Polynesian introductions such as *kukui* (*Aleurites moluccana*), *kī* or *tī* (*Cordyline fruticosa*), and *noni* (*Morinda citrifolia*). Some of

these Hawaiian canoe plants (plants brought by the early Polynesians in their canoes) are indicators of former Hawaiian habitation. For example, *kī* was often planted around *heiau* (temples), and considered a sacred plant in parts of Polynesia. *Kī* was also planted around taro *lo'i* (pondfields) (http://www.canoeplants.com).

A contributor to this cultural assessment mentioned past or ongoing plant gathering of the *ko'oko'olau (Bidens* spp.). Emphasizing that the project area is "the only place you'll find the plant," Mr. Keanaaina discussed the use of the *ko'oko'olau* plant for tea and as a medicinal tonic. Its pleasant taste when dried makes it preferable to "store-bought" teas, according to Mr. Keanaaina. He and several other participants also noted the presence of one of the last remnants of a dry land forest located on the project area. Other plants present in the project area include the native *pili* grass (*Heteropogon contortus*), *'ōhi'a* trees (*Metrosideros polymorpha*), *laua'e* ferns (*Phymatosorus scolopendria*), *'ohe* trees (*Reynoldsia sandwicensis*), *alahe'e* (*Psydrax odorata*), and *halapepe* (*Pleomele* spp.). Native plants observed at higher elevations include: *naio* (*Myoporum sandwicense*), *'a'ali'i* (*Dodonaea sp.*) and *'ulei* (*Osteomeles anthyllidifolia*).

Mr. Mahi specifically names native trees like *alahe'e* (*Canthium odoratum*) in the project area. During the 1930s to 1940s, the *alahe'e* along with mango, banana, *uhi* or yam (*Dioscorea alata*), and *pia*, a Polynesian arrowroot (*Tacca leontopetaloides*) used as medicine and food by Hawaiians, were also widely distributed in the project area. "All kinds of plants were present, until these were choked by the bushes," said Mr. Mahi.

7.3 Marine and Freshwater Resources

Like the integrated system of Hawaiian culture where an individual is linked to the surrounding environment, there is often a connection between marine resources and the agricultural plants found in the project area. For example, Mr. Mahi noted the presence of *alahe'e* trees in the project area and cited a proverb that when the *alahe'e* tree blooms, the *he'e* (squid, octopus) are *momona* and ready to harvest. Another saying involves the *lākana* (Lantana camara); when this plant blossoms, the hā'uke'uke (*Colobocentrotus atratus*), an edible variety of sea urchin, are also *momona*.

Although outside the project area, the Kaloko-Honokōhau fishponds provided Hawaiians with a rich resource for fish and shellfish. The ingenious design of the fishponds allowed fresh water in but prevented large fish from getting out. Besides the extensive aquaculture and tidepools available for shellfish and several types of *limu*, the ocean near the project area abounds with all kinds of fish. Both Mr. Mahi and Mr. Ako fished in the ocean for *aku* and bonito near the project area, and they shared their traditional methods of preserving fish in brine solutions. Mr. Kunewa recalled a time when everything was abundant. "The *limu kohu* down the side of the cliff, the fish dancing all around you, and seeing the black crabs crawling all over, like a lava flow..."

There are no springs or ponds located in the project area; however, there are dozens of water collection lava tubes identified during the archaeological inventory survey. As described in more detail in the archaeological reports (see Bell et al. 2008a, b, c; Esh et al. 2008), most of these subterranean water sources are relatively small and require intensive and careful methods of collection, including building of small rock structures to hold *ipu* (gourds) in place for days in order to fill them. Both Mr. Mahi and Mr. Haleamau knew of caves that were used as fresh water collection sites, although the latter also had the use of a ranch-owned well.

In addition to these water collection lava tubes, which were probably used most intensively in pre-Contact times, community participants recall using anchialine ponds in the *makai* areas of Kaloko and Kohanaiki in historic times as drinking water for themselves and for their animals. Mr. Haleamau states that cows from the ranch would be driven over the lava so they could refresh themselves with the brackish water that was high in minerals and good for their health. Mr. Mahi also shared his experience of diving into the deep sea to collect water from the fresh water springs in the ocean, and collecting rain for water.

7.4 Burials

There have been at least 65 burials found at about two dozen sites within the current project area. Most of the community participants were aware of the presence of burials throughout the project area. It was a common practice to use lava caves as burial sites in addition to other uses like water collection and habitation. Mr. Ako remembered his father taking him to an overlook above the project area when he was a little boy, to point out the lava tubes where relatives were buried. Mr. Mahi confirmed the traditional practice of burying loves ones in the caves after wrapping their bodies with tapa cloth. All participants who mentioned the presence of burials in the project area were adamant at preserving the *iwi kūpuna* in place.

7.5 Trails

There were seven trails or trail segments observed during the archaeological inventory survey (Bell et al. 2008a, b, c; Esh et al. 2008). Trails are a common site type within the Kekaha region in general. Although some of the trails in the project area were little more than remnants, several run many hundreds of meters and are in good-to-excellent condition. The intersection of three of the trails is especially of interest, as it appears to represent trail use during subsequent periods of time. The construction type also is indicative of changing needs in transportation, specifically the creation of trails more amenable to travel by horse or other pack animal.

The trails indicate a network of transportation corridors that focus on transportation over the large *'a'ā* flow that dominates the project area, with *mauka/makai* and cross slope-oriented trails. The network of trails thus provides fairly direct coast-to-uplands routes via the project area and access to activity areas within the project area. The activity areas include: agricultural pursuits, a ceremonial site, and temporary and recurrent habitation sites, as well as an animal husbandry area. Overall the trails suggest a high level of energy investment in constructing paths for traversing the *'a'ā* flow, both in pre-Contact times as well as historically.

OHA's response letter highlights the importance of the "Road to Sea" trail that has been a subject of some controversy in past archaeological projects, given the uneven nature of its preservation and integrity as a historic property. OHA strongly advocates for a relatively broad interpretation of this particular trail's importance and significance to the wider Kona community, rather than a more narrow scientific view that some or much of the trail has been altered beyond its "traditional" design or intent. Many older people from this area used this "Road to the Sea" trail during the early twentieth century for subsistence purposes.

Several community participants described their use of trails during their childhood and adult years. Mr. Haleamau mentioned three trails, including a secret one that he called "Uluwini." All

three trails began *mauka* and branched out depending on their use, whether to lead Hawaiians to another *ahupua'a* or to the ocean to gather fish. Mr. Mahi stated there numerous *mauka-makai* trails in the project area and warned against blocking the trails with houses. Mr. Keanaaina noted the custom of one family being designated to maintain each trail, and that trail would then be named after them.

7.6 Hunting

A variety of animals were present in the project area into historic times, including wild pigs and goats. The presence of ranches such as Hu'ehu'e Ranch also meant numerous cattle abounded in the area.

Section 8 Summary and Recommendations

At the request of Stanford Carr Development, LLC, Cultural Surveys Hawai'i, Inc. (CSH) conducted a cultural impact assessment (CIA) of a 1,150-acre parcel within portions of Kaloko Ahupua'a and Kohanaiki Ahupua'a, North Kona District, Hawai'i Island, TMK: [3] 7-3-009:017, 025, 026, 028 (see Figures 1-3).

In addition to conducting background research into the traditional and historic importance of the project area, in the context of Kaloko and Kohanaiki Ahupua'a, including results from previous archaeological studies, CSH also made a substantial effort to consult with community members and organizations. A total of twenty-five people were contacted for the purposes of this CIA; 18 people responded; and 12 *kūpuna* and/or *kama'āina* were interviewed for more in-depth contributions. At this writing, a total of nine of these individuals have consented to have their testimonies included in this report. Efforts at obtaining permission to include the testimonies of the remaining three individuals who were interviewed for this CIA are ongoing.

8.1 Summary of Results

Background research conducted for this project yields the following results:

1. The project area is part of the traditional region known as Kekaha, extending from Honokōhau to 'Anaeho'omalu in North Kona. Mary Kawena Pukui notes that Kekaha, within which Kaloko and Kohanaiki Ahupua'a are located, is known "for its scarcity of water but is dearly loved by its inhabitants" (Pukui 1983:185). Despite being a dry place, the project area contains many unique resources—including dozens of subterranean lava tubes and caverns used to collect water; the project area included an extensive pre-Contact Hawaiian settlement that continued to support a subsistence-based lifestyle into the early historic era.
2. Archaeological research shows the project area contains hundreds of culturally and historically significant sites and thousands of individual features within these sites; adjacent areas contain even more significant sites and features. Sites in the project area include permanent and temporary habitation structures—many of which incorporate natural features of subterranean lava tubes into their design, agricultural features (including extensive rock mounds used to plant sweet potatoes), at least 65 burials located in approximately two dozen burial sites, *ahu* (stone markers), trails, petroglyphs, *ahupua'a* boundary walls, *papamū* (traditional gaming site), and others.
3. Radiocarbon dating from nearby sites definitively shows the general area has been utilized by humans for at least 1,000 years.
4. The project area is likely to contain substantial additional subsurface deposits—as yet undiscovered and undocumented—associated with lava tubes and subterranean chambers, including burials and other highly sacred materials.

5. The project area is also associated with the unique history of Hawaiian-style ranching and *paniolo* ("Hawaiian cowboys"), including the well-documented Hu'ehu'e Ranch.
6. Because of its association with Kaloko and Kohanaiki Ahupua'a and the Kekaha region, the project area is associated with specific *mo'olelo* (oral history) about (a) the sixteenth or seventeenth century ruler of Hawai'i Island Lonoikamakahiki (Lono-i-ka-makahiki), who was involved in several famous battles with the chiefs of Maui (including Kama-lala-walu) and other parts of Hawai'i, (b) Kamehameha I, whose remains were reportedly interred near Kaloko Fishpond (*makai* of the project area), (c) 'Umi-a-Liloa, who frequented the famous fisheries of Kaloko and Kohanaiki, and (d) the Nahulu chiefs (including Ka-me'e-ia-moku and Ka-manawa); the project area is also associated with more legendary references to Ka-Miki, various *mo'o* (water spirits) that resided at fishponds at and near the seashore, and Hualālai; and more general references to water-collection lava tubes and the unique environmental conditions of the region (e.g., the heavy night dew that formed and was carefully used by gardeners to grow sweet potatoes and other foods in a seemingly marginal environment).

Community consultation conducted for this project yields the following results:

1. Several participants voiced negative feelings and opinions about the overall cumulative impacts of ongoing and future developments in Kona District and the project area environs pointing out such factors as a diminished quality of life for locals, dwindling resources, prices beyond the reach of most *kama'āina* and overtaxed infrastructure as contributing to a loss of what is authentic and traditional about Kona.
2. Several participants talked about subsistence resources that were previously available to, and enjoyed by, locals—such as various *limu* (seaweeds), crabs and fish—but that are no longer available or easily accessed due to the cumulative impacts of development in Kona.
3. Most participants talked about the presence of burials and *iwi kūpuna* (ancestral remains) throughout the project area. It is clear from some of the interviews that there are many lineal and/or cultural descendents to some of these burials that should be consulted during the proposed development, since some historic-era family burial sites, in particular, may be impacted by the subject project.
4. A few participants talked specifically about changing patterns of vegetation and plant life, highlighting the loss of native and Polynesian-introduced species as well as useful historic introductions such as mango trees. In particular, there is a remnant area of lowland forest in the project area containing several endangered and threatened native species, including *ko'oko'olau* (*Bidens* spp.). It is important to understand that such natural

resources are significant cultural and historical resources to many native Hawaiians.

5. A few participants talked about drinking from water collection caves in historic times, as they moved around the landscape (e.g., as ranchers), and of brackish pools used by their animals (e.g., cattle and horses).
6. Several individuals discussed trails in the project area, including a historic trail running from the ocean to the mountains (this is the so-called "Road to the Sea") along the *ahupua'a* boundary between Kaloko and Kohanaiki, that were used in the recent memories of some participants to gather resources from the sea and the uplands. Given many changes and modern developments, the trails in the project area have not been used by many people for several decades.

8.2 Recommendations

The following recommendations are based on a synthesis of all the information gathered during preparation of this CIA. Faithful attention to these recommendations, and efforts to develop appropriate measures to address these concerns, will help mitigate the adverse impacts of the proposed action on Hawaiian cultural beliefs, practices and resources by the project:

1. Most of the people who voiced negative feelings and opinions about the overall cumulative impacts of ongoing and future developments in Kona District stopped short of saying they were entirely opposed to the proposed project; however, some participants recommended the project proponent prepare a draft Master Plan for review and comment by the public so that the various short- and long-term cumulative impacts, both negative and positive (e.g., the construction of recreational facilities and/or parks and other "green spaces"), can be assessed by the community.
2. Several participants, including the Office of Hawaiian Affairs (OHA), recommend the project proponents work together with the local community in order to develop plans that are *pono* (i.e., harmonious with the local environment), culturally sensitive and fair and balanced with respect to the *'āina* and its natural and cultural resources.
3. Efforts should be made to protect and preserve brackish water pools and water collection lava tubes.
4. Most participants strongly urged that no burials or *iwi kūpuna* (ancestral remains) should be relocated or moved to make way for the proposed project.
5. One participant who worked as a *paniolo* for many years recommended preservation and protection of "holding corrals" (*puakini*) in order to educate present and future generations about the unique Hawaiian-style "cowboys" that flourished in and around the subject project area in historic times.

6. Efforts should be made to preserve and protect all trails in the project area, including designing around trails to maintain an authentic sense of place that is unique to Kona.
7. Efforts should be made to preserve and protect the remnant lowland forest and any other native and Polynesian-introduced plants species in the project area, including *ko'oko'olau* plants and other endangered and threatened species. Preparation of a "vegetation master plan," which could be combined with the next item (below), would help guide plans and commitments to preserve and protect these unique resources.
8. Several participants stated that, if the proposed development goes forward, it should use environmentally-appropriate landscaping that enhances the sense of place, including native and Polynesian-introduced species. Preparation of a "vegetation master plan," which could be combined with the previous item (above), would help guide plans and commitments to preserve and protect these unique resources.
9. OHA, in particular, recommends the project proponents faithfully follow all applicable laws with respect to the treatment of all historic properties located within the subject project area.
10. Cultural monitoring should be conducted during all phases of development, including all significant ground disturbances, to ensure that significant cultural and historical resources are protected and preserved in accordance with appropriate mitigation plans.
11. Community members and groups responsible for the long-term care of the Kohanaiki and Kaloko Ahupua'a, as well as cultural practitioners who utilize the area for gathering and for cultural and educational activities, should be further consulted regarding the above issues and other concerns throughout the planning, development and operation of the proposed housing development. This consultation should include all interested community groups and individuals who have a stake in the project area.

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Appendix A OHA Response Letter

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STATE OF HAWAI'I
OFFICE OF HAWAIIAN AFFAIRS
711 KAPI'OLANI BOULEVARD, SUITE 600
HONOLULU, HAWAI'I 96813

April 24, 2008

HRD08-3552

Margaret Magat, Researcher
Cultural Surveys Hawai'i, Inc.
P.O. Box 1114
Kailua, Hawai'i 96734

Re: **Cultural Impact Assessment**
Kohanaiki and Kaloko Ahupua'a
North Kona District, Island of Hawai'i

Dear Ms. Magat:

The Office of Hawaiian Affairs (OHA) is in receipt of your letter initiating consultation ahead of a cultural impact assessment for a 1,150 acre project located in Kohanaiki and Kaloko Ahupua'a. Based on the information contained within your letter, it is our understanding that Stanford Carr Development has proposed development plans which include residential units, commercial and neighborhood retail centers, recreational facilities, schools and associated infrastructure.

OHA recommends that your firm conduct a thorough review of all archaeological reports and cultural studies related to the larger area which will be subject to the cultural impact assessment.

OHA requests that a comprehensive archaeological inventory survey for the project area be conducted and submitted to the Department of Land and Natural Resources-Historic Preservation Division for review and approval. OHA should be allowed the opportunity to comment on the criteria assigned to any cultural or archaeological sites identified within the archaeological inventory survey pursuant to §13-284-6(e), Hawai'i Administrative Rules. Consideration should also be afforded to any individuals accessing the project area for constitutionally protected traditional and customary purposes.

We are aware that numerous cultural sites and resources were identified within the "Kaloko Heights" project area which is adjacent to this proposed development. Numerous families have been recognized as cultural descendants to burials within the "Kaloko Heights" project area by the Hawai'i Island Burial Council. OHA recommends that consultation occur with these families occur regarding cultural sites and resources within the proposed development area. The Historic Preservation Division should be able to provide you with the names of these families.

Margaret Magat
Cultural Surveys Hawai'i, Inc.
April 24, 2008
Page 2

Community groups such as "Kahu o Kahiko" should also be consulted regarding cultural sites and resources within the proposed development area.

The maps included with your letter which depict the proposed development area indicate that it is highly probable that the "Road to the Sea" trail is within the boundaries of the proposed development area. OHA strongly advocates that the "Road to the Sea" trail alignment be preserved in perpetuity.

Please note that the significance members of the Hawaiian community associate with this trail are not being conjured up from stories of a distant past. There are kama'āina of Kona still living today who recall accessing this trail to gather land and ocean resources for subsistence. These are traditional and customary practices which are protected by the Constitution of the State of Hawai'i as well as in the Hawai'i Revised Statutes and in court decisions. While the constant and active use of this trail may have faded through the years due to multiple factors, the passage of time and physical changes can never eliminate the trail's history and significance to the Hawaiian people.

Thank you for initiating consultation at this early stage. We look forward to the opportunity to review the completed cultural impact assessment. Should you have any questions, please contact Keola Lindsey, Lead Advocate-Culture at (808) 594-1904 or keolal@oha.org.

'O wau iho nō,

Clyde W. Nāmu'o
Administrator

C: Ruby McDonald, OHA- Community Resource Coordinator- West Hawai'i
75-5706 Hanama Place, Suite 107
Kailua-Kona, Hawai'i 96740

Appendix K

Traffic Impact Study for Kaloko Makai
KOA Corporation
September 12, 2012

Traffic Impact Study for Kaloko Makai in Kona, Hawaii

Prepared For:

Wilson Okamoto Corporation
1907 South Beretania Street, Suite 400
Honolulu, HI 96826

Prepared by:

KOA CORPORATION
PLANNING & ENGINEERING
2141 West Orangewood Avenue, Suite A
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September 12, 2012

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September 12, 2012

Ms. Cathy Leong
Wilson Okamoto Corporation
1907 South Beretania Street, Suite 400
Honolulu, HI 96826

Subject: Traffic Impact Study for Kaloko Makai in Kona, Hawaii

Dear Ms. Leong:

KOA Corporation is pleased to present the traffic impact study for the proposed Kaloko Makai project in Kona, Hawaii on Big Island. It is recommended that the traffic study be updated periodically every 5 years to monitor the actual traffic growth and provide appropriate mitigation.

It has been a pleasure to provide this traffic impact study to you. Please contact me if you have any questions about the report, or if you need additional information. If there are any comments or revisions that require my response, please notify me as soon as possible for prompt attention.

Sincerely,

Min Zhou, PE
Vice President

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1. Introduction

The purpose of this report is to assess the traffic impact of the proposed Kaloko Makai project on the existing and future roadway network in vicinity of the project site. This report documents the existing and future years (2025, 2035 and 2045) roadway conditions and operation performance, forecast traffic volumes, methodologies used in roadway segment and intersection Level of Service (LOS) analysis, and recommendations for roadway improvement.

1.1 Project Description

The project site is located east of Queen Kaahumanu Highway (State Route 19) and along the north and south sides of Hina Lani Street in Kona on the Island of Hawaii. The project vicinity map is shown in Figure 1.

The proposed Kaloko Makai project is a 1,139-acre mixed-use development consists of over 20 different types of land uses. Conceptual land use plan is shown in Figure 2. Additional details for the proposed land use are included in Appendix A of this report. The proposed mixed-use project includes the following land uses:

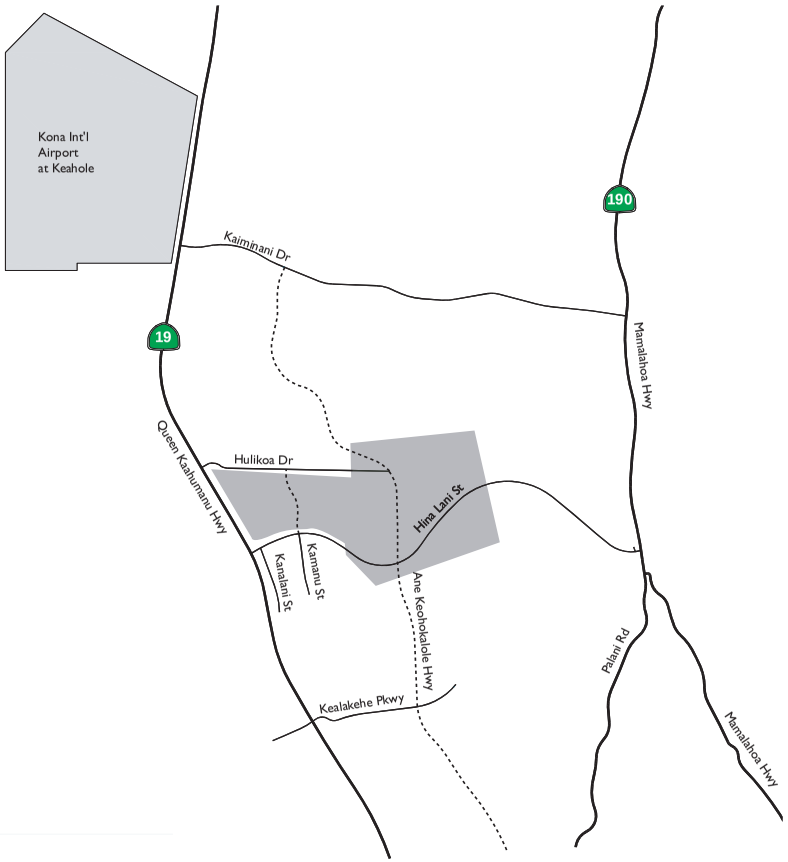
- Transit station
- Light industrial
- Waste waster treatment plant
- Single-family detached housing
- Affordable multi-family
- Market multi-family
- Multi-family market senior
- Multi-family affordable senior
- Live-work units
- Lodge (hotel)
- District park, TOD park
- Elementary school, middle school
- Hospital/medical center
- Long-term care facility
- Legal office, retail-office
- Urgent care/clinic, medical office
- Judiciary (government) building
- Fire station
- Police sub-station
- Retail, shopping center

1.2 Project Phasing

The project is expected to be developed in 3 phases. The project construction will start in 2015 with 10-year development increments. The horizon years for the phases are conservatively assessed at the end of each 10-year increment, but the improvements are assumed to be implemented at the start of each phase. As such, the study horizon years assessed for each phase are as follows:

- Phase 1 – 2025
- Phase 2 – 2035
- Phase 3 – 2045

The project phasing plan is shown in Figure 3.



LEGEND
- Site
- Analysis Intersection
- Future Roadways

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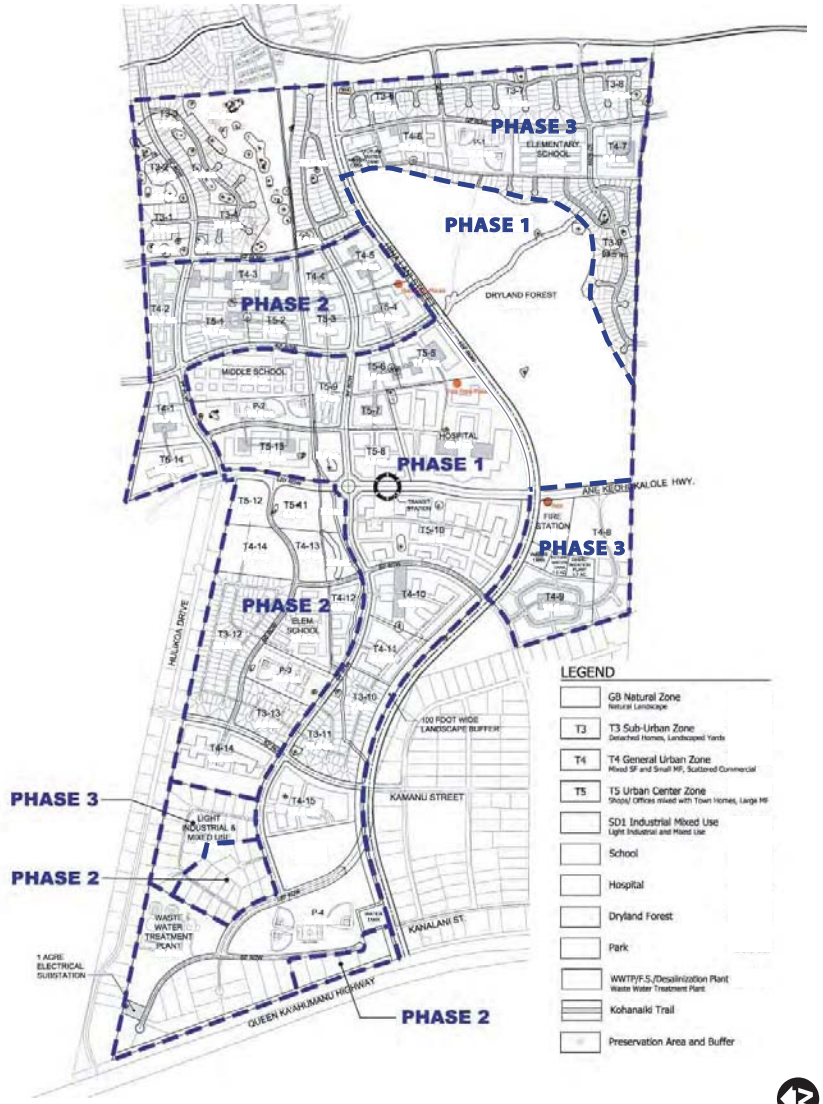
Kaloko Makai Project — Figure 1
Kona, Hawaii — Vicinity Map



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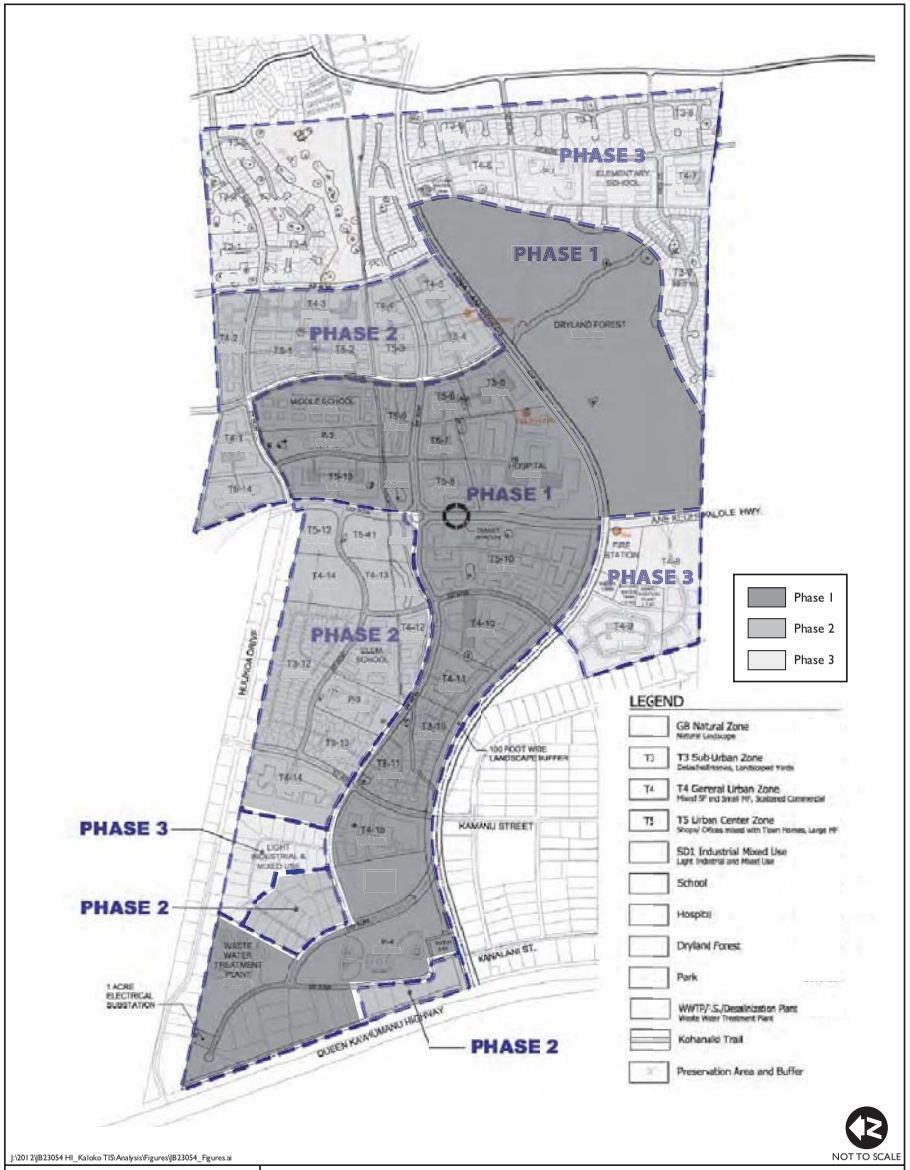
Kaloko Makai, Project — Figure 2
Kona, Hawaii — New Land Use Plan



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KOA CORPORATION PLANNING & ENGINEERING	Kaloko Makai, Project	Figure 3
	Kona, Hawaii	Project Phasing Plan

2. Traffic Operations Analysis Methodology

This section documents the methodologies and assumptions used to conduct the traffic operations analysis for the project site. The following background information is included:

- Study scenarios
- Study area description
- Capacity analysis methodologies

2.1 Study Scenarios

This report presents an analysis of the intersection operating conditions during the AM and PM peak hours for the following anticipated timeframes:

- Existing Condition
- 2025 without Project Condition
- 2035 without Project Condition
- 2045 without Project Condition
- 2025 with Project Phase 1 Condition
- 2035 with Project Phase 2 Condition
- 2045 with Project Phase 3 Condition

2.2 Project Study Area

The study area consists of the following eight intersections:

- Queen Kaahumanu Highway at Kaiminani Drive
- Queen Kaahumanu Highway at Hulikoa Drive
- Queen Kaahumanu Highway at Hina Lani Street
- Kanalani Street at Hina Lani Street
- Kamanu Street at Hina Lani Street
- Ane Keohokalole Highway at Hina Lani Street
- Mamalahoa Highway at Hina Lani Street
- Queen Kaahumanu Highway at Kealakehe Parkway

2.3 Intersection Analysis Methodologies

Street system operating conditions are typically described in terms of level of service (LOS). Level of service is a report-card scale used to indicate the quality of traffic flow on roadway segments and at intersections. Levels of service range from Level A (free flow, little congestion) to Level F (forced flow, extreme congestion).

Intersection level of service analysis was conducted using Synchro software which applies the principles or the specific analysis methods contained in the *Highway Capacity Manual*, 2000 Edition (*HCM*), a publication of the Transportation Research Board, a research agency affiliated with the Federal Government. Chapter 9 of the *HCM* is devoted to analysis of signalized intersections and Chapter 10 is devoted to the analysis of unsignalized intersections. The methodology in the *HCM* for signalized intersections is based upon measurements or forecasts of control delay for traffic utilizing all approaches to the intersection. Intersection average delay and poorest movement delay are reported for all unsignalized intersections. Table 1 defines the level of service and control delay ranges for signalized and unsignalized intersections.

Table 1 – Levels of Service for Intersections

Level of Service	Signalized Intersection Control Delay (seconds/vehicle)	Unsignalized Intersection Control Delay (seconds/vehicle)
A	0 to 10	0 to 10
B	10.1 to 20	10 to 15
C	20.1 to 35	15 to 25
D	35.1 to 55	25 to 35
E	55.1 to 80	35 to 50
F	More than 80	More than 50

Source: Highway Capacity Manual, 2000.

A lane capacity of 1,900 vehicles per hour per lane and a 2 second loss time per phase were used for this study. Unsignalized intersections were analyzed using the *HCM 2000* method for unsignalized intersections.

3. Existing Conditions

This section documents existing conditions in the study area at the time when the traffic counts were taken in 2010. The topics of discussion include local land uses, roadway characteristics, and intersection operation performance. The discussion presented here is limited to specific roadways and study area intersections in the project vicinity.

3.1 Existing Land Use

The project site is currently vacant. The surrounding area is also mostly vacant. There is an industrial park located south of Hina Lani Street between Queen Kaahumanu Highway and Kamanu Street.

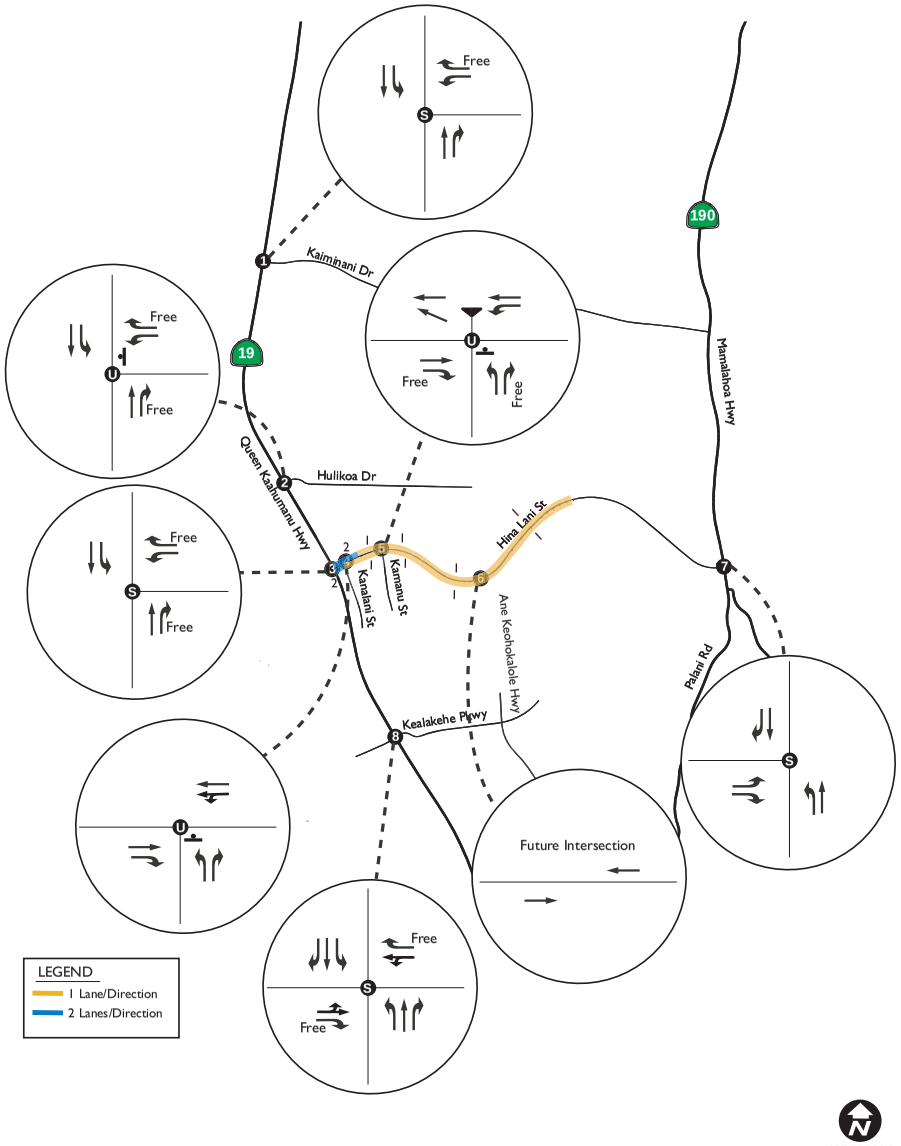
3.2 Existing Roadway Network

Queen Kaahumanu Highway and Mamalahoa Highway currently provide regional access to the project site, and they both runs in a north-south direction. Hina Lani Street runs in an east-west direction through the project site, and Hina Lani Street connects to Queen Kaahumanu Highway to the west and Mamalahoa Highway to the east. Other local streets include Kaiminani Drive, Hulikoa Drive, Kanalani Street, Kamanu Street, Kealakehe Parkway, and Palani Road. Figure 4 shows the existing roadway and intersection lane configurations in the vicinity of the study roadway network.

3.3 Future Planned Roadway Network

Queen Kaahumanu Highway was a two-lane roadway when the traffic counts were taken in 2010, and as such the existing conditions reflect this. However, since then Queen Kaahumanu Highway has been widened to four lanes from Kealakehe Parkway to the south. It is anticipated that Queen Kaahumanu Highway north of Kealakehe Parkway will be widening to a four-lane roadway prior to Year 2025. The planned roadway widening along Queen Kaahumanu Highway will provide an additional northbound and southbound travel lane to the study area intersections along Queen Kaahumanu Highway from north of Kealakehe Parkway to Kaiminani Drive.

The future Ane Keohokalole Highway will be a two-lane Mid-Level Road that is planned to be constructed in a north-south direction between Queen Kaahumanu Highway and Mamalahoa Highway. By the first horizon year of this traffic study (Year 2025), Ane Keohokalole Highway is anticipated to be completed between Hulikoa Drive and Palani Road to the south. As of June 2012, Ane Keohokalole Highway has been completed between Hina Lani Street and Kealakehe Parkway. The northerly extension of Ane Keohokalole Highway to Kaiminani Drive will be completed by 2028 (or near the beginning of Project Phase 2). The completion of Ane Keohokalole Highway will serve as a parallel corridor to relief traffic congestion on Queen Kaahumanu Highway and Mamalahoa Highway.



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Kaloko Makai Project — Figure 4

Kona, Hawaii — Existing Lane Geometry

3.4 Traffic Count Data

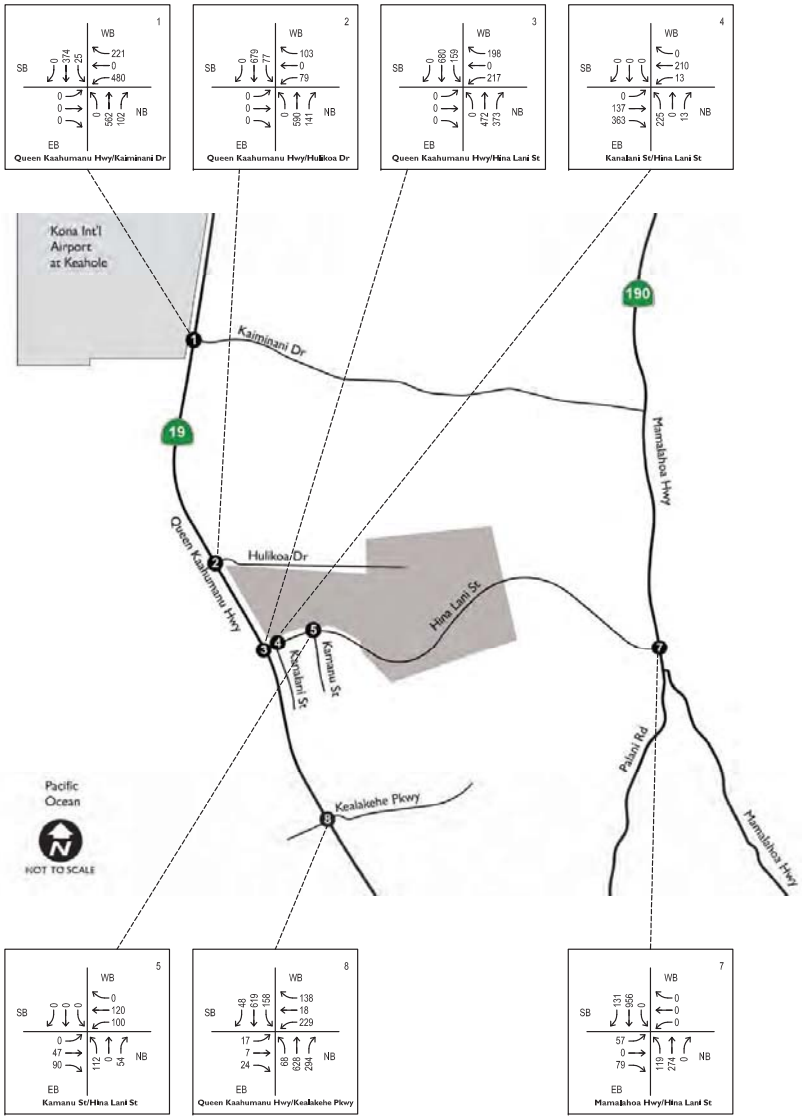
Figures 5 and 6 show the existing AM and PM peak hour traffic volumes for the study intersections. The AM and PM peak hour counts were conducted on Tuesday, September 21, and Wednesday, September 22 in Year 2010. Traffic count data sheets are included in Appendix B of this report. The AM and PM peak periods for the count data are from 6:00 AM to 9:00 AM and from 3:00 PM to 6:00 PM, respectively.

3.5 Existing Transit Service

The County of Hawaii Mass Transit Agency provides an island-wide public bus transit system, called Hele-On Bus. The Hele-On Bus currently provides bus service along Queen Kaahumanu Highway (State Route 19) in the study area. The Hele-On Bus route map and schedule are included in Appendix C.

3.6 Level of Service Analysis of Existing Conditions

Intersection Level of Service (LOS) analysis was conducted using Synchro software based on the analysis methodologies mentioned in Section 2 on this report. Table 2 below shows the existing intersection LOS for both AM and PM peak hours. Appendix D contains the Synchro level of service analysis worksheets for the Existing Conditions. As shown in the Table 2, all of the study area intersections are currently operating at Level of Service C or better during AM and PM peak hours.



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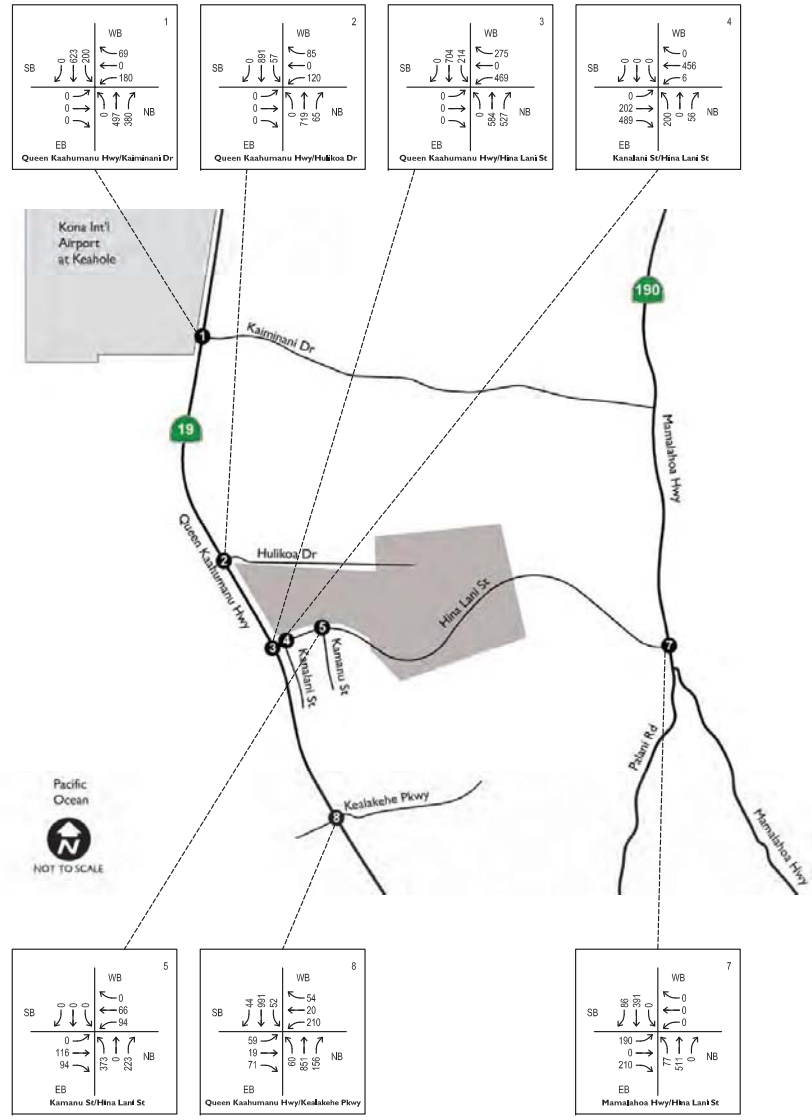
Kaloko Makai Project — Figure 5

Kona, Hawaii — Existing AM Peak Hour Intersection Turning Movement Volumes



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Kaloko Makai Project — Figure 6

Kona, Hawaii — Existing PM Peak Hour Intersection Turning Movement Volumes

Table 2 - Existing Conditions
Intersection Level of Service Analysis Summary

No.	Intersection	Peak Hour	EXISTING		
			Delay (Sec)	V / C	LOS
1	Queen Kaahumanu Hwy at Kaiminani Dr	AM	16.9	0.85	B
		PM	8.6	0.65	A
2	Queen Kaahumanu Hwy at Hulikoa Dr[1]	AM	25.2	0.50	C
		PM	52.1	0.85	C
3	Queen Kaahumanu Hwy at Hina Lani St	AM	11.1	0.65	B
		PM	15.7	0.82	C
4	Kanalani St at Hina Lani St[1]	AM	19.2	0.36	B
		PM	22.8	0.58	C
5	Kamanu St at Hina Lani St[1]	AM	10.7	0.25	B
		PM	14.1	0.40	B
6	Ane Keohokalole Hwy at Hina Lani St[2]	AM	--	--	--
		PM	--	--	--
7	Mamalahoa Hwy at Hina Lani St	AM	44.8	1.01	B
		PM	22.2	0.55	A
8	Queen Kaahumanu Hwy at Kealakehe Pkwy	AM	15.7	0.79	B
		PM	26.5	0.92	C

[1] Non-signalized. The delay is for the most constrained stop-controlled approach.

[2] Intersection does not currently exist at the time of data collection.

4. Future Traffic Forecast Methodology

This section documents the methodologies and assumptions used to forecast the future traffic volumes for the project vicinity. The following background information is included:

- Existing traffic count data
- Trip generation rates
- Pass-by trip reduction
- Internal trip capture
- Transit trip discount
- Project traffic generation
- Project trip distribution patterns
- Other cumulative development traffic
- Ambient background growth

It should be noted that the overall future traffic forecast is a worst-case scenario because this analysis utilized a conservative approach in the overall traffic projection. The project trip reduction adjustments, such as pass-by trips and transit discounts that are used in this analysis are conservatively low. In addition to accounting for cumulative development traffic in the vicinity of the project site, a conservatively-high ambient background growth factor is also used to assess other unidentified projects and general population growth traffic that may contribute to overall traffic growth.

4.1 Existing Traffic Count Data

Wilson Okamoto Corporation conducted traffic counts at existing study area intersections on Tuesday, September 21, and Wednesday, Sept 22, 2010. The AM and PM peak hour counts were conducted from 6:00 AM to 9:00 AM and from 3:00 PM to 6:00 PM, respectively. Existing traffic counts are summarized in Table 3.

Since the connectivity of the Mid-Level Road (Ane Keohokalole Highway) will be completed by 2028 (or near the beginning of Phase 2), the existing traffic patterns for Years 2035 and 2045 will be different than that of 2025. It is anticipated that a portion of the existing northbound and southbound through traffic along Mamalahoa Highway will be diverted to the future Ane Keohokalole Highway. Future traffic diversion calculations for the existing background traffic are included in Appendix E of this report. As shown on Appendix E, the following traffic volumes on Mamalahoa Highway are diverted to Ane Keohokalole Highway for 2035 and 2045 conditions:

- AM Peak Hour – 100 Northbound vehicles; 300 Southbound vehicles
- PM Peak Hour – 150 Northbound vehicles; 100 Southbound vehicles

Table 3 - Existing Conditions Peak Hour Intersection Volumes

Int.	Intersection Name	Peak Hr.	Northbound			Southbound			Eastbound			Westbound			Total
			NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	
1	Queen Kaahumanu Hwy./Kaiminani Dr.	AM	0	562	102	25	374	0	0	0	0	480	0	221	1,764
		PM	0	497	380	200	623	0	0	0	0	180	0	69	1,949
2	Queen Kaahumanu Hwy./Hulikoa Dr.	AM	0	590	141	77	679	0	0	0	0	79	0	103	1,669
		PM	0	719	65	57	891	0	0	0	0	120	0	85	1,937
3	Queen Kaahumanu Hwy./Hina Lani St.	AM	0	472	373	159	680	0	0	0	0	217	0	198	2,099
		PM	0	584	527	214	704	0	0	0	0	469	0	275	2,773
4	Kanalani St./ Hina Lani St.	AM	225	0	13	0	0	0	0	137	363	13	210	0	961
		PM	200	0	56	0	0	0	0	202	489	6	456	0	1,409
5	Kamanu St./ Hina Lani St.	AM	112	0	54	0	0	0	0	47	90	100	120	0	523
		PM	373	0	223	0	0	0	0	116	94	94	66	0	966
6	Ane Keohokalole Hwy./Hina Lani St.	AM	0	0	0	0	0	0	0	101	0	0	220	0	321
		PM	0	0	0	0	0	0	0	339	0	0	160	0	499
7	Mamalahoa Hwy./ Hina Lani St.	AM	119	274	0	0	956	131	57	0	79	0	0	0	1,616
		PM	77	511	0	0	391	86	190	0	210	0	0	0	1,465
8	Queen Kaahumanu Hwy./Kealakehe Pkwy.	AM	68	628	294	158	619	48	17	7	24	229	18	138	2,248
		PM	60	851	156	52	991	44	59	19	71	210	20	54	2,587

4.2 Trip Generation Rates

This study used the nationally recognized trip rates, published by the Institute of Transportation Engineers (ITE), 8th Edition, to determine the site-only traffic volumes generated by the proposed Kaloko Makai project. Based on the proposed land use plan, the following ITE trip rates are used for the project land uses as listed in Table 4:

- Park-and-Ride Lot with Bus Service (ITE Code 090): Transit station; TOD square
- General Light Industrial (ITE Code 110): Light industrial
- Utilities (ITE Code 170): Waste waster treatment plant; electrical substation
- Single-Family Detached Housing (ITE Code 210)
- Apartments (ITE Code 220): Affordable and regular multi-family (>10 DU/acre)
- Residential Condominium/Townhouse (ITE Code 230): Live-work units; affordable and regular multi-family (<10 DU/acre)
- Senior Adult Housing-Attached (ITE Code 252): Senior
- Hotel (ITE Code 310): Lodge
- County park (ITE Code 412): District-sized park; drainage retention
- Elementary School (ITE Code 520): Elementary school
- Middle School/Junior High School (ITE Code 522): Middle school
- Hospital (ITE Code 610): Hospital
- Nursing Home (ITE Code 620): Long term care
- General Office Building (ITE 710): Legal office; office
- Medical-Dental Office Building (ITE Code 720): Medical office
- Government Office Building (ITE 730): Fire station
- Business Park (ITE 770): Business center
- Shopping Center (ITE Code 820): Retail, shopping center

Trip reduction adjustment has been made to the overall project traffic generation to account for pass-by trips, internal capture and transit trip discount. The reduction percentage assumption has been based on past experience for this type of development and the reference information obtained from other studies in the area.

4.3 Pass-By Trip Reduction

Pass-by trip is a portion of traffic generated by retail uses already on the road stopping at a secondary destination on its way to an ultimate destination. For instance, a driver that got off from work at an off-site location on his way home may stop by a retail center along his travel route to do some shopping, and his shopping trip is considered a pass-by trip already on the road because it is not a new trip generated by the retail center impacting the external roadway network. The average pass-by percentage for shopping center is approximately 34% based on the ITE Trip Generation Handbook. In other references, pass-by percentages for community and neighborhood shopping centers are between 30% and 40%, as suggested in the San Diego Trip Generators published by San Diego Association of Governments (SANDAG). However, this traffic study uses a conservatively-low 15% pass-by trip discount factor to reduce the project retail trips for the PM peak hour and daily traffic conditions.

Table 4 - Trip Generation Rates

No.	Land Use	ITE[1] Code	Unit[2]	Daily	AM Peak Hour			PM Peak Hour		
					Total	In	Out	Total	In	Out
1	Park-and-Ride Lot with Bus Service	90	AC	372.32	48.81	39.54	9.27	43.75	10.06	33.69
2	General Light Industrial	110	AC	51.80	7.51	6.23	1.28	7.26	1.60	5.66
3	Utilities[3]	170	AC	13.36	2.49	1.57	0.92	1.32	0.59	0.73
4	Single-Family Detached Housing	210	DU	9.57	0.75	0.19	0.56	1.01	0.64	0.37
5	Apartment	220	DU	6.65	0.51	0.10	0.41	0.62	0.40	0.22
6	Residential Condo/Townhouse	230	DU	5.81	0.44	0.07	0.37	0.52	0.35	0.17
7	Senior Adult Housing-Attached	252	DU	3.48	0.13	0.05	0.08	0.16	0.10	0.06
8	Hotel	310	RM	8.17	0.56	0.34	0.22	0.59	0.31	0.28
9	County Park	412	AC	2.28	0.01	0.01	-	0.06	0.02	0.04
10	Elementary School	520	STU	1.29	0.45	0.25	0.20	0.15	0.07	0.08
11	Middle School/Junior High School	522	STU	1.62	0.54	0.30	0.24	0.16	0.08	0.08
12	Hospital	610	BEDS	11.81	1.14	0.81	0.33	1.31	0.47	0.84
13	Nursing Home	620	BEDS	2.37	0.17	0.12	0.05	0.22	0.07	0.15
14	General Office Building	710	TSF	11.01	1.55	1.36	0.19	1.49	0.25	1.24
15	Medical-Dental Office Building	720	TSF	36.13	2.30	1.82	0.48	3.46	0.93	2.53
16	Government Office Building	730	TSF	68.93	5.88	4.94	0.94	1.21	0.38	0.83
17	Business Park	770	TSF	12.76	1.43	1.20	0.23	1.29	0.30	0.99
18	Shopping Center	820	TSF	42.94	1.00	0.61	0.39	3.73	1.83	1.90

**** See Table 5 for project traffic generation summary and Appendix G for detailed calculations.**

Footnote

[1] Institute of Transportation Engineer (ITE) Trip Generation Handbook, 8th Edition, Regression Equation

[2] AC = Acre; DU = Dwelling Units; RM = Room; STU = Student; TSF = Thousand Square Feet

[3] Trip rate for daily is not available in ITE Trip Generation. The daily to AM/PM peak hours ratio for general light industrial use was applied to the AM plus PM peak hour rates to estimate the daily trip rate for utilities use.

4.4 Internal Trip Capture

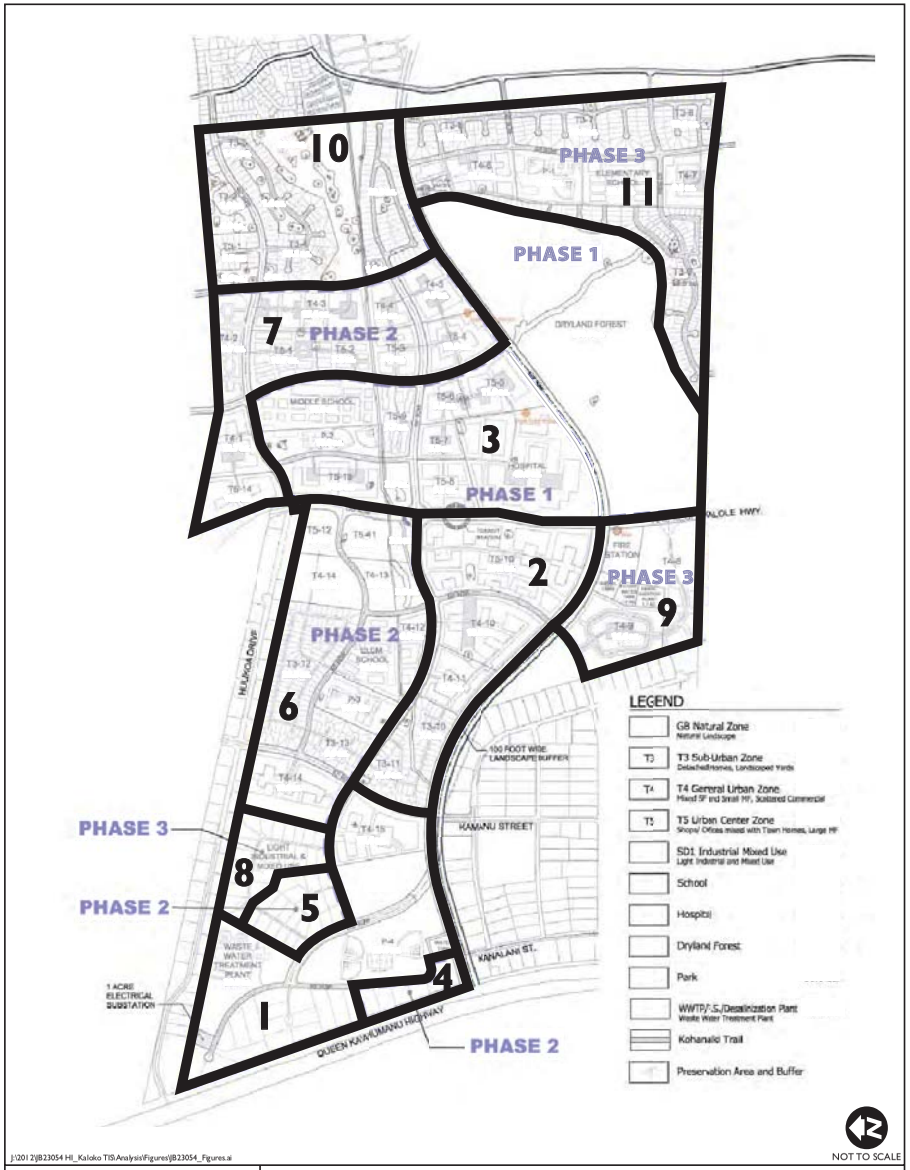
Internal capture is a portion of traffic that visits multiple uses within the project boundary on a single trip. An example may be a patient that visits the medical clinic and then goes shopping afterwards at an adjacent retail center without driving out of the project boundary. His shopping trip would be considered an internal trip already accounted for by his medical office trip. Internal capture trip discount factors have been estimated based on the Multi-Use Development trip generation methodology stated in the ITE Trip Generation Handbook. Internal capture factors are based on the interactions for the residential, office and commercial retail uses within the same Traffic Analysis Zones (TAZ). For the purpose of this traffic analysis, the project land use plan is divided into 11 TAZ's, and internal capture trip discount factors have been calculated within each TAZ for AM peak hour, PM peak hour and daily traffic conditions. The project TAZ boundary is shown in Figure 7. The internal capture trip calculation worksheets are included in Appendix F of this report.

4.5 Transit Trip Discount

Transit trip is a portion of traffic that utilizes public transportation or vanpool opportunities instead of driving alone in personal vehicles to their destinations. For instance, a driver may drive from his residence to a near-by park-and-ride facility to ride a vanpool to go to work at a further destination. Transit discount factor is assessed based on the available transit-oriented development and opportunities in the surrounding community. The County of Hawaii Mass Transit Agency provides an island-wide public bus transit system, called Hele-On Bus. The Hele-On Bus currently provides bus service along Queen Kaahumanu Highway (State Route 19) in the study area. It should be noted that in accordance with the Kona Community Development Plan (KCDP), Ane Keohokalole Highway (Mid-Level Road) is eventually expected to be a transit corridor with dedicated transit lanes and transit oriented developments along its proposed alignment. In the future, this Mid-Level Roadway is expected to extend further north and new transit routes are expected to be established along its alignment. At that time, transit may have a more significant effect on reducing vehicular trips generated by the proposed project. Based on a review of the available transit opportunities for the project site, this study has included a conservatively-low 5% transit trip discount factor to account for traffic utilizing transit-oriented opportunities.

4.6 Project Traffic Generation

Table 5 summarizes the project traffic generation for the proposed Kaloko Makai project. As shown in Table 5, the proposed project is anticipated to generate 57,672 daily trips with 5,023 AM peak hour trips and 5,834 PM peak hour trips, with pass-by, internal capture and transit trip discount adjustments. Detailed calculation for the project traffic generation is included in Appendix G of this report.



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Kaloko Makai, Project — Figure 7

Kona, Hawaii — Project Traffic Analysis Zones (TAZ)

Table 5 (1 of 2) - Project Traffic Generation Summary

Project Phasing	Traffic Analysis Zone (TAZ)	Traffic Componenets	Daily Trips	AM Peak Hour			PM Peak Hour		
				Total	In	Out	Total	In	Out
Phase 1	TAZ 1	Total without Trip Discount	4,412	440	251	190	494	221	273
		Trip Discount	-481	-30	-16	-14	-48	-22	-26
		Total with Trip Discount	3,931	410	235	176	446	199	247
	TAZ 2	Total without Trip Discount	10,355	671	269	402	1,015	543	472
		Trip Discount	-2,004	-60	-25	-35	-183	-95	-88
		Total with Trip Discount	8,351	611	244	367	832	448	384
	TAZ 3	Total without Trip Discount	15,513	1,165	691	473	1,429	620	809
		Trip Discount	-2,936	-91	-55	-36	-253	-113	-140
		Total with Trip Discount	12,577	1,074	636	437	1,176	507	669
	Phase 1 Subtotal	Total without Trip Discount	30,280	2,276	1,211	1,065	2,938	1,384	1,554
		Trip Discount	-5,421	-181	-96	-85	-484	-230	-254
		Total with Trip Discount	24,859	2,095	1,115	980	2,454	1,154	1,300
Phase 2	TAZ 4	Total without Trip Discount	518	75	62	13	73	16	57
		Trip Discount	-26	-4	-3	-1	-4	-1	-3
		Total with Trip Discount	492	71	59	12	69	15	54
	TAZ 5	Total without Trip Discount	777	113	93	19	109	24	85
		Trip Discount	-39	-6	-5	-1	-5	-1	-4
		Total with Trip Discount	738	107	88	18	104	23	81
	TAZ 6	Total without Trip Discount	8,931	797	297	500	907	527	381
		Trip Discount	-287	12	-5	16	-24	-7	-17
		Total with Trip Discount	8,644	809	292	516	884	520	364
	TAZ 7	Total without Trip Discount	10,737	693	184	508	1,007	609	399
		Trip Discount	-1,393	-42	-11	-31	-128	-74	-54
		Total with Trip Discount	9,344	651	173	477	879	535	345
	Phase 2 Subtotal	Total without Trip Discount	20,963	1,678	637	1,041	2,096	1,176	921
		Trip Discount	-1,745	-40	-24	-17	-161	-83	-78
		Total with Trip Discount	19,218	1,637	614	1,024	1,936	1,093	843

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Kona, HI / Kaloko Makai

Traffic Impact Study

Table 5 (2 of 2) - Project Traffic Generation Summary

Project Phasing	Traffic Analysis Zone (TAZ)	Traffic Componenets	Daily Trips	AM Peak Hour			PM Peak Hour		
				Total	In	Out	Total	In	Out
Phase 3	TAZ 8	Total without Trip Discount	1,295	188	156	32	182	40	142
		Trip Discount	-65	-9	-8	-1	-9	-2	-7
		Total with Trip Discount	1,230	179	148	31	173	38	135
	TAZ 9	Total without Trip Discount	4,642	341	113	228	450	267	184
		Trip Discount	-496	-20	-6	-14	-44	-25	-19
		Total with Trip Discount	4,146	321	107	214	406	242	165
	TAZ 10	Total without Trip Discount	2,067	162	41	121	218	138	80
		Trip Discount	-103	-8	-2	-6	-11	-7	-4
		Total with Trip Discount	1,964	154	39	115	207	131	76
	TAZ 11	Total without Trip Discount	6,585	670	228	442	692	429	264
		Trip Discount	-329	-33	-12	-21	-34	-22	-12
		Total with Trip Discount	6,256	637	216	421	658	407	252
	Phase 3 Subtotal	Total without Trip Discount	14,589	1,360	538	822	1,542	874	669
		Trip Discount	-993	-70	-28	-42	-98	-56	-42
		Total with Trip Discount	13,596	1,290	510	780	1,444	818	627
Project Total		Total without Trip Discount	65,832	5,314	2,386	2,928	6,577	3,433	3,144
		Trip Discount	-8,159	-291	-148	-144	-743	-369	-374
		Total with Trip Discount	57,672	5,023	2,239	2,784	5,834	3,064	2,770

** **See Appendix G for detailed project traffic generation calculations.**

4.7 Project Trip Distribution Patterns

Trip distribution is the process of identifying the probable destination, direction or traffic routes that will be utilized by project traffic. The potential interaction between the proposed land use and surrounding regional access routes are considered when identifying the route where the project traffic will distribute. Approved and proposed roadway improvements and programs have been reviewed to determine the study area roadway network for the 3 different analysis phasing years (2025, 2035 and 2045) being analyzed in the traffic impact analysis.

Queen Kaahumanu Highway is currently a two-lane roadway, and it is anticipated to be widening to a four-lane roadway prior to Year 2025. The planned roadway widening along Queen Kaahumanu Highway will provide an additional northbound and southbound travel lane to the study area intersections along Queen Kaahumanu Highway. Additional capacity along Queen Kaahumanu Highway will attract more traffic.

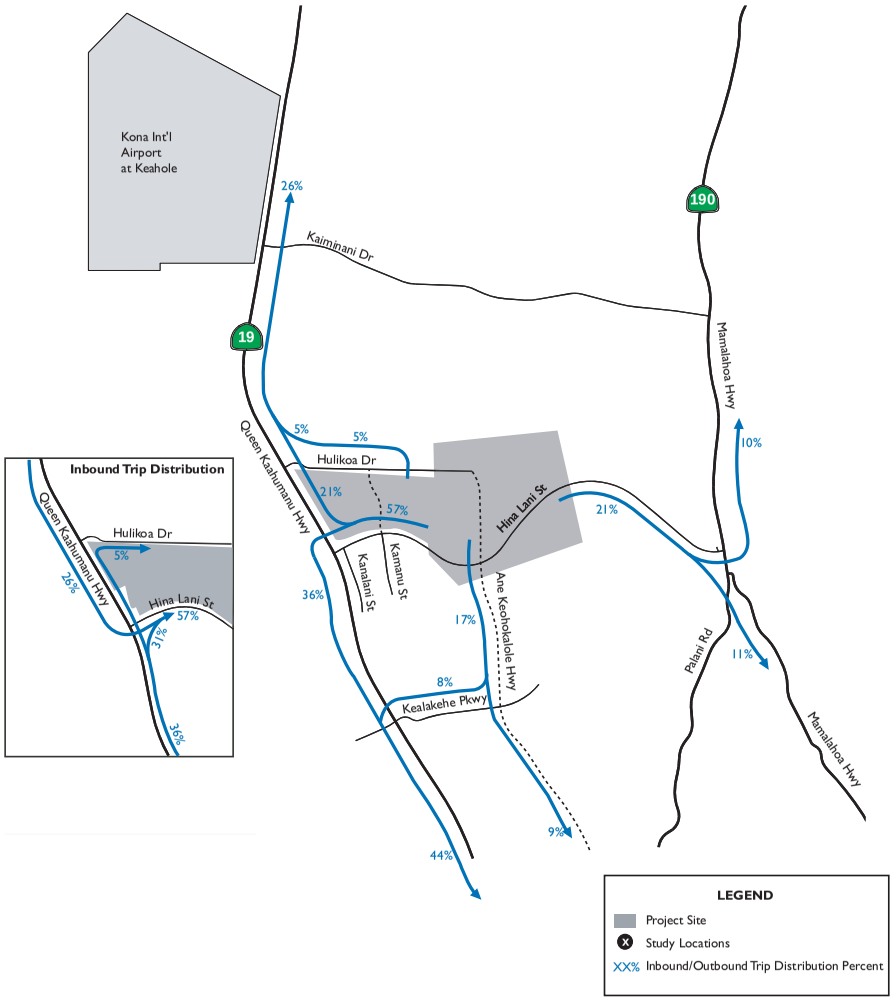
The future Ane Keohokalole Highway will be a two-lane Mid-Level Road that is planned to be constructed in a north-south direction between Queen Kaahumanu Highway and Mamalahoa Highway. By the first horizon year of this traffic (Year 2025), Ane Keohokalole Highway is anticipated to be completed between Hulikoa Drive and Palani Road to the south. As of June 2012, Ane Keohokalole Highway has been completed between Hina Lani Street and Kealakehe Parkway. The northerly extension of Ane Keohokalole Highway to Kaiminani Drive will be completed by 2028 (or near the beginning of Project Phase 2). The completion of Ane Keohokalole Highway will serve as a parallel corridor to relief traffic congestion on Queen Kaahumanu Highway and Mamalahoa Highway.

The project's overall external trip distribution patterns for Phase 1 of the proposed Kaloko Makai project are shown in Figure 8. Since the connectivity of the Mid-Level Road (Ane Keohokalole Highway) will be completed by 2028 (or near the beginning of Phase 2), the project distribution patterns for Phases 2 and 3 will be different than that of Phase 1. The project's overall external trip distribution patterns for Phases 2 and 3 of the proposed Kaloko Makai project are shown in Figure 9, which includes the northerly extension of Ane Keohokalole Highway to Kaiminani Drive. The Project Phase 1 trip distribution patterns for the first 3 TAZ's are shown in Figures 10 through 12. The Phases 2 and 3 trip distribution patterns for the 11 project TAZ's are shown in Figures 13 through 23.

4.8 Project Trip Assignment

Based on the traffic generation and trip distribution patterns presented above, project-only traffic volumes are shown in the following tables and figures for the 3 project phases:

- Table 6, and Figures 24 and 25: Total Project Phase 1 Traffic
- Table 7, and Figures 26 and 27: Total Project Phase 2 Traffic
- Table 8, and Figures 28 and 29: Total Project Phase 3 Traffic



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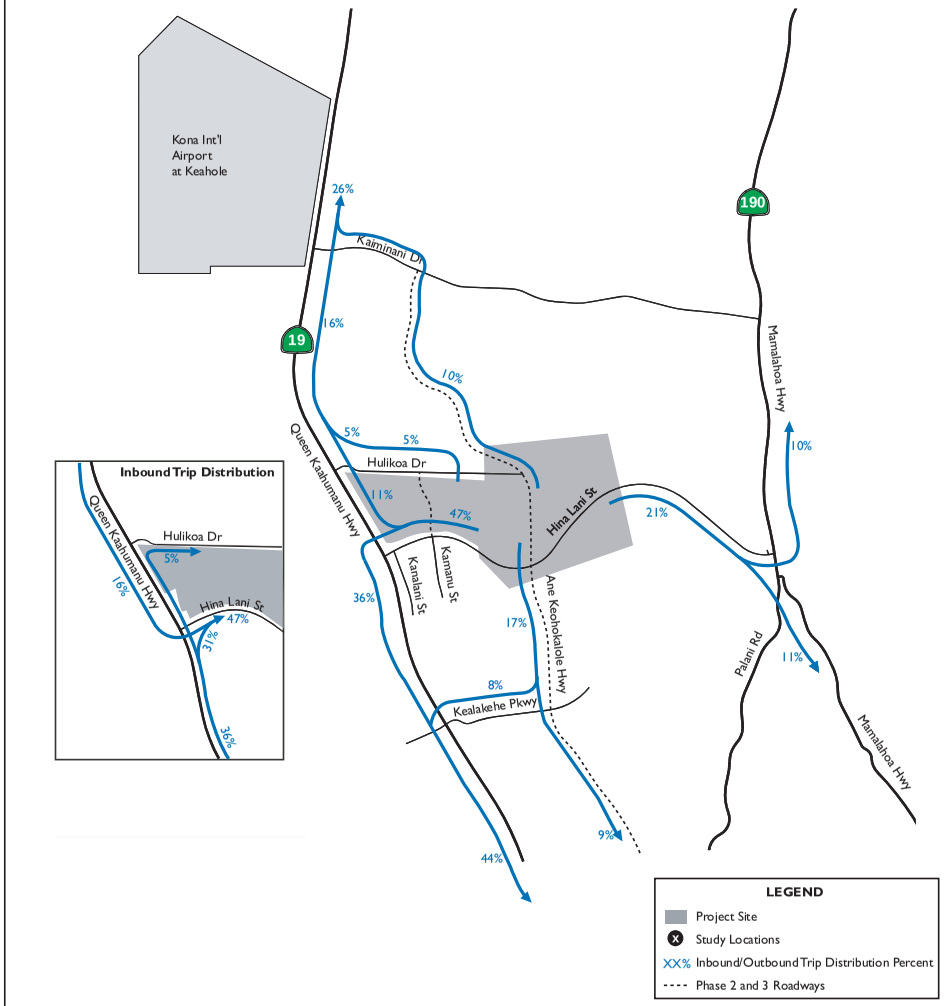
KOA CORPORATION PLANNING & ENGINEERING

Kaloko Makai Project — Figure 8

Kona, Hawaii — Project Phase 1 Overall External Trip Distribution



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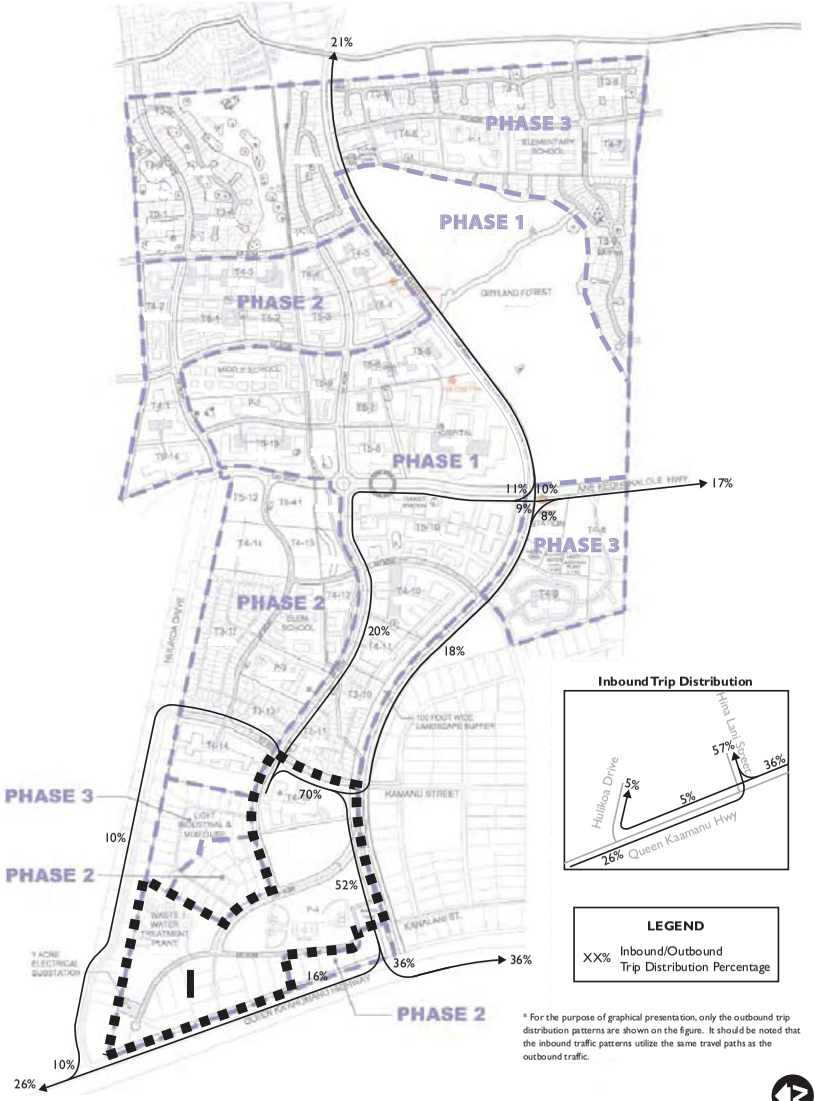
Kaloko Makai Project — Figure 9

Kona, Hawaii — Project Phases 2 and 3 Overall External Trip Distribution



* For the purpose of graphical presentation, only the outbound trip distribution patterns are shown on the figure. It should be noted that the inbound traffic patterns utilize the same travel paths as the outbound traffic.

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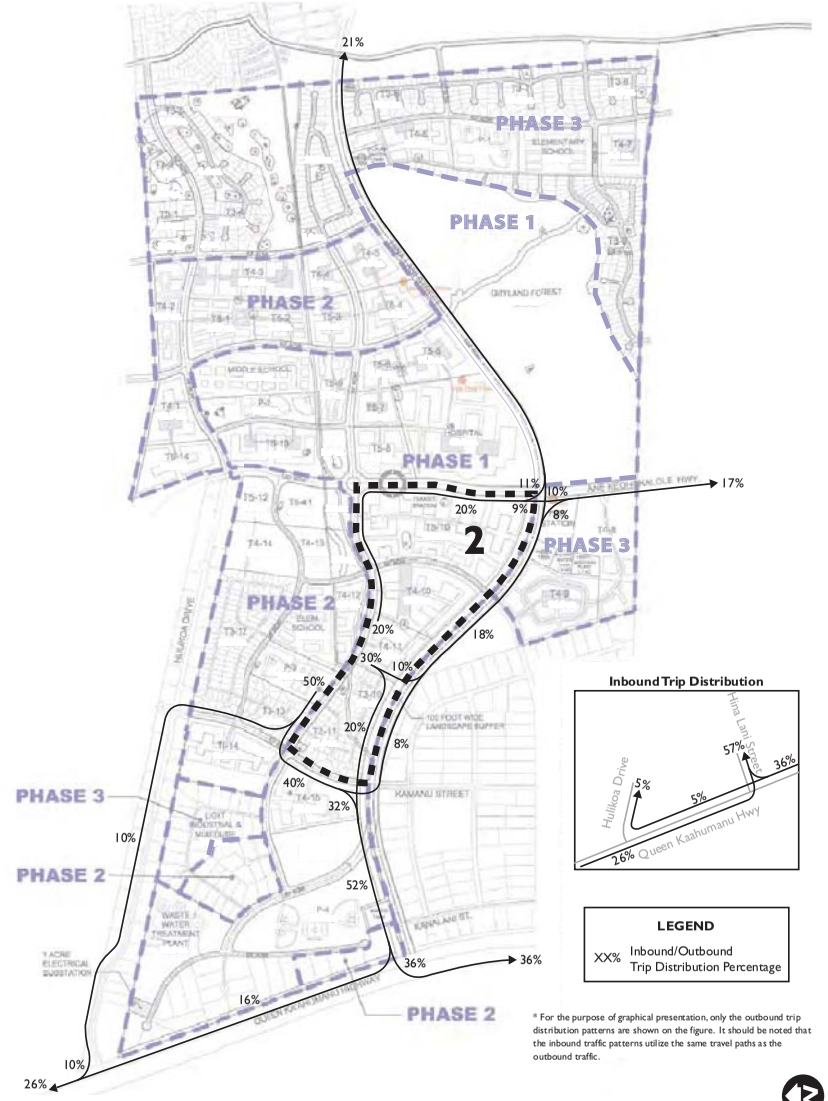
Kaloko Makai, Project — Figure 10

Kona, Hawaii — Phase 1 Project TAZ 1 Trip Distribution



* For the purpose of graphical presentation, only the outbound trip distribution patterns are shown on the figure. It should be noted that the inbound traffic patterns utilize the same travel paths as the outbound traffic.

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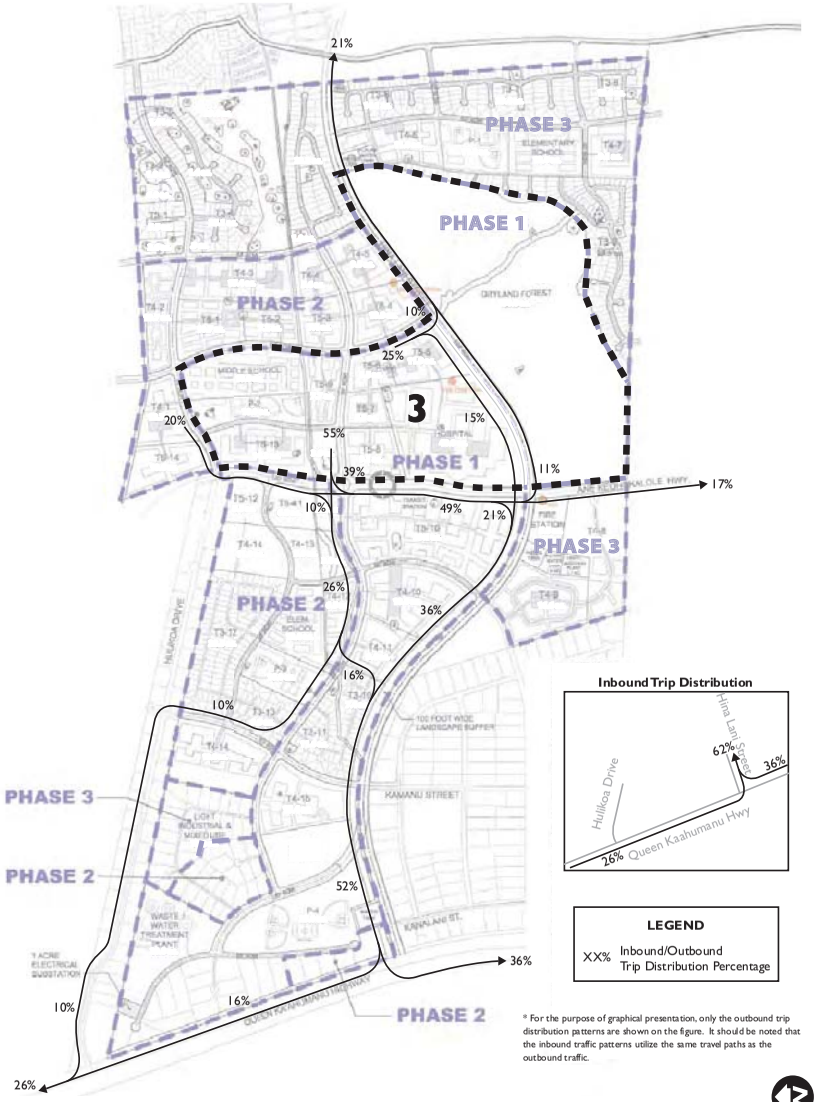
Kaloko Makai, Project — Figure 11

Kona, Hawaii — Phase 1 Project TAZ 2 Trip Distribution



* For the purpose of graphical presentation, only the outbound trip distribution patterns are shown on the figure. It should be noted that the inbound traffic patterns utilize the same travel paths as the outbound traffic.

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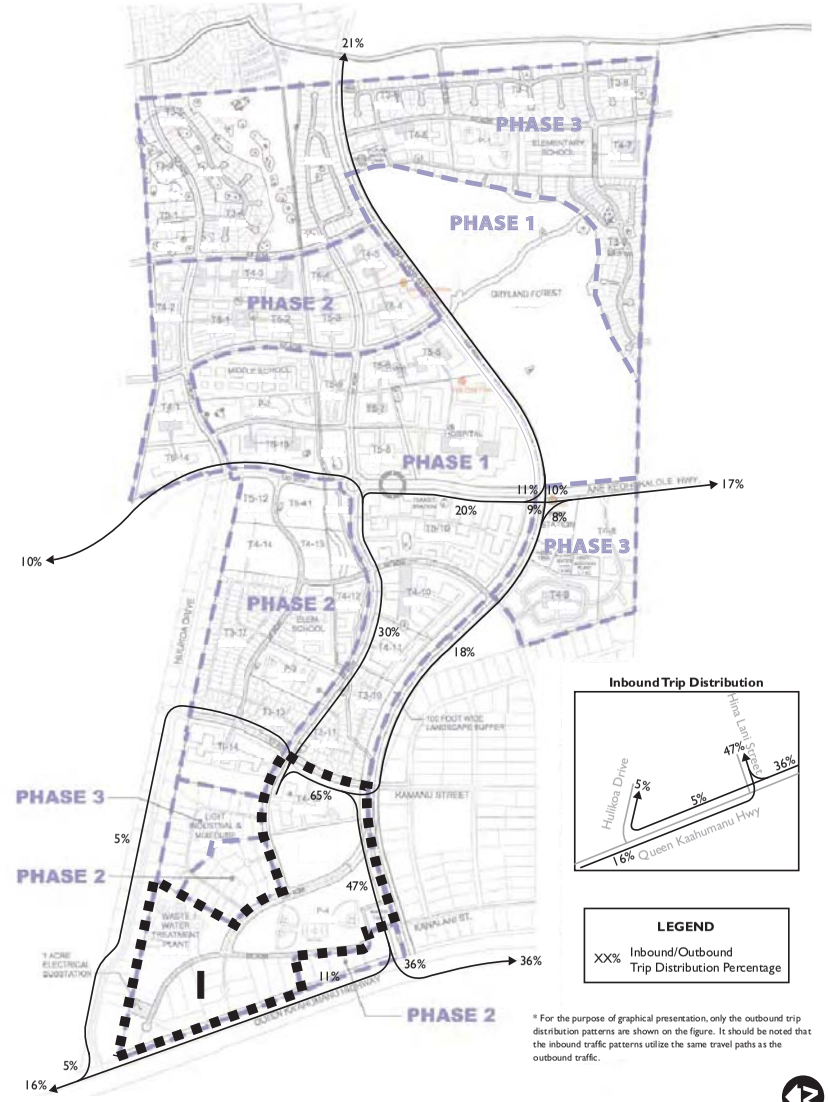
Kaloko Makai, Project — Figure 12

Kona, Hawaii — Phase 1 Project TAZ 3 Trip Distribution



* For the purpose of graphical presentation, only the outbound trip distribution patterns are shown on the figure. It should be noted that the inbound traffic patterns utilize the same travel paths as the outbound traffic.

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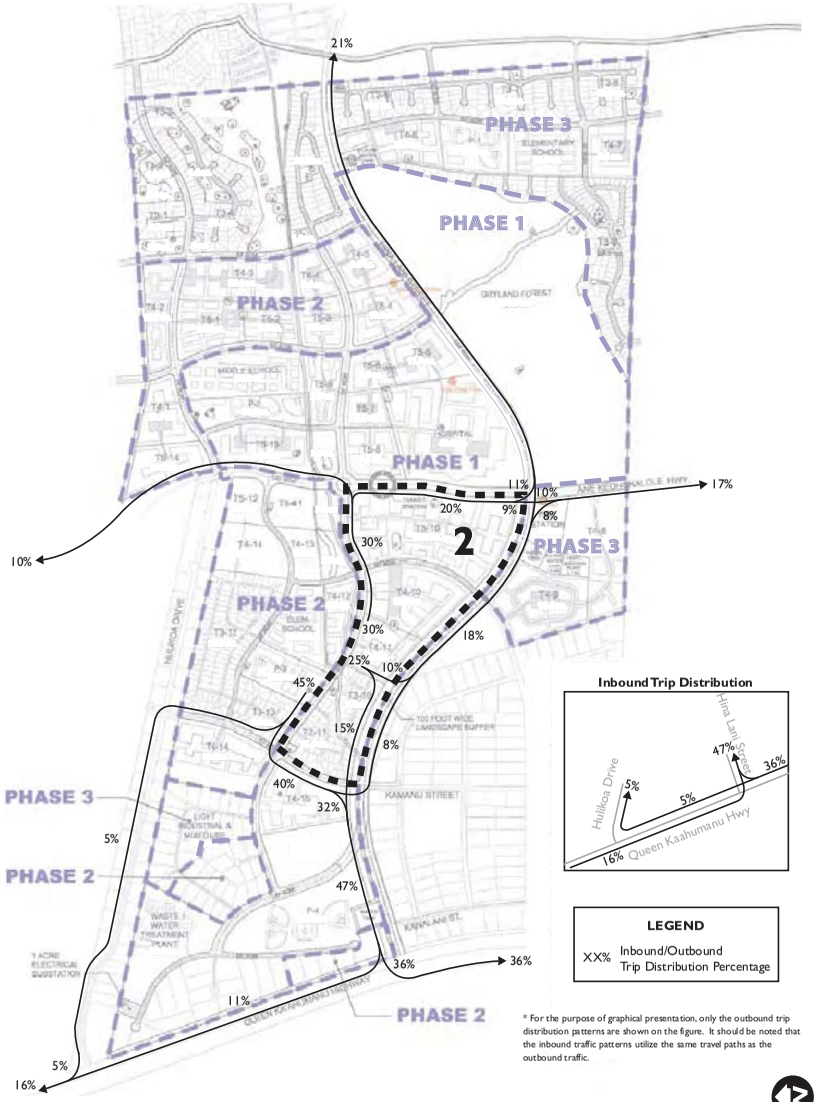
Kaloko Makai, Project — Figure 13

Kona, Hawaii — Phases 2 and 3 Project TAZ 1 Trip Distribution



* For the purpose of graphical presentation, only the outbound trip distribution patterns are shown on the figure. It should be noted that the inbound traffic patterns utilize the same travel paths as the outbound traffic.

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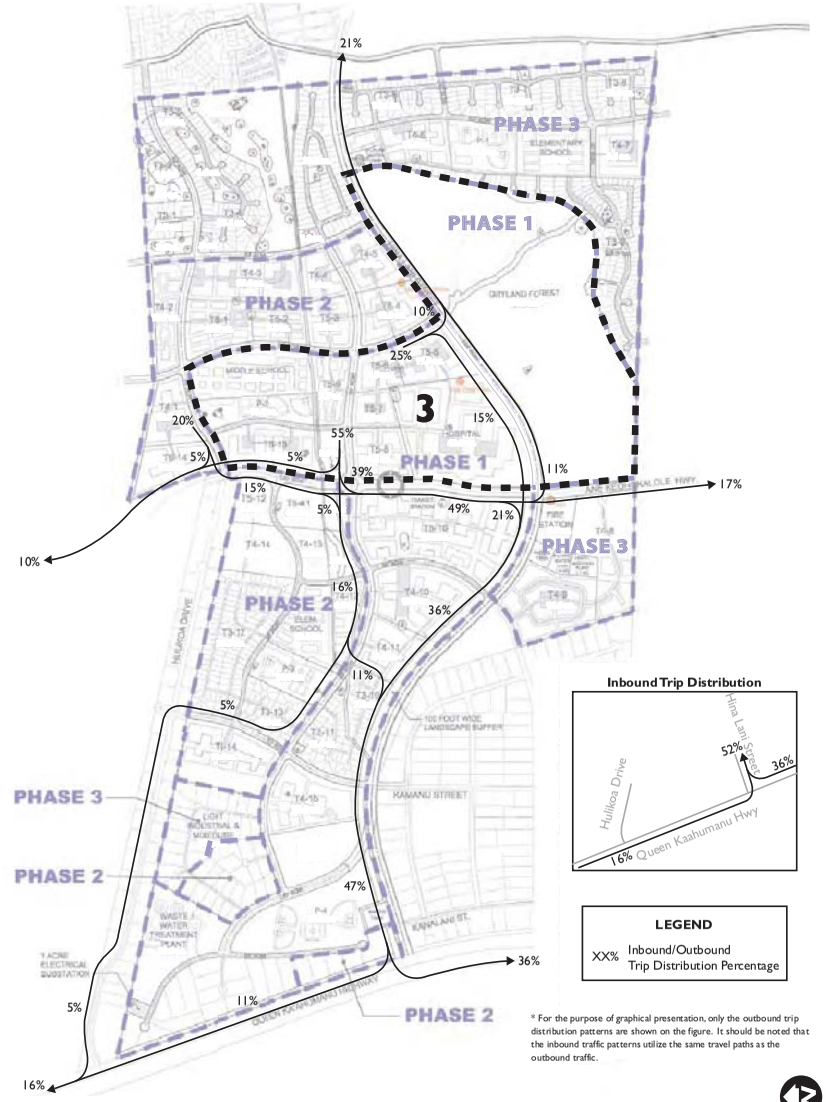
Kaloko Makai, Project — Figure 14

Kona, Hawaii — Phases 2 and 3 Project TAZ 2 Trip Distribution



* For the purpose of graphical presentation, only the outbound trip distribution patterns are shown on the figure. It should be noted that the inbound traffic patterns utilize the same travel paths as the outbound traffic.

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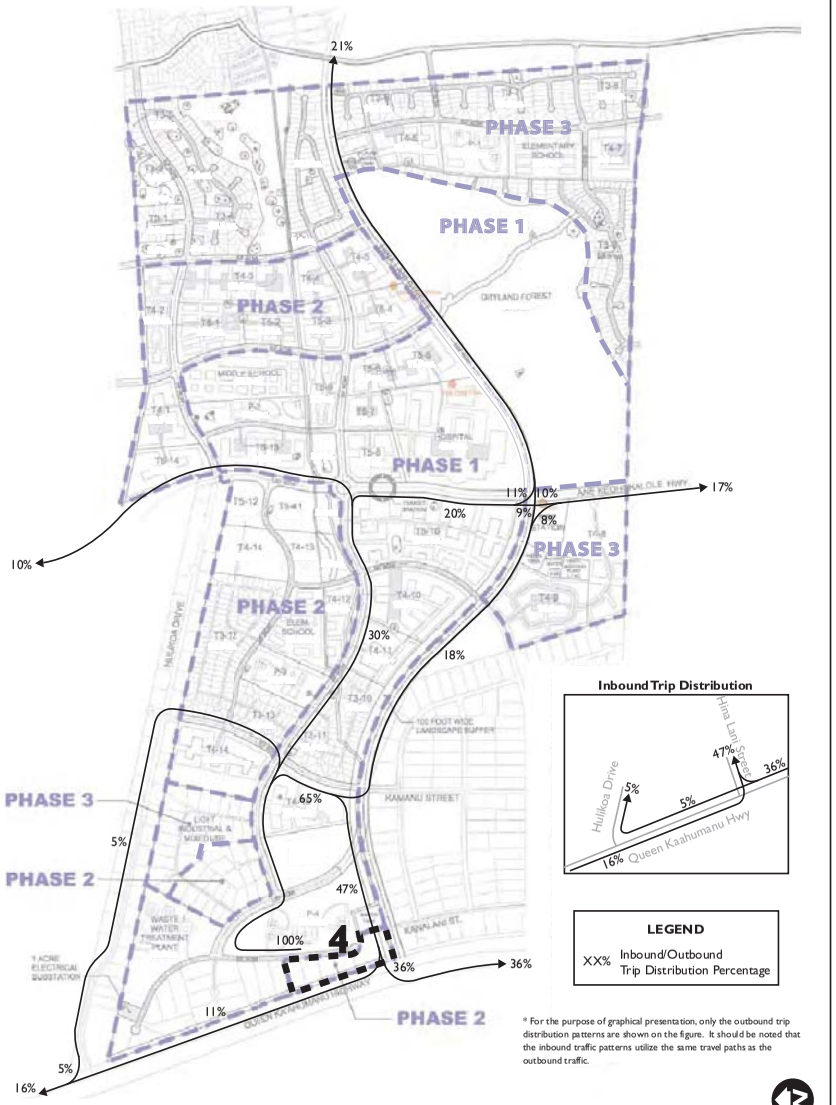
Kaloko Makai, Project — Figure 15

Kona, Hawaii — Phases 2 and 3 Project TAZ 3 Trip Distribution



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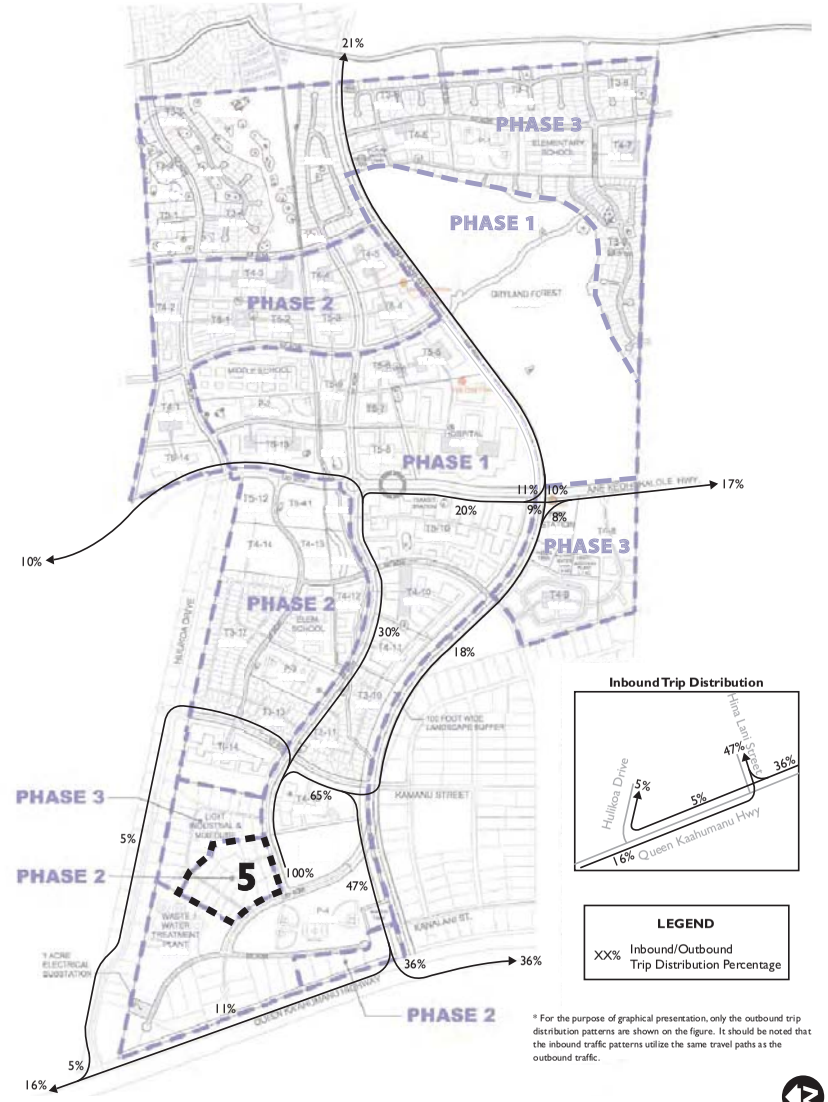
Kaloko Makai, Project — Figure 16

Kona, Hawaii — Phases 2 and 3 Project TAZ 4 Trip Distribution



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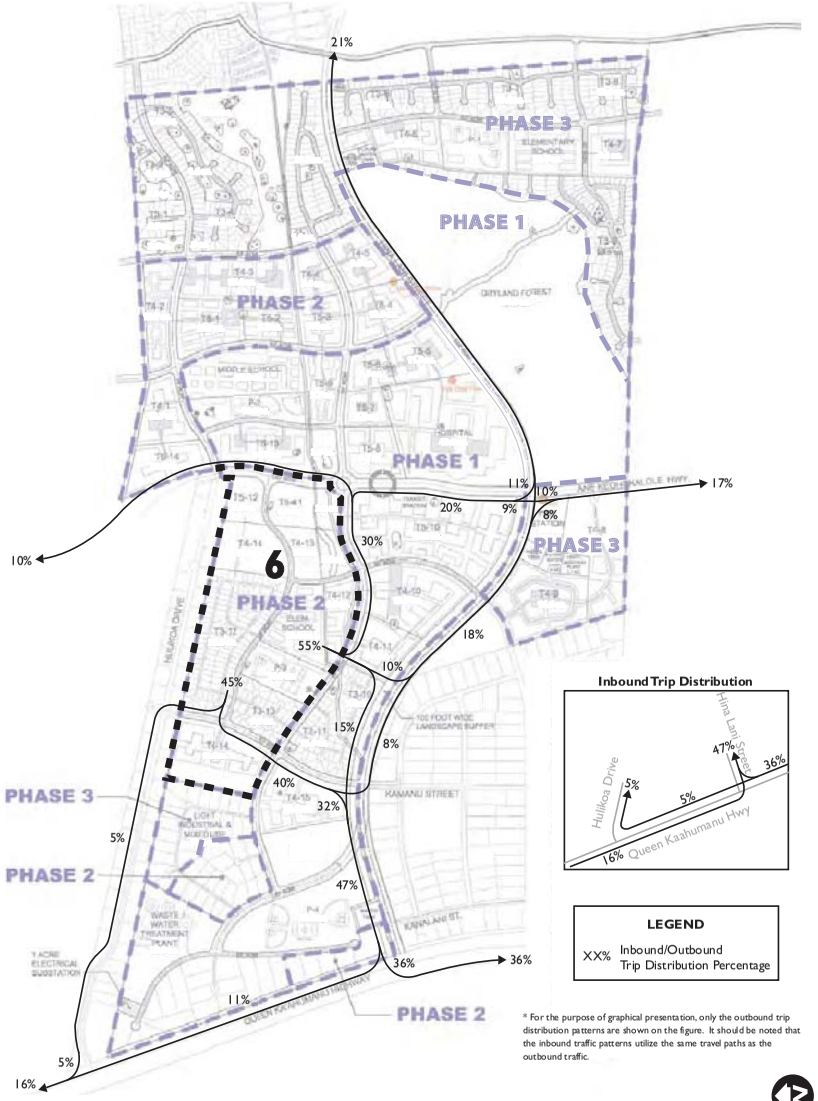
Kaloko Makai, Project — Figure 17

Kona, Hawaii — Phases 2 and 3 Project TAZ 5 Trip Distribution



* For the purpose of graphical presentation, only the outbound trip distribution patterns are shown on the figure. It should be noted that the inbound traffic patterns utilize the same travel paths as the outbound traffic.

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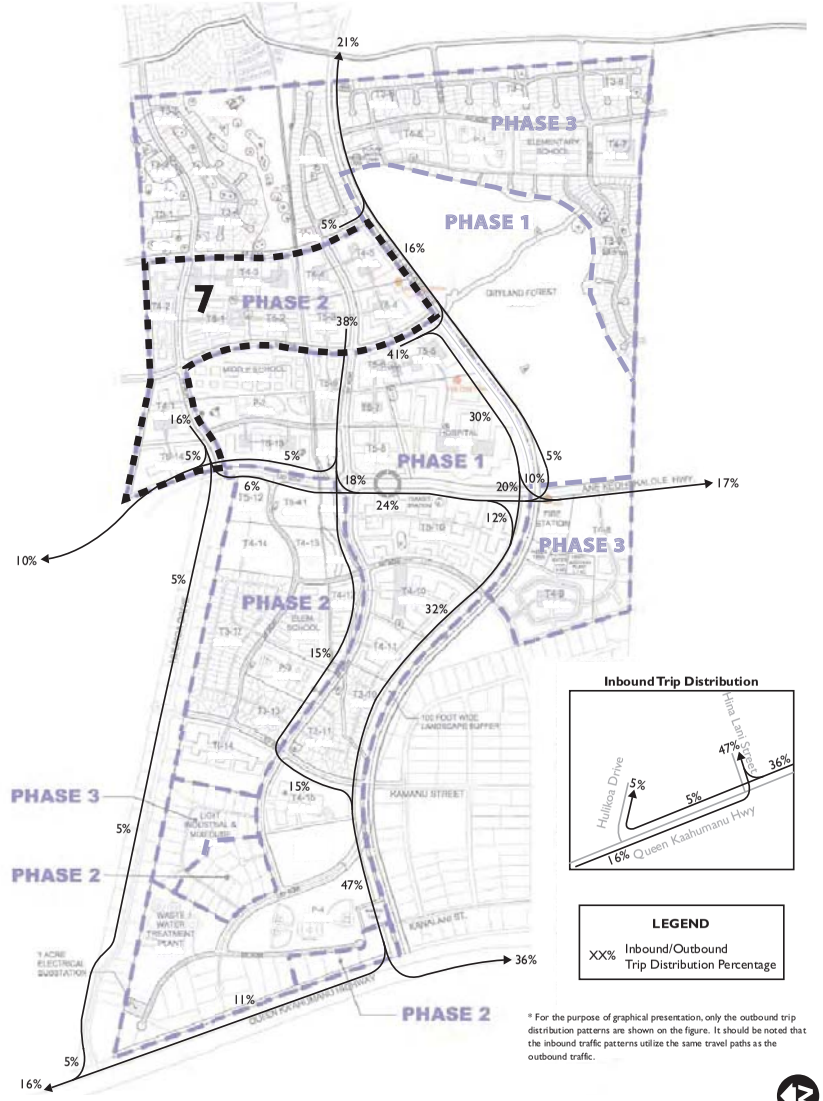
Kaloko Makai, Project — Figure 18

Kona, Hawaii — Phases 2 and 3 Project TAZ 6 Trip Distribution



* For the purpose of graphical presentation, only the outbound trip distribution patterns are shown on the figure. It should be noted that the inbound traffic patterns utilize the same travel paths as the outbound traffic.

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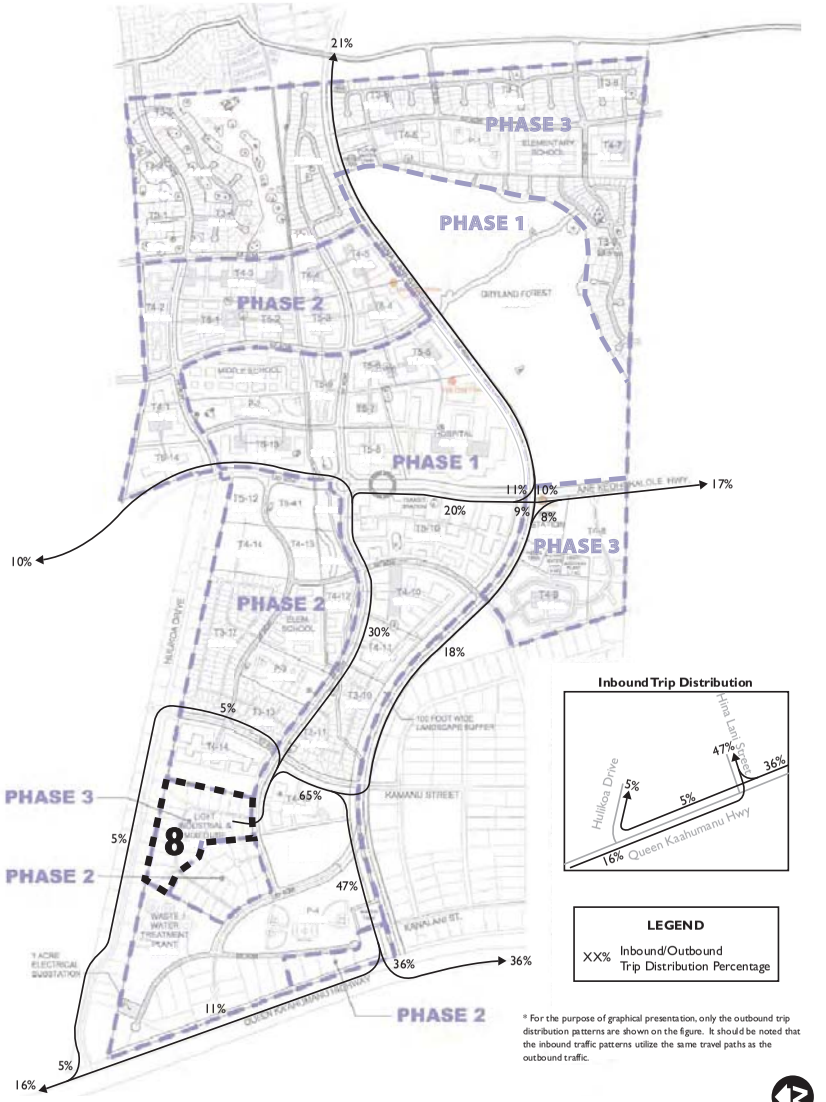
Kaloko Makai, Project — Figure 19

Kona, Hawaii — Phases 2 and 3 Project TAZ 7 Trip Distribution



* For the purpose of graphical presentation, only the outbound trip distribution patterns are shown on the figure. It should be noted that the inbound traffic patterns utilize the same travel paths as the outbound traffic.

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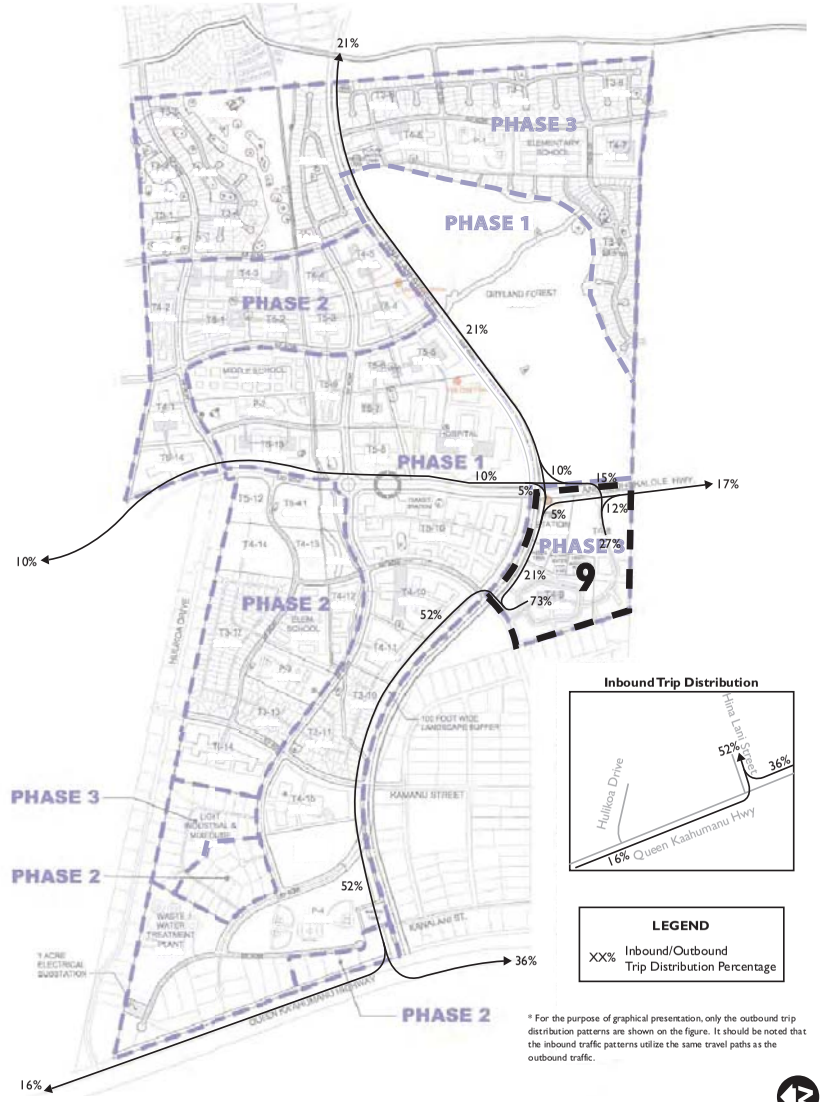
Kaloko Makai, Project — Figure 20

Kona, Hawaii — Phase 3 Project TAZ 8 Trip Distribution



* For the purpose of graphical presentation, only the outbound trip distribution patterns are shown on the figure. It should be noted that the inbound traffic patterns utilize the same travel paths as the outbound traffic.

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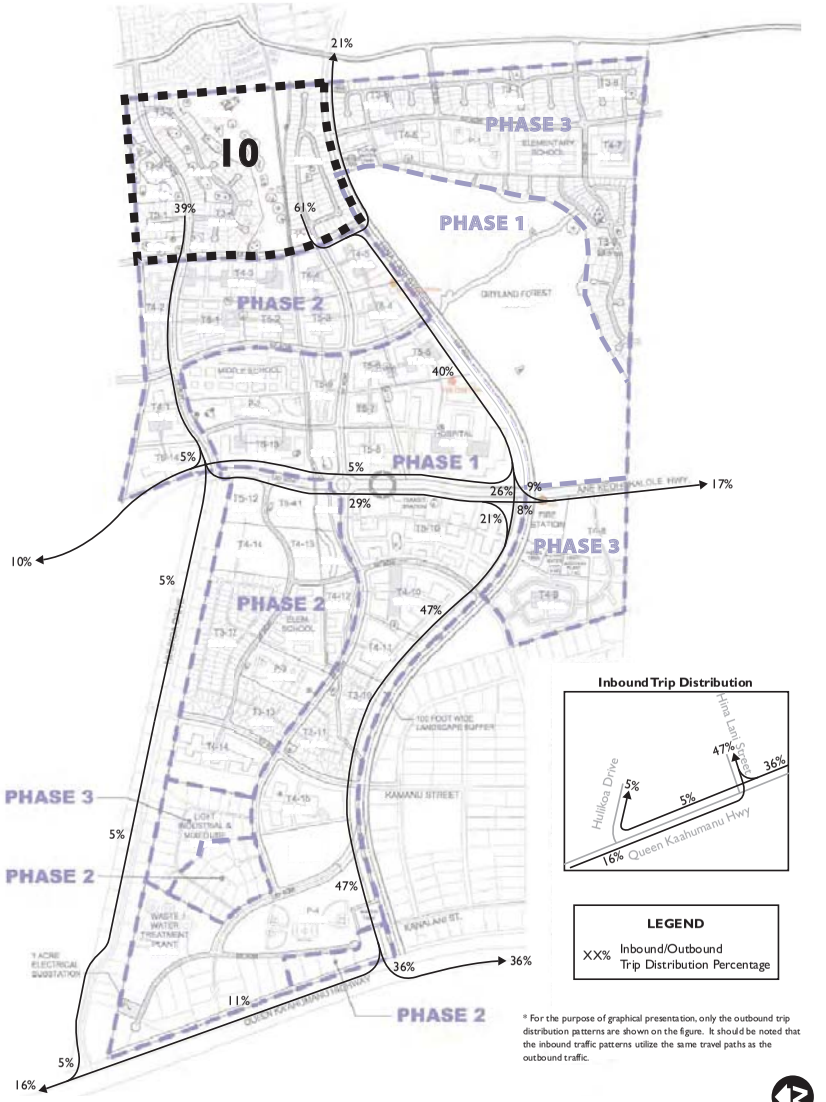
Kaloko Makai, Project — Figure 21

Kona, Hawaii — Phase 3 Project TAZ 9 Trip Distribution



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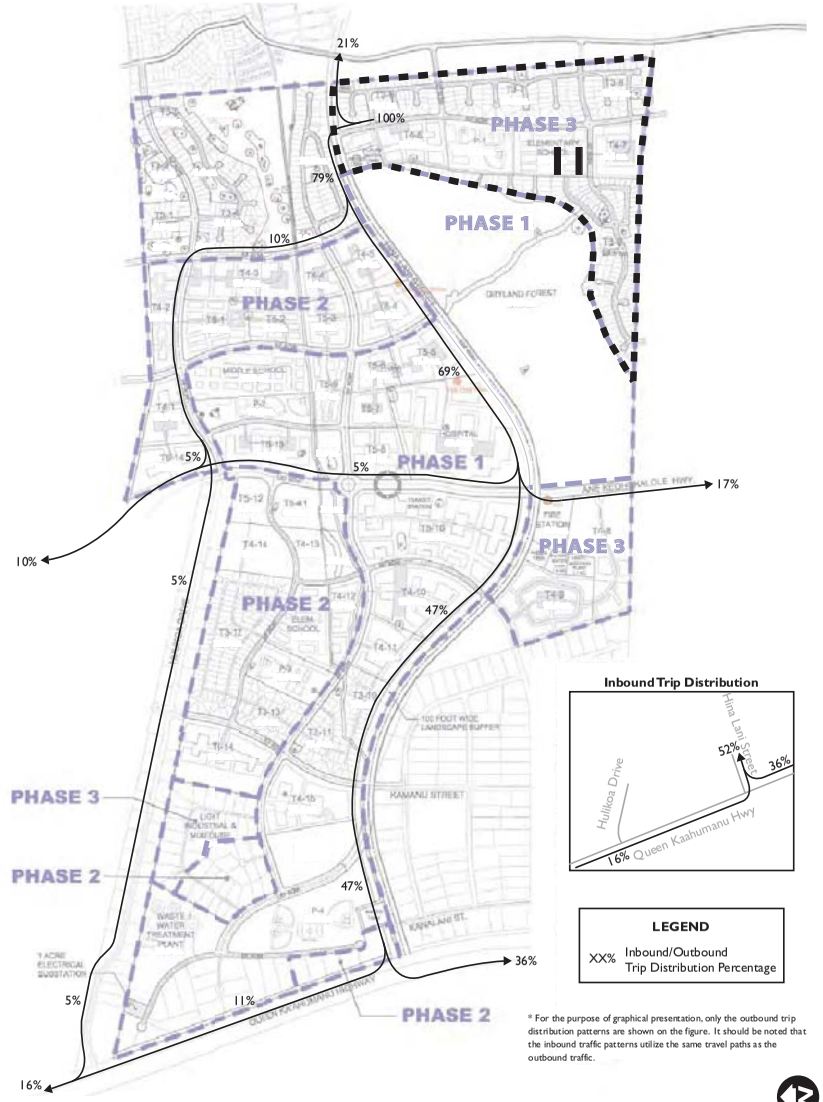
Kaloko Makai, Project — Figure 22

Kona, Hawaii — Phase 3 Project TAZ 10 Trip Distribution



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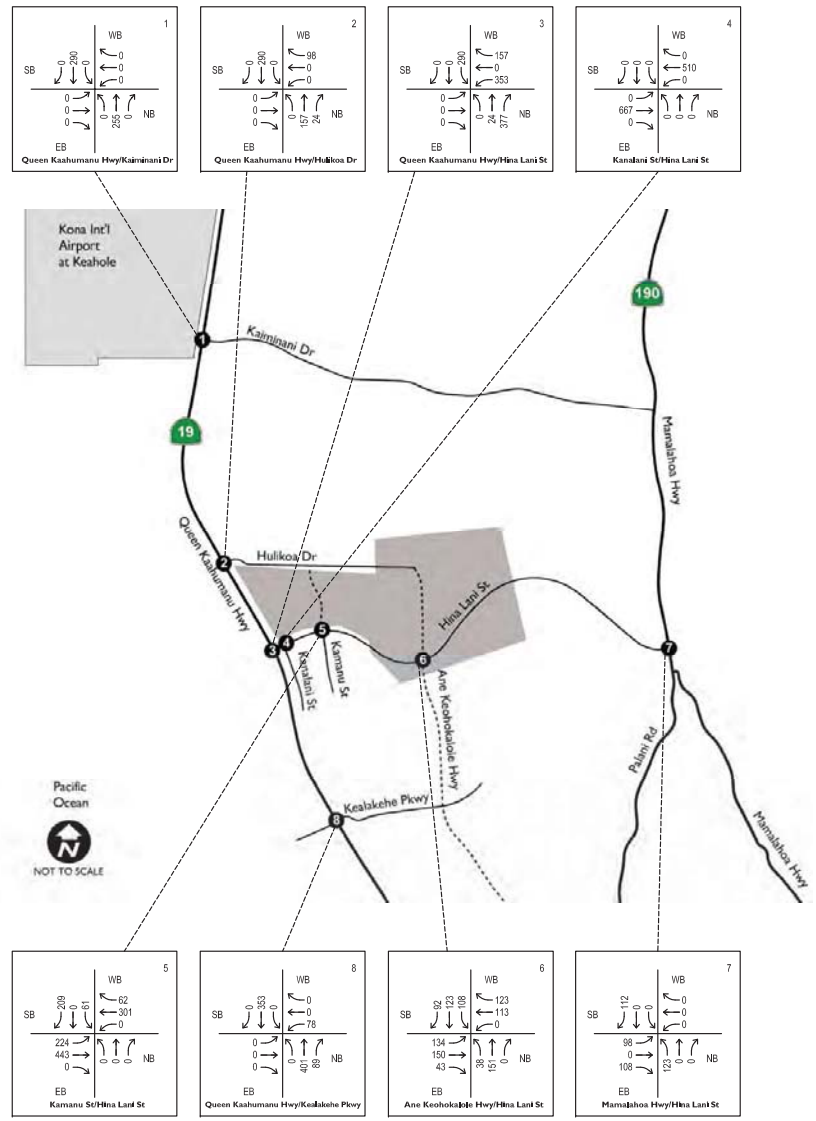
Kaloko Makai, Project — Figure 23

Kona, Hawaii — Phase 3 Project TAZ 11 Trip Distribution

Table 6 - Phase I Project-Only Conditions Peak Hour Intersection Volumes

Int.	Intersection Name	Peak Hr.	Northbound			Southbound			Eastbound			Westbound			Total
			NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	
1	Queen Kaahumanu Hwy./Kaiminani Dr.	AM	0	255	0	0	290	0	0	0	0	0	0	0	545
		PM	0	338	0	0	300	0	0	0	0	0	0	0	638
2	Queen Kaahumanu Hwy./Hulikoa Dr.	AM	0	157	24	0	290	0	0	0	0	0	0	98	569
		PM	0	208	32	0	300	0	0	0	0	0	0	130	670
3	Queen Kaahumanu Hwy./Hina Lani St.	AM	0	24	377	290	0	0	0	0	0	353	0	157	1,201
		PM	0	32	383	300	0	0	0	0	0	468	0	208	1,391
4	Kanalani St./ Hina Lani St.	AM	0	0	0	0	0	0	0	667	0	0	510	0	1,177
		PM	0	0	0	0	0	0	0	683	0	0	676	0	1,359
5	Kamanu St./ Hina Lani St.	AM	0	0	0	61	0	209	224	443	0	0	301	62	1,300
		PM	0	0	0	75	0	251	279	404	0	0	425	72	1,506
6	Ane Keohokalole Hwy./Hina Lani St.	AM	38	151	0	108	123	92	134	150	43	0	113	123	1,075
		PM	52	144	0	143	171	140	106	139	50	0	165	127	1,237
7	Mamalahoa Hwy./ Hina Lani St.	AM	123	0	0	0	0	112	98	0	108	0	0	0	441
		PM	127	0	0	0	0	115	130	0	143	0	0	0	515
8	Queen Kaahumanu Hwy./Kealakehe Pkwy.	AM	0	401	89	0	353	0	0	0	0	78	0	0	921
		PM	0	415	92	0	468	0	0	0	0	104	0	0	1,079



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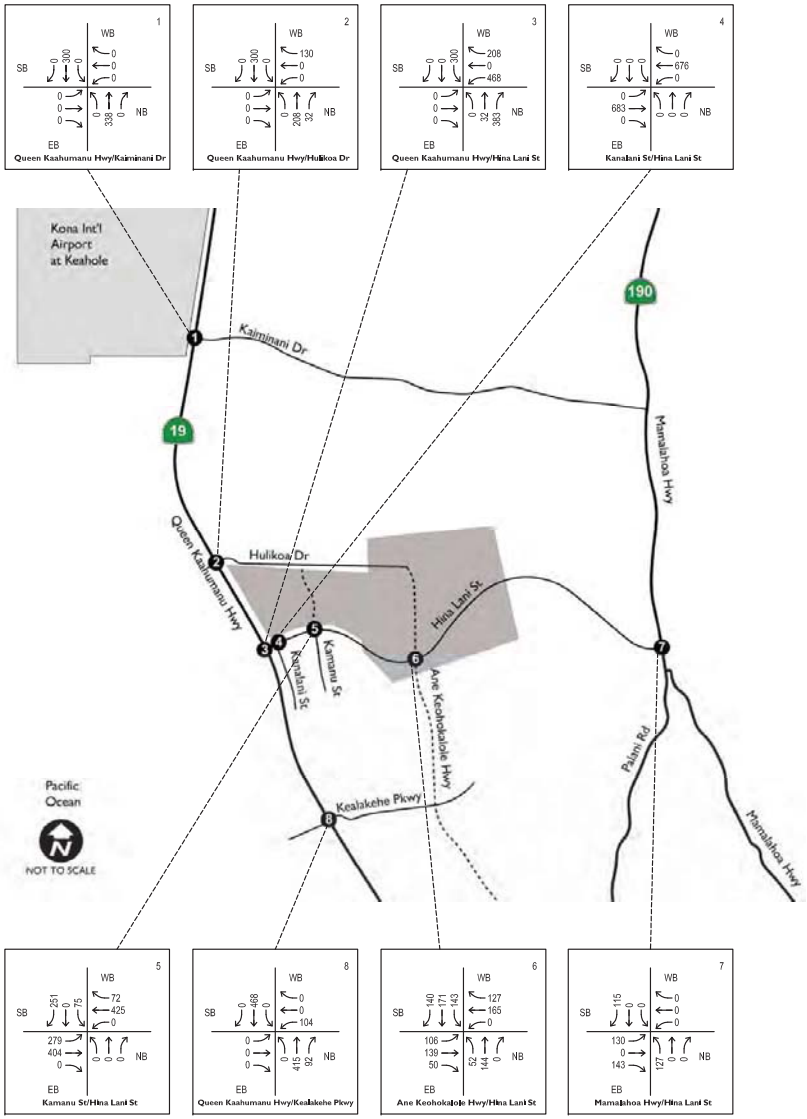
Kaloko Makai Project — Figure 24

Kona, Hawaii — Phase I Project-Only AM Peak Hour Intersection Movement Volumes



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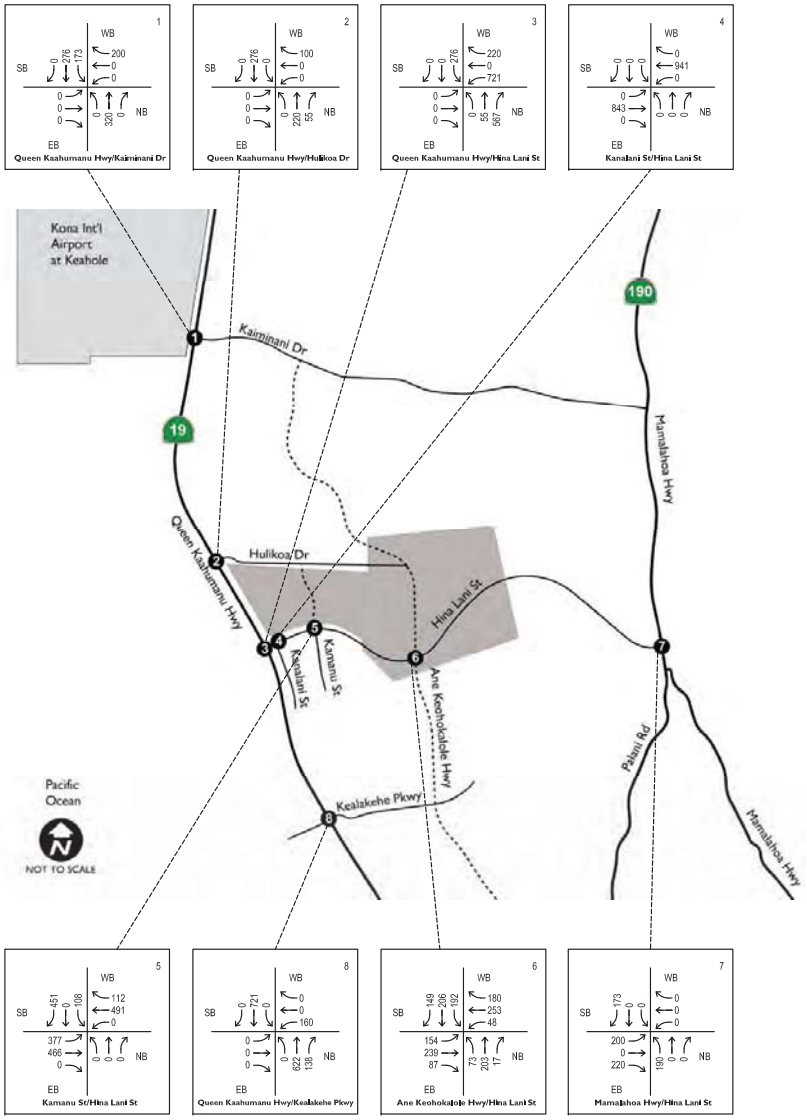
Kaloko Makai Project — Figure 25

Kona, Hawaii — Phase 1 Project-Only PM Peak Hour Intersection Turning Movement Volumes

Table 7 - Phase 2 Project-Only Conditions Peak Hour Intersection Volumes

Int.	Intersection Name	Peak Hr.	Northbound			Southbound			Eastbound			Westbound			Total
			NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	
1	Queen Kaahumanu Hwy./Kaiminani Dr.	AM	0	320	0	173	276	0	0	0	0	0	0	200	969
		PM	0	343	0	225	360	0	0	0	0	0	0	214	1,142
2	Queen Kaahumanu Hwy./Hulikoa Dr.	AM	0	220	55	0	276	0	0	0	0	0	0	100	651
		PM	0	236	87	0	360	0	0	0	0	0	0	107	790
3	Queen Kaahumanu Hwy./Hina Lani St.	AM	0	55	567	276	0	0	0	0	0	721	0	220	1,839
		PM	0	87	722	360	0	0	0	0	0	772	0	236	2,177
4	Kanalani St./ Hina Lani St.	AM	0	0	0	0	0	0	0	843	0	0	941	0	1,784
		PM	0	0	0	0	0	0	0	1,081	0	0	1,008	0	2,089
5	Kamanu St./ Hina Lani St.	AM	0	0	0	108	0	451	377	466	0	0	491	112	2,005
		PM	0	0	0	129	0	471	501	580	0	0	537	120	2,338
6	Ane Keohokalole Hwy./Hina Lani St.	AM	73	203	17	192	206	149	154	239	87	48	253	180	1,801
		PM	96	232	53	215	240	182	171	296	90	34	290	215	2,114
7	Mamalahoa Hwy./ Hina Lani St.	AM	190	0	0	0	0	173	200	0	220	0	0	0	783
		PM	247	0	0	0	0	225	214	0	236	0	0	0	922
8	Queen Kaahumanu Hwy./Kealakehe Pkwy.	AM	0	622	138	0	721	0	0	0	0	160	0	0	1,641
		PM	0	809	180	0	772	0	0	0	0	172	0	0	1,933



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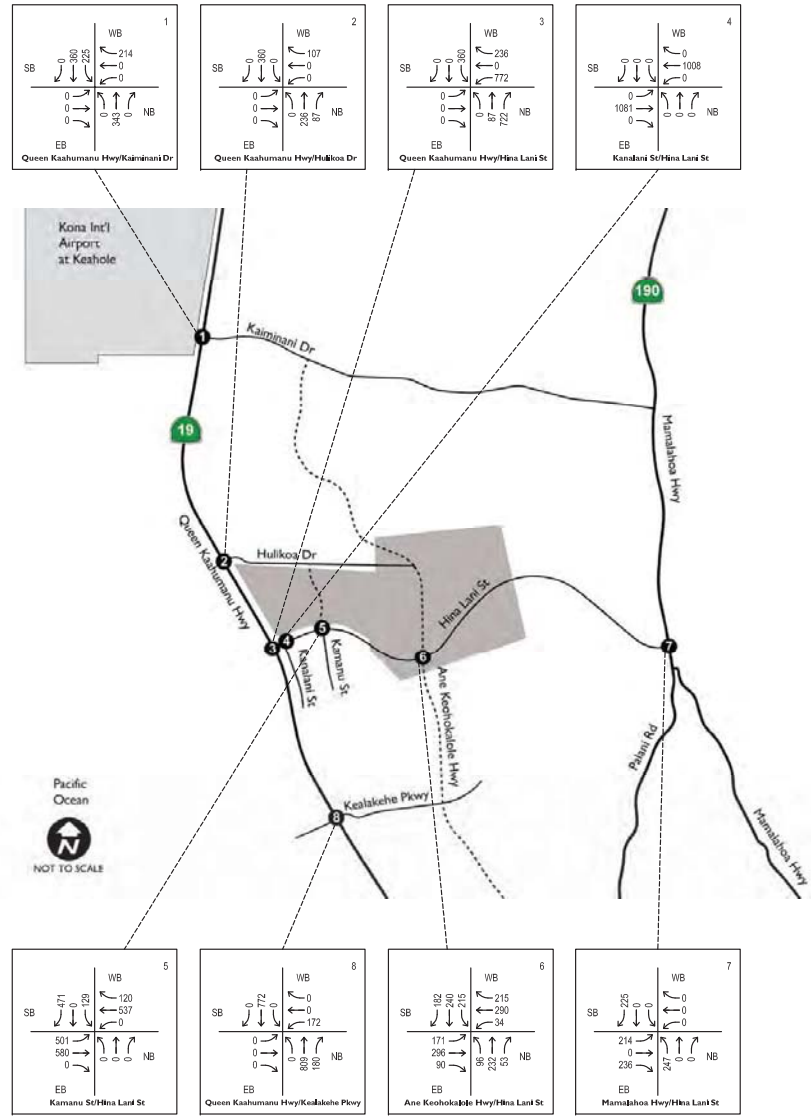
Kaloko Makai Project — Figure 26

Kona, Hawaii — Phase 2 Project-Only AM Peak Hour Intersection Turning Movement Volumes



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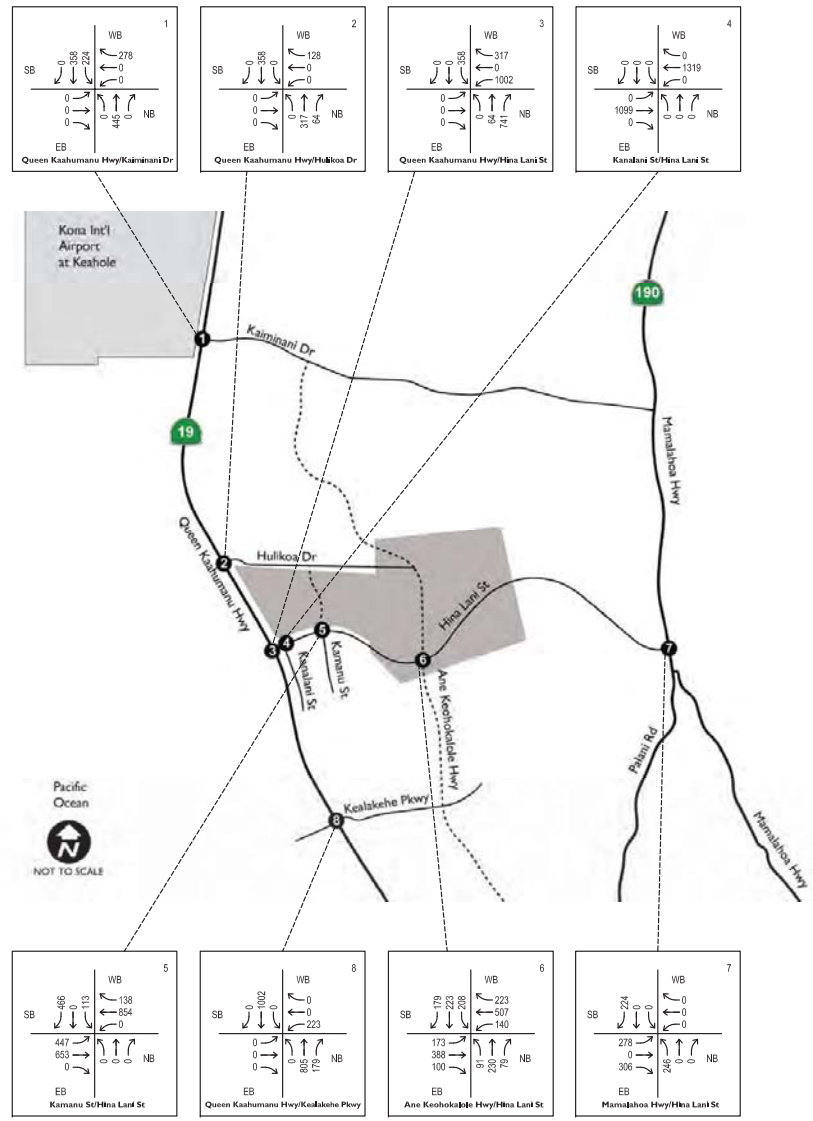
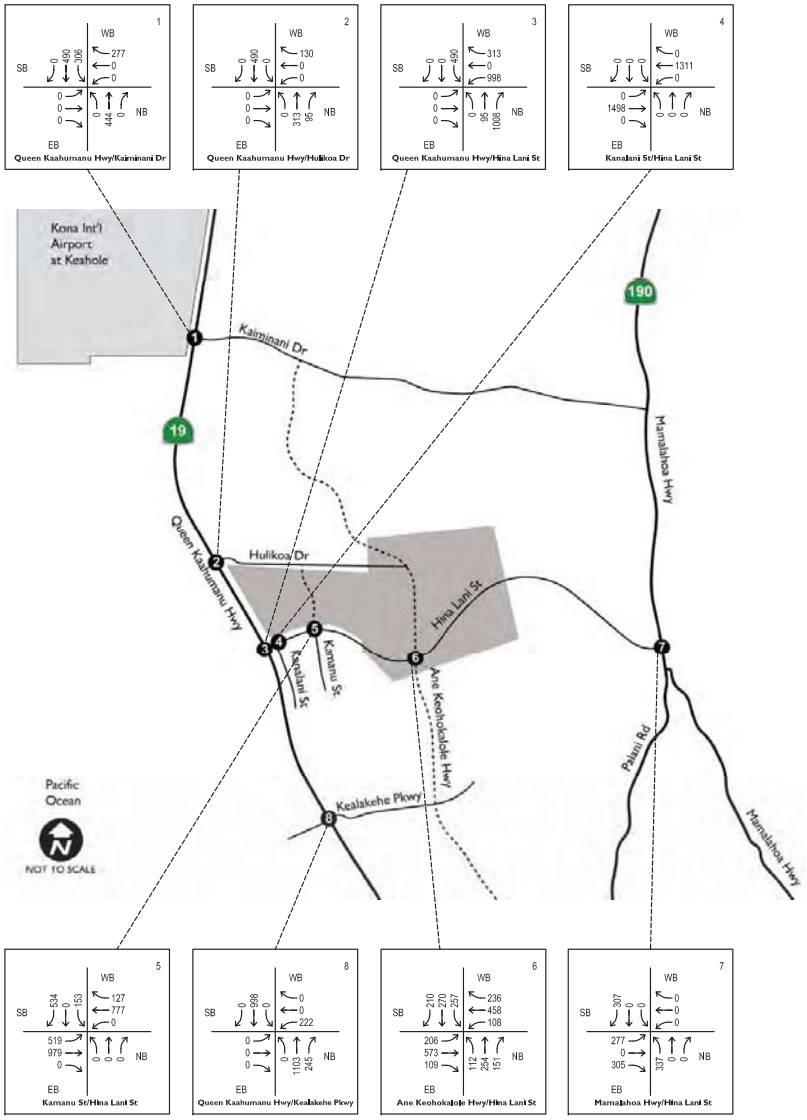
Kaloko Makai Project — Figure 27

Kona, Hawaii — Phase 2 Project-Only PM Peak Hour Intersection Turning Movement Volumes

Table 8 - Phase 3 Project-Only Conditions Peak Hour Intersection Volumes

Int.	Intersection Name	Peak Hr.	Northbound			Southbound			Eastbound			Westbound			Total
			NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	
1	Queen Kaahumanu Hwy./Kaiminani Dr.	AM	0	445	0	224	358	0	0	0	0	0	0	278	1,305
		PM	0	444	0	306	490	0	0	0	0	0	0	277	1,517
2	Queen Kaahumanu Hwy./Hulikoa Dr.	AM	0	317	64	0	358	0	0	0	0	0	0	128	867
		PM	0	313	95	0	490	0	0	0	0	0	0	130	1,028
3	Queen Kaahumanu Hwy./Hina Lani St.	AM	0	64	741	358	0	0	0	0	0	1,002	0	317	2,482
		PM	0	95	1,008	490	0	0	0	0	0	998	0	313	2,904
4	Kanalani St./ Hina Lani St.	AM	0	0	0	0	0	0	0	1,099	0	0	1,319	0	2,418
		PM	0	0	0	0	0	0	0	1,498	0	0	1,311	0	2,809
5	Kamanu St./ Hina Lani St.	AM	0	0	0	113	0	466	447	653	0	0	854	138	2,671
		PM	0	0	0	153	0	534	519	979	0	0	777	127	3,089
6	Ane Keohokalole Hwy./Hina Lani St.	AM	91	230	79	208	223	179	173	388	100	140	507	223	2,541
		PM	112	254	151	257	270	210	206	573	109	108	458	236	2,944
7	Mamalahoa Hwy./ Hina Lani St.	AM	246	0	0	0	0	224	278	0	306	0	0	0	1,054
		PM	337	0	0	0	0	307	277	0	305	0	0	0	1,226
8	Queen Kaahumanu Hwy./Kealakehe Pkwy.	AM	0	805	179	0	1,002	0	0	0	0	223	0	0	2,209
		PM	0	1,103	245	0	998	0	0	0	0	222	0	0	2,568





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Kaloko Makai Project — Figure 29

Kona, Hawaii — Phase 3 Project-Only PM Peak Hour Intersection Turning Movement Volumes

4.9 Other Cumulative Development Traffic

Future traffic increases consider additional traffic that are generated by other cumulative developments that either are under construction, approved, planned, or proposed for development near the study area based on the available information obtained by the project team. Estimated trips from the cumulative developments have been assigned to the study area roadway system based on their anticipated travel patterns. This study includes the following 5 other cumulative developments in the vicinity of the project site, as shown in Figure 30:

- Kaloko Heights – 300 dwelling units of single-family detached housing
- Kule Nei – 270 dwelling units of single-family detached housing
- West Hawaii Business Park – Mixed use development
- Kohanaiki Business Park – A business park development
- Kaloko Industrial Park Phases 3 (2015) and Phase 4 (2025) – A100-acre industrial park.

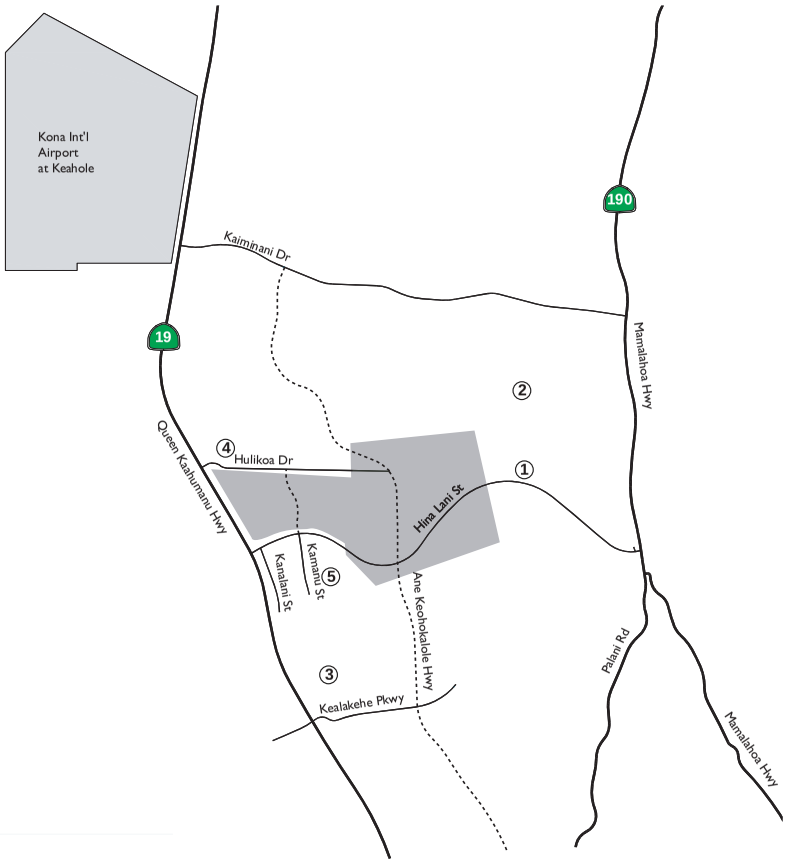
The cumulative development trip generation summary is shown in Table 9. The trip distribution patterns for the cumulative developments are included in Appendix H of this report. It should be noted that although there may be other projects planned in the Kona region, the development plan and implementation schedule for these projects are not known at this time. As such, for the purpose of this report, the cumulative effect of these other future projects is assumed to be captured by ambient growth traffic in the vicinity.

4.10 Ambient Background Growth

In addition to cumulative development traffic, other unidentified projects and general population growth will contribute to ambient background traffic growth. Ambient growth is calculated as an annual growth percentage increase from existing traffic count volumes.

Based on a comparison of the historic traffic count data from 1996 through 2010 for the segment of Queen Kaahumanu Highway north of OTEC Access Road (Station T8M), an average annual growth rate of 1.74% is calculated as shown in Appendix I of this report. KOA has reviewed available traffic data and other similar traffic studies in the surrounding area, and it appears that an annual growth rate of 1.74% is comparable and consistent to other available data. Therefore, this study utilized a 1.74% ambient growth rate to assess future traffic conditions. The total ambient growth rates for the 3 analysis horizon years are as follow:

- Phase 1 (2025) – 29.6%
- Phase 2 (2035) – 54.0%
- Phase 3 (2045) – 83.1%



LEGEND

① Kaloko Heights
② Kule Nei
③ West Hawaii Business Park
④ Kohanaiki Business Park
⑤ Kaloko Industrial Park

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Kaloko Makai Project — Figure 30

Kona, Hawaii — Other Cumulative Development Locations

Table 9 - Other Cumulative Development Traffic Generation

No.	Name	Year	Land Use	Quantity	Daily Trips	AM Peak Hour			PM Peak Hour		
						Total	In	Out	Total	In	Out
1	Kaloko Heights	2015	Single-Family Housing	300 DU	2,871	225	57	168	303	192	111
2	Kule Nei	2015	Single-Family Housing	270 DU	2,584	202	51	151	273	173	100
3	West Hawaii Business Park	2015	Mixed-Use	n/a	22,691	1,098	822	276	2,294	911	1,383
4	Kohanaiki Business Park	2015	Business Park	n/a	1,197	146	81	65	121	52	69
5	Kaloko Industrial Park	2025	Industrial Park	60.7 AC	3,831	519	431	88	537	113	424
Total Cumulative 2025 Traffic					33,174	2,190	1,442	748	3,528	1,441	2,087

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Kona, HI / Kaloko Makai Project

Traffic Impact Study

The 1.74% ambient growth rate is applied to the north-south directional through traffic along major highways to account for regional growth in the study area, including Queen Kaahumanu Highway, Mamalahoa Highway, and the intersection of Queen Kaahumanu Highway at Kaiminani Drive. Other intersection traffic movements not covered by the 1.74% north-south regional growth will be assessed by the traffic volumes generated by other cumulative developments in the study area. The ambient growth rate calculations are included in Appendix I of this report.

4.11 Future Traffic Volumes

Based on the traffic forecast methodologies mentioned above, the future traffic volumes for the study area intersections and analysis years assessed in this traffic study are shown in the following tables:

- Table 10 – 2025 Without Project Traffic
- Table 11 – 2025 With Project Phase 1 Traffic
- Table 12 – 2035 Without Project Traffic
- Table 13 – 2035 With Project Phase 2 Traffic
- Table 14 – 2045 Without Project Traffic
- Table 15 – 2045 With Project Phase 3 Traffic

Table 10 - 2025 Without Project Conditions Peak Hour Intersection Volumes

Int.	Intersection Name	Peak Hr.	Northbound			Southbound			Eastbound			Westbound			Total
			NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	
1	Queen Kaahumanu Hwy./Kaiminani Dr.	AM	0	869	109	33	830	0	0	0	0	480	0	244	2,565
		PM	0	1,135	387	226	1,114	0	0	0	0	180	0	84	3,126
2	Queen Kaahumanu Hwy./Hulikoa Dr.	AM	0	881	299	0	1,333	0	0	0	0	0	0	247	2,760
		PM	0	1,340	174	0	1,604	0	0	0	0	0	0	274	3,392
3	Queen Kaahumanu Hwy./Hina Lani St.	AM	0	752	433	382	1,032	0	0	0	0	275	0	270	3,144
		PM	0	1,105	594	358	1,154	0	0	0	0	544	0	414	4,169
4	Kanalani St./ Hina Lani St.	AM	225	0	18	0	0	0	0	322	363	29	339	0	1,296
		PM	200	0	74	0	0	0	0	343	489	17	669	0	1,792
5	Kamanu St./ Hina Lani St.	AM	134	0	77	0	0	0	0	130	198	202	243	0	984
		PM	479	0	326	0	0	0	0	247	122	127	184	0	1,485
6	Ane Keohokalole Hwy./Hina Lani St.	AM	129	9	64	0	11	0	0	164	26	189	437	0	1,029
		PM	34	7	282	0	9	0	0	561	127	180	269	0	1,469
7	Mamalahoa Hwy./ Hina Lani St.	AM	150	378	0	0	1,307	270	110	0	103	0	0	0	2,318
		PM	104	740	0	0	552	213	382	0	246	0	0	0	2,237
8	Queen Kaahumanu Hwy./Kealakehe Pkwy.	AM	68	1,063	441	240	878	48	17	7	24	270	18	166	3,240
		PM	60	1,276	264	143	1,564	44	59	19	71	412	20	192	4,124

Table 11 - 2025 With Project Phase 1 Conditions Peak Hour Intersection Volumes

Int.	Intersection Name	Peak Hr.	Northbound			Southbound			Eastbound			Westbound			Total
			NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	
1	Queen Kaahumanu Hwy./Kaiminani Dr.	AM	0	1,124	109	33	1,120	0	0	0	0	480	0	244	3,110
		PM	0	1,473	387	226	1,414	0	0	0	0	180	0	84	3,764
2	Queen Kaahumanu Hwy./Hulikoa Dr.	AM	0	1,037	323	0	1,623	0	0	0	0	0	0	345	3,328
		PM	0	1,548	206	0	1,904	0	0	0	0	0	0	404	4,062
3	Queen Kaahumanu Hwy./Hina Lani St.	AM	0	775	810	672	1,032	0	0	0	0	627	0	427	4,343
		PM	0	1,138	977	658	1,154	0	0	0	0	1,012	0	622	5,561
4	Kanalani St./ Hina Lani St.	AM	225	0	18	0	0	0	0	990	363	29	849	0	2,474
		PM	200	0	74	0	0	0	0	1,026	489	17	1,345	0	3,151
5	Kamanu St./ Hina Lani St.	AM	134	0	77	61	0	209	224	573	198	202	544	62	2,284
		PM	479	0	326	75	0	251	279	651	122	127	608	72	2,990
6	Ane Keohokalole Hwy./Hina Lani St.	AM	168	160	64	108	134	92	134	313	70	189	550	123	2,105
		PM	86	151	282	143	180	140	106	700	178	180	434	127	2,707
7	Mamalahoa Hwy./ Hina Lani St.	AM	273	378	0	0	1,307	382	208	0	211	0	0	0	2,759
		PM	231	740	0	0	552	328	512	0	389	0	0	0	2,752
8	Queen Kaahumanu Hwy./Kealakehe Pkwy.	AM	68	1,464	530	240	1,231	48	17	7	24	348	18	166	4,161
		PM	60	1,691	356	143	2,032	44	59	19	71	516	20	192	5,203

Table 12 - 2035 Without Project Conditions Peak Hour Intersection Volumes

Int.	Intersection Name	Peak Hr.	Northbound			Southbound			Eastbound			Westbound			Total
			NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	
1	Queen Kaahumanu Hwy./Kaiminani Dr.	AM	0	941	109	188	766	0	0	0	0	480	0	310	2,794
		PM	0	1,038	387	363	1,131	0	0	0	0	180	0	303	3,402
2	Queen Kaahumanu Hwy./Hulikoa Dr.	AM	0	953	299	0	1,268	0	0	0	0	0	0	247	2,767
		PM	0	1,242	174	0	1,621	0	0	0	0	0	0	274	3,311
3	Queen Kaahumanu Hwy./Hina Lani St.	AM	0	862	433	308	1,041	0	0	0	0	275	0	231	3,150
		PM	0	1,088	594	312	1,216	0	0	0	0	544	0	333	4,087
4	Kanalani St./ Hina Lani St.	AM	225	0	18	0	0	0	0	249	363	29	301	0	1,185
		PM	200	0	74	0	0	0	0	297	489	17	589	0	1,666
5	Kamanu St./ Hina Lani St.	AM	121	0	81	0	0	0	0	121	133	224	218	0	898
		PM	415	0	347	0	0	0	0	218	105	133	167	0	1,385
6	Ane Keohokalole Hwy./Hina Lani St.	AM	129	121	141	9	334	65	13	155	26	420	411	25	1,849
		PM	34	266	398	29	184	17	64	532	127	257	252	17	2,177
7	Mamalahoa Hwy./ Hina Lani St.	AM	150	291	0	0	1,078	501	187	0	103	0	0	0	2,310
		PM	104	634	0	0	493	290	498	0	246	0	0	0	2,265
8	Queen Kaahumanu Hwy./Kealakehe Pkwy.	AM	68	1,201	441	199	969	48	17	7	24	270	18	152	3,414
		PM	60	1,397	264	98	1,717	44	59	19	71	412	20	123	4,284

Table 13 - 2035 With Project Phase 2 Conditions Peak Hour Intersection Volumes

Int.	Intersection Name	Peak Hr.	Northbound			Southbound			Eastbound			Westbound			Total
			NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	
1	Queen Kaahumanu Hwy./Kaiminani Dr.	AM	0	1,261	109	361	1,042	0	0	0	0	480	0	510	3,763
		PM	0	1,381	387	587	1,490	0	0	0	0	180	0	517	4,542
2	Queen Kaahumanu Hwy./Hulikoa Dr.	AM	0	1,173	353	0	1,545	0	0	0	0	0	0	347	3,418
		PM	0	1,478	261	0	1,980	0	0	0	0	0	0	381	4,100
3	Queen Kaahumanu Hwy./Hina Lani St.	AM	0	916	1,000	585	1,041	0	0	0	0	996	0	452	4,990
		PM	0	1,175	1,316	671	1,216	0	0	0	0	1,315	0	569	6,262
4	Kanalani St./ Hina Lani St.	AM	225	0	18	0	0	0	0	1,093	363	29	1,242	0	2,970
		PM	200	0	74	0	0	0	0	1,378	489	17	1,597	0	3,755
5	Kamanu St./ Hina Lani St.	AM	121	0	81	108	0	451	377	588	133	224	709	112	2,904
		PM	415	0	347	129	0	471	501	798	105	133	704	120	3,723
6	Ane Keohokalole Hwy./Hina Lani St.	AM	203	323	158	200	540	214	168	394	114	467	664	205	3,650
		PM	130	498	452	244	424	199	234	829	218	291	542	232	4,293
7	Mamalahoa Hwy./ Hina Lani St.	AM	340	291	0	0	1,078	674	388	0	324	0	0	0	3,095
		PM	352	634	0	0	493	515	712	0	482	0	0	0	3,188
8	Queen Kaahumanu Hwy./Kealakehe Pkwy.	AM	68	1,822	579	199	1,691	48	17	7	24	430	18	152	5,055
		PM	60	2,206	444	98	2,489	44	59	19	71	583	20	123	6,216

Table 14 - 2045 Without Project Conditions Peak Hour Intersection Volumes

Int.	Intersection Name	Peak Hr.	Northbound			Southbound			Eastbound			Westbound			Total
			NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	
1	Queen Kaahumanu Hwy./Kaiminani Dr.	AM	0	1,104	109	188	875	0	0	0	0	480	0	310	3,066
		PM	0	1,183	387	363	1,312	0	0	0	0	180	0	303	3,728
2	Queen Kaahumanu Hwy./Hulikoa Dr.	AM	0	1,116	299	0	1,377	0	0	0	0	0	0	247	3,039
		PM	0	1,387	174	0	1,802	0	0	0	0	0	0	274	3,637
3	Queen Kaahumanu Hwy./Hina Lani St.	AM	0	1,025	433	308	1,150	0	0	0	0	275	0	231	3,422
		PM	0	1,233	594	312	1,397	0	0	0	0	544	0	333	4,413
4	Kanalani St./ Hina Lani St.	AM	225	0	18	0	0	0	0	249	363	29	301	0	1,185
		PM	200	0	74	0	0	0	0	297	489	17	589	0	1,666
5	Kamanu St./ Hina Lani St.	AM	121	0	81	0	0	0	0	121	133	224	218	0	898
		PM	415	0	347	0	0	0	0	218	105	133	167	0	1,385
6	Ane Keohokalole Hwy./Hina Lani St.	AM	129	144	156	9	388	65	13	155	26	464	411	25	1,985
		PM	34	294	419	29	207	17	64	532	127	272	252	17	2,264
7	Mamalahoa Hwy./ Hina Lani St.	AM	150	342	0	0	1,269	545	202	0	103	0	0	0	2,611
		PM	104	739	0	0	578	305	519	0	246	0	0	0	2,491
8	Queen Kaahumanu Hwy./Kealakehe Pkwy.	AM	68	1,364	441	199	1,078	48	17	7	24	270	18	152	3,686
		PM	60	1,542	264	98	1,898	44	59	19	71	412	20	123	4,610

Table 15 - 2045 With Project Phase 3 Conditions Peak Hour Intersection Volumes

Int.	Intersection Name	Peak Hr.	Northbound			Southbound			Eastbound			Westbound			Total
			NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	
1	Queen Kaahumanu Hwy./Kaiminani Dr.	AM	0	1,549	109	412	1,232	0	0	0	0	480	0	588	4,370
		PM	0	1,626	387	669	1,802	0	0	0	0	180	0	580	5,244
2	Queen Kaahumanu Hwy./Hulikoa Dr.	AM	0	1,433	363	0	1,735	0	0	0	0	0	0	375	3,906
		PM	0	1,701	269	0	2,292	0	0	0	0	0	0	404	4,666
3	Queen Kaahumanu Hwy./Hina Lani St.	AM	0	1,089	1,174	666	1,150	0	0	0	0	1,277	0	548	5,904
		PM	0	1,328	1,602	802	1,397	0	0	0	0	1,542	0	647	7,318
4	Kanalani St./ Hina Lani St.	AM	225	0	18	0	0	0	0	1,348	363	29	1,620	0	3,603
		PM	200	0	74	0	0	0	0	1,795	489	17	1,900	0	4,475
5	Kamanu St./ Hina Lani St.	AM	121	0	81	113	0	466	447	774	133	224	1,072	138	3,569
		PM	415	0	347	153	0	534	519	1,197	105	133	944	127	4,474
6	Ane Keohokalole Hwy./Hina Lani St.	AM	220	374	235	216	611	243	186	543	127	604	919	248	4,526
		PM	145	549	570	286	477	227	270	1,106	237	380	710	252	5,209
7	Mamalahoa Hwy./ Hina Lani St.	AM	396	342	0	0	1,269	769	481	0	410	0	0	0	3,667
		PM	442	739	0	0	578	611	796	0	551	0	0	0	3,717
8	Queen Kaahumanu Hwy./Kealakehe Pkwy.	AM	68	2,169	620	199	2,081	48	17	7	24	492	18	152	5,895
		PM	60	2,645	509	98	2,896	44	59	19	71	634	20	123	7,178

5. 2025 Without Project Traffic Conditions

5.1 Future Traffic Volumes for 2025 Without Project Conditions

Future AM and PM peak hour intersection traffic volumes for 2025 Without Project Conditions are shown in Figures 31 and 32. The future traffic forecast is estimated based on the methodologies are presented in Section 4.

5.2 Future Planned Improvements

For 2025 Without Project Conditions, there are some planned improvements that will implemented in the future which include the widening of Queen Kaahumanu Highway and the new construction of a Mid-Level Road (Ane Keohokalole Highway) that will run in a north-south direction between Queen Kaahumanu Highway and Mamalahoa Highway.

Queen Kaahumanu Highway is currently a two-lane roadway, and it is anticipated to be widening to a four-lane roadway prior to Year 2025. The planned roadway widening along Queen Kaahumanu Highway will provide additional northbound and southbound travel lane improvements to the following study area intersections:

Queen Kaahumanu Highway at Kaiminani Drive (#1)

- Add a Second Northbound Through Lane
- Add a Second Southbound Through Lane

Queen Kaahumanu Highway at Hulikoa Drive (#2)

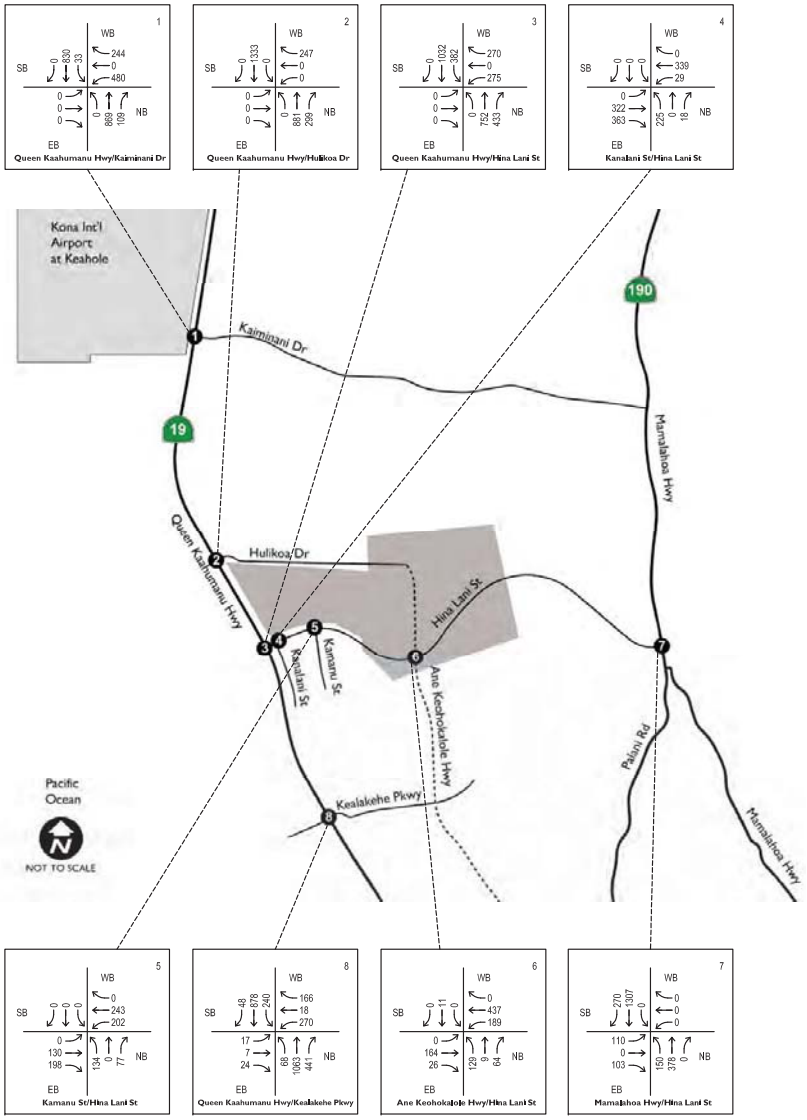
- Add a Second Northbound Through Lane
- Add a Second Southbound Through Lane
- Restrict southbound and westbound left turn movements – this intersection is anticipated to remain unsignalized

Queen Kaahumanu Highway at Hina Lani Street (#3)

- Add a Second Northbound Through Lane
- Add a Second Southbound Through Lane
- Add a Second Southbound Left-Turn Lane
- Add a second Westbound Left-Turn Lane

Queen Kaahumanu Highway at Kealakehe Parkway (#8)

- Add a Second Northbound Through Lane
- Convert Southbound Right-Turn Lane to a shared (Second) Through/Right-Turn Lane



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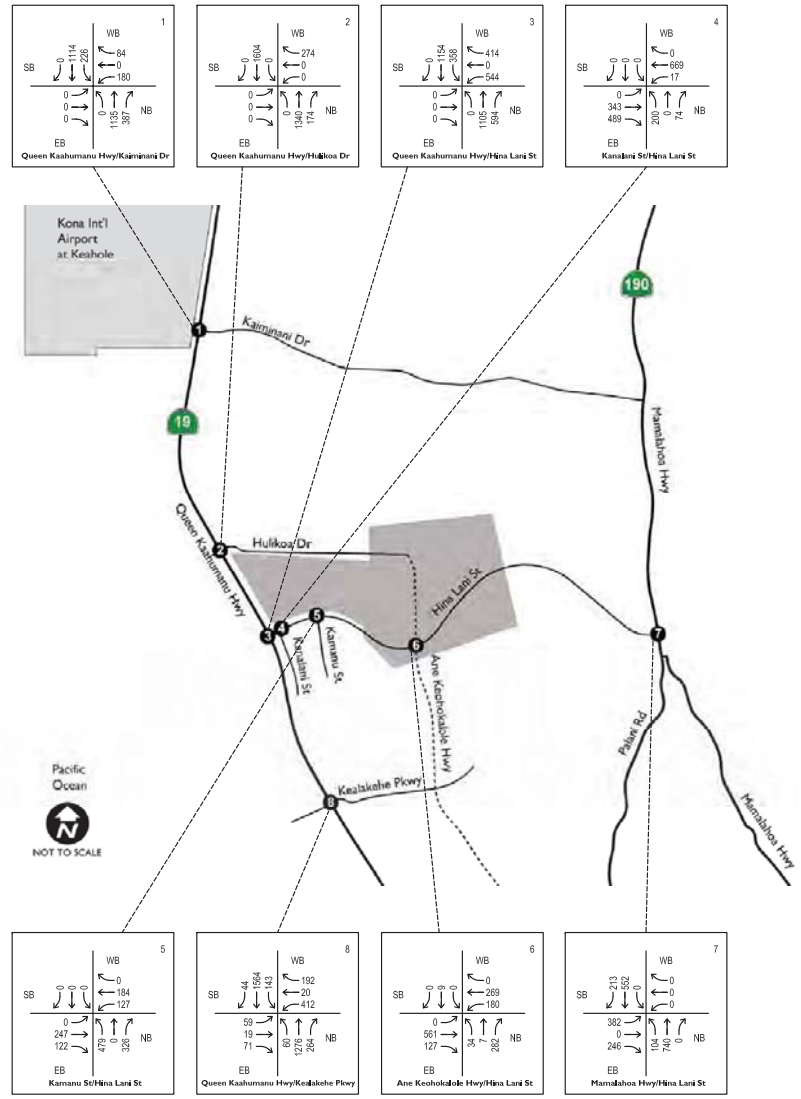
Kaloko Makai Project — Figure 31

Kona, Hawaii — 2025 Without Project AM Peak Hour Intersection Turning Movement Volumes



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KOA CORPORATION PLANNING & ENGINEERING

Kaloko Makai Project — Figure 32

Kona, Hawaii — 2025 Without Project PM Peak Hour Intersection Turning Movement Volumes

The future Ane Keohokalole Highway will be a two-lane Mid-Level Road that is planned to be constructed in a north-south direction between Queen Kaahumanu Highway and Mamalahoa Highway. By the first horizon year of this traffic study (Year 2025), Ane Keohokalole Highway is anticipated to be completed between Hulikoa Drive and Palani Road to the south. As of June 2012, Ane Keohokalole Highway has been completed between Hina Lani Street and Kealakehe Parkway. The northerly extension of Ane Keohokalole Highway to Kaiminani Drive will be completed by 2028 (or near the beginning of Project Phase 2). The completion of Ane Keohokalole Highway will serve as a parallel corridor to relief traffic congestion on Queen Kaahumanu Highway and Mamalahoa Highway. The planned Mid-Level Road will provide lane improvements to the following study area intersection:

Ane Keohokalole Highway at Hina Lani Street (#6)

- Ane Keohokalole Highway will be constructed as a new Mid-Level Road, and it will run in a generally north-south direction through the project site.
- Construct new intersection: Provide Left-Turn, Through, and Right-Turn for all approaches
- Install a new traffic signal

By 2025, there are additional planned improvements to the study area intersections that will be implemented by other surrounding developments to accommodate the overall traffic growth due to background ambient growth and new cumulative developments. The following planned intersection improvements are anticipated:

Kamanu Street at Hina Lani Street (#5)

- Install a New Traffic Signal
- Add a Second Northbound Left-Turn Lane

5.3 Level of Service Analysis for 2025 Without Project Conditions

Synchro software was used to conduct intersection level of service analysis. Table 16 summarizes the results for the 2025 Without Project Conditions intersection level of service analysis, with existing geometry and planned improvements. As shown in Table 16, the following study area intersection is projected to operate at Level of Service "E" or worse for 2025 Without Project Conditions during the peak hours, with existing lane geometry and planned improvements:

- Queen Kaahumanu Highway at Hulikoa Drive (#2)

Appendix J contains the analysis worksheets for 2025 Without Project Conditions, with existing geometry and planned improvements.

Table 16 - 2025 Without Project Conditions
Intersection Level of Service Analysis Summary

No.	Intersection	Peak Hour	WITHOUT PROJECT				WITHOUT PROJECT PLUS MITIGATION			
			Delay (Sec)	V/C	LOS	Cum. Impact	Delay (Sec)	V/C	LOS	Cum. Impact
1	Queen Kaahumanu Hwy at Kaiminani Dr	AM	14.0	0.79	B	NO	14.0	0.79	B	NO
		PM	9.7	0.68	A	NO	9.7	0.68	A	NO
2	Queen Kaahumanu Hwy at Hulikoa Dr	AM	18.4	0.50	C	NO	0.1	0.01	A	NO
		PM	46.2	0.81	E	YES	0.1	0.01	A	NO
3	Queen Kaahumanu Hwy at Hina Lani St	AM	10.6	0.59	B	NO	10.6	0.59	B	NO
		PM	14.8	0.79	B	NO	14.8	0.79	B	NO
4	Kanalani St at Hina Lani St	AM	24.2	0.59	C	NO	24.2	0.59	C	NO
		PM	29.2	0.67	D	NO	29.2	0.67	D	NO
5	Kamanu St at Hina Lani St	AM	4.1	0.30	A	NO	4.1	0.30	A	NO
		PM	4.6	0.46	A	NO	4.6	0.46	A	NO
6	Ane Keohokalole Hwy at Hina Lani St	AM	9.3	0.47	A	NO	9.3	0.47	A	NO
		PM	15.4	0.65	B	NO	15.4	0.65	B	NO
7	Mamalahoa Hwy at Hina Lani St	AM	40.7	0.98	D	NO	40.7	0.98	D	NO
		PM	15.9	0.79	B	NO	15.9	0.79	B	NO
8	Queen Kaahumanu Hwy at Kealakehe Pkwy	AM	17.5	0.79	B	NO	17.5	0.79	B	NO
		PM	43.3	1.00	D	NO	43.3	1.00	D	NO

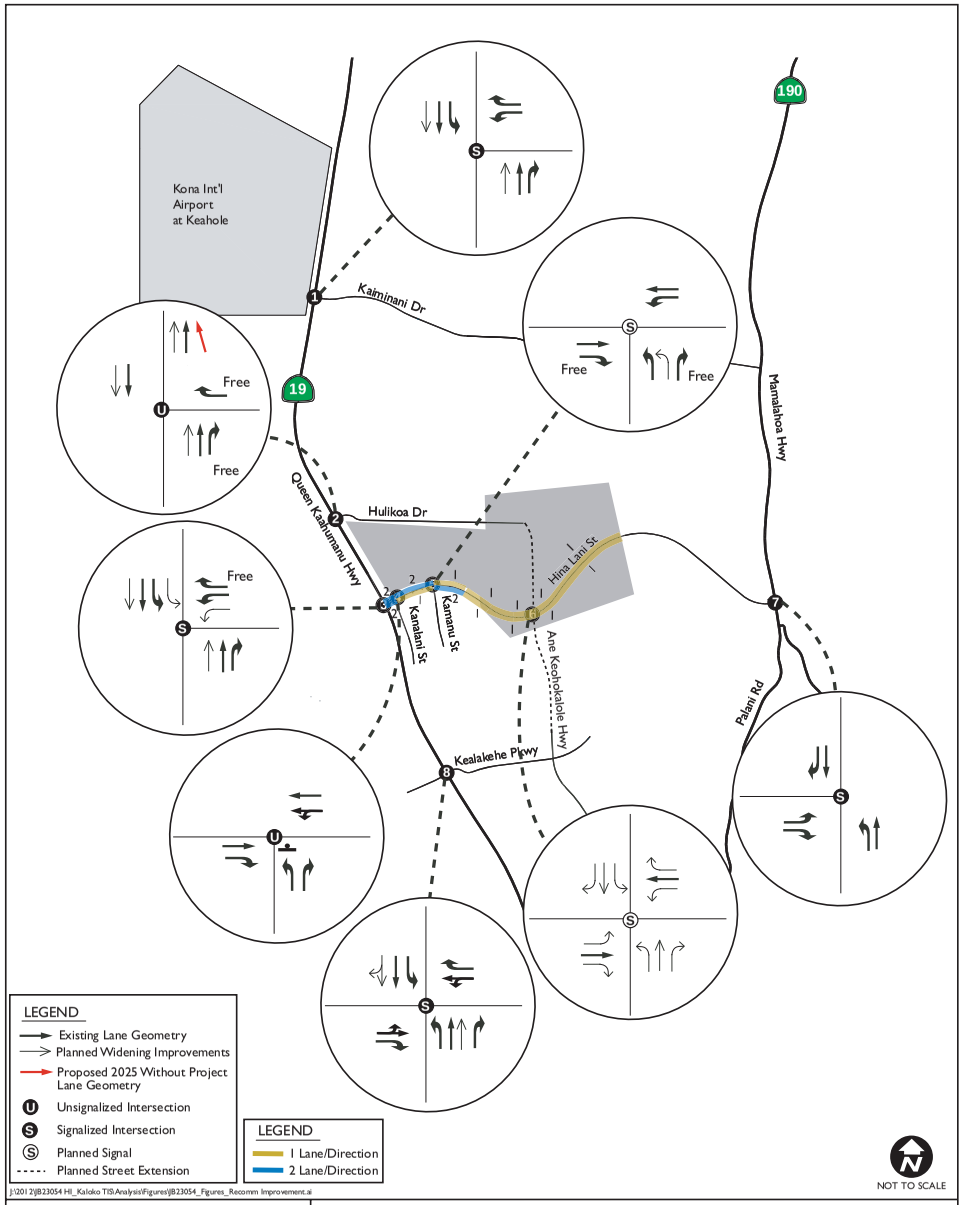
5.4 Recommended Improvements for Year 2025 Without Project Conditions

Figure 33 shows the recommended roadway network and intersection lane geometry for 2025 Without Project Conditions to mitigate the traffic impact. In addition to the planned improvements that are mentioned in Section 5.2, the following additional improvement is recommended to accommodate 2025 Without Project Conditions:

Queen Kaahumanu Highway at Hulikoa Drive (#2)

- Retain westbound free-right turn lane along with the roadway widening on Queen Kaahumanu Highway

With recommended 2025 Without Project intersection lane improvements, the study area intersections are projected to be mitigated to Level of Service "D" or better during the peak hours. The intersection operations analysis worksheets for 2025 Without Project Conditions, with recommended mitigation measures, are included in Appendix K of this report.



KOA CORPORATION PLANNING & ENGINEERING | Kaloko Makai Project | Figure 33
Kona, Hawaii | Recommended 2025 Without Project Lane Geometry

6. 2035 Without Project Traffic Conditions

6.1 Future Traffic Volumes for 2035 Without Project Conditions

Future AM and PM peak hour intersection traffic volumes for 2035 Without Project Conditions are shown in Figures 34 and 35. The future traffic forecast is estimated based on the methodologies are presented in Section 4.

6.2 Future Planned Improvements

It should be noted that the 2035 Without Project Conditions have the same planned improvements as the 2025 Without Project Conditions which were listed in previous Section 5.2 of this report. The planned improvements include the widening of Queen Kaahumanu Highway and the new construction of a Mid-Level Road (Ane Keohokalole Highway) that will run in a north-south direction between Queen Kaahumanu Highway and Mamalahoa Highway.

6.3 Level of Service Analysis for 2035 Without Project Conditions

Table 17 summarizes the results for the 2035 Without Project Conditions intersection level of service analysis, with existing geometry and planned improvements. As shown in Table 17, the following study area intersection is projected to operate at Level of Service "E" or worse for 2035 Without Project Conditions during the peak hours, with existing lane geometry and planned improvements:

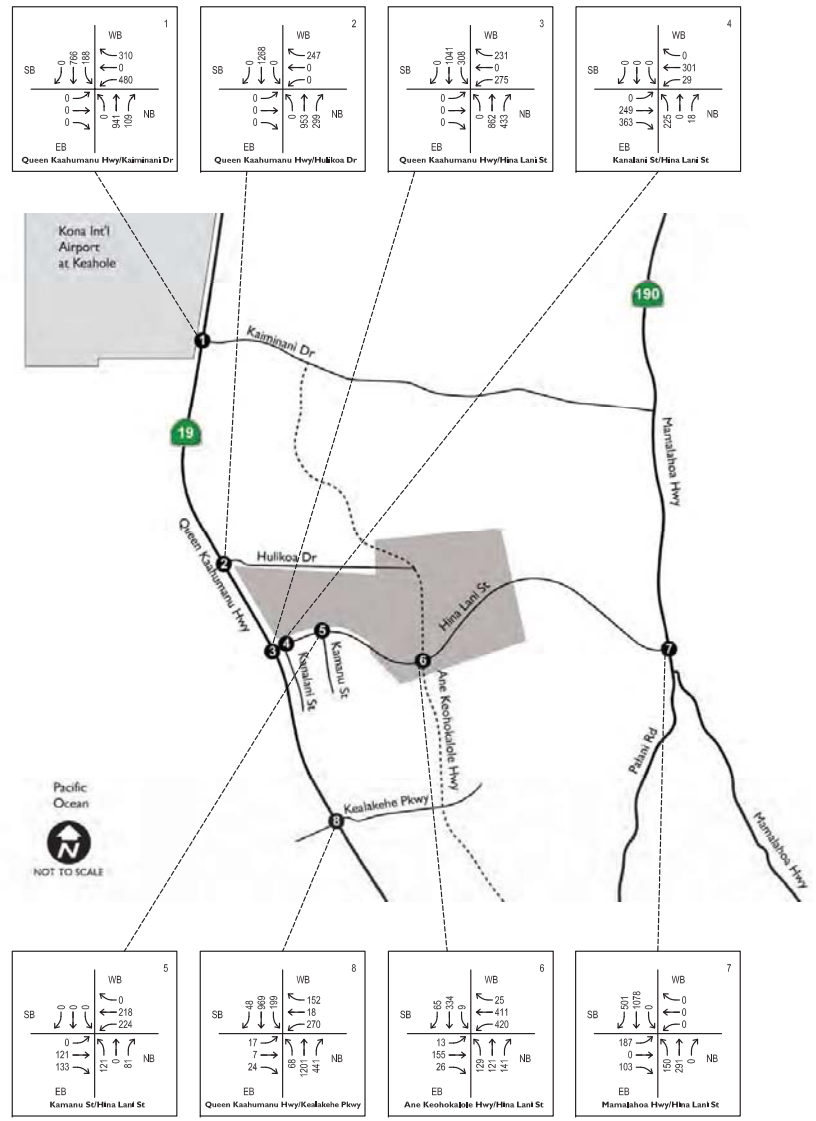
- Queen Kaahumanu Highway at Hulikoa Drive (#2)

Appendix L contains the analysis worksheets for 2035 Without Project Conditions, with existing geometry and planned improvements.

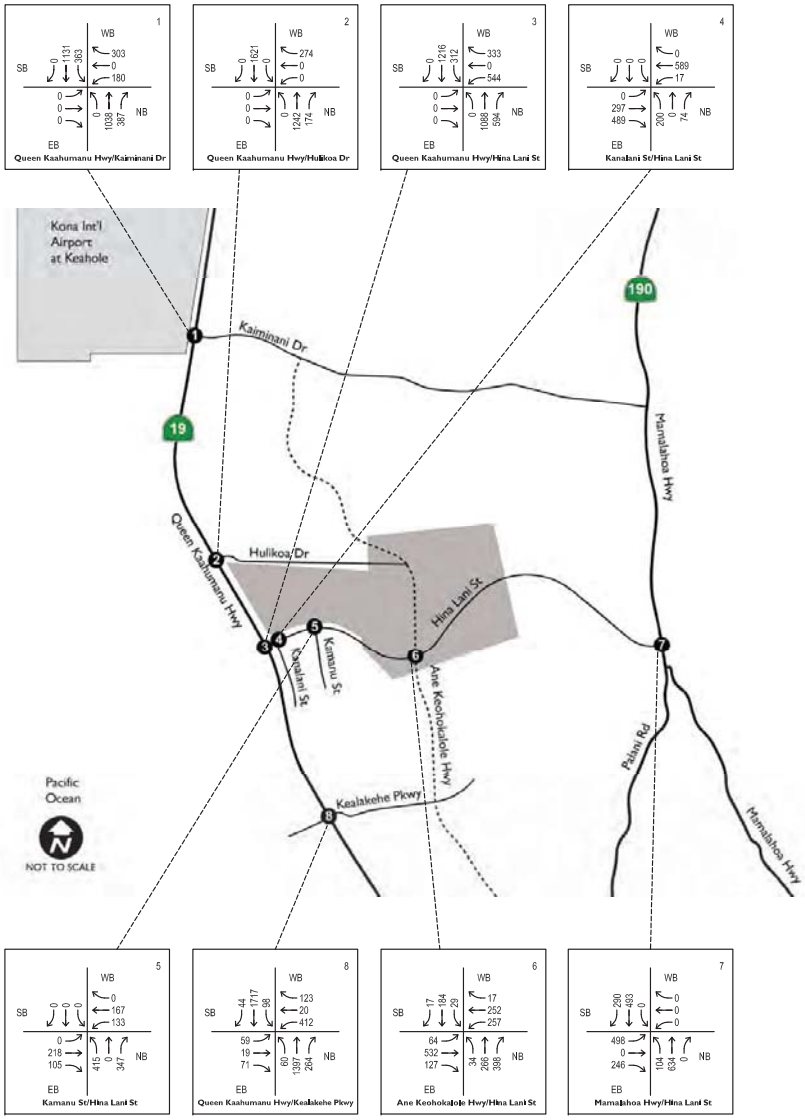
6.4 Recommended Improvements for Year 2035 Without Project Conditions

Figure 36 shows the recommended roadway network and intersection lane geometry for 2035 Without Project Conditions to mitigate the traffic impact. The recommended lane improvements for 2035 Without Project Conditions are same as the ones previously listed in Section 5.4 and shown in Figure 35 for 2025 Without Project Conditions.

With recommended 2035 Without Project intersection lane improvements, the study area intersections are projected to be mitigated to Level of Service "D" or better during the peak hours. The intersection operations analysis worksheets for 2035 Without Project Conditions, with recommended mitigation measures, are included in Appendix M of this report.



KOA CORPORATION PLANNING & ENGINEERING
Kaloko Makai Project — Figure 34
Kona, Hawaii — 2035 Without Project AM Peak Hour Intersection Turning Movement Volumes



Kaloko Makai Project — Figure 35

Kona, Hawaii — 2035 Without Project PM Peak Hour Intersection Turning Movement Volumes

Table 17 - 2035 Without Project Conditions
Intersection Level of Service Analysis Summary

No.	Intersection	Peak Hour	WITHOUT PROJECT				WITHOUT PROJECT PLUS MITIGATION			
			Delay (Sec)	V/C	LOS	Cum. Impact	Delay (Sec)	V/C	LOS	Cum. Impact
1	Queen Kaahumanu Hwy at Kaiminani Dr	AM	17.1	0.77	B	NO	17.1	0.77	B	NO
		PM	14.5	0.73	B	NO	14.5	0.73	B	NO
2	Queen Kaahumanu Hwy at Hulikoa Dr	AM	20.1	0.53	C	NO	0.1	0.01	A	NO
		PM	36.9	0.75	E	YES	0.1	0.01	A	NO
3	Queen Kaahumanu Hwy at Hina Lani St	AM	10.6	0.59	B	NO	10.6	0.59	B	NO
		PM	14.2	0.77	B	NO	14.2	0.77	B	NO
4	Kanalani St at Hina Lani St	AM	19.2	0.51	C	NO	19.2	0.51	C	NO
		PM	22.8	0.58	C	NO	22.8	0.58	C	NO
5	Kamanu St at Hina Lani St	AM	3.7	0.42	A	NO	3.7	0.42	A	NO
		PM	4.3	0.4	A	NO	4.3	0.4	A	NO
6	Ane Keohokalole Hwy at Hina Lani St	AM	25.9	0.71	C	NO	25.9	0.71	C	NO
		PM	22.6	0.79	C	NO	22.6	0.79	C	NO
7	Mamalahoa Hwy at Hina Lani St	AM	26.7	0.92	C	NO	26.7	0.92	C	NO
		PM	18.2	0.8	B	NO	18.2	0.8	B	NO
8	Queen Kaahumanu Hwy at Kealakehe Pkwy	AM	17.8	0.92	B	NO	17.8	0.92	B	NO
		PM	50.4	1.04	D	NO	50.4	1.04	D	NO

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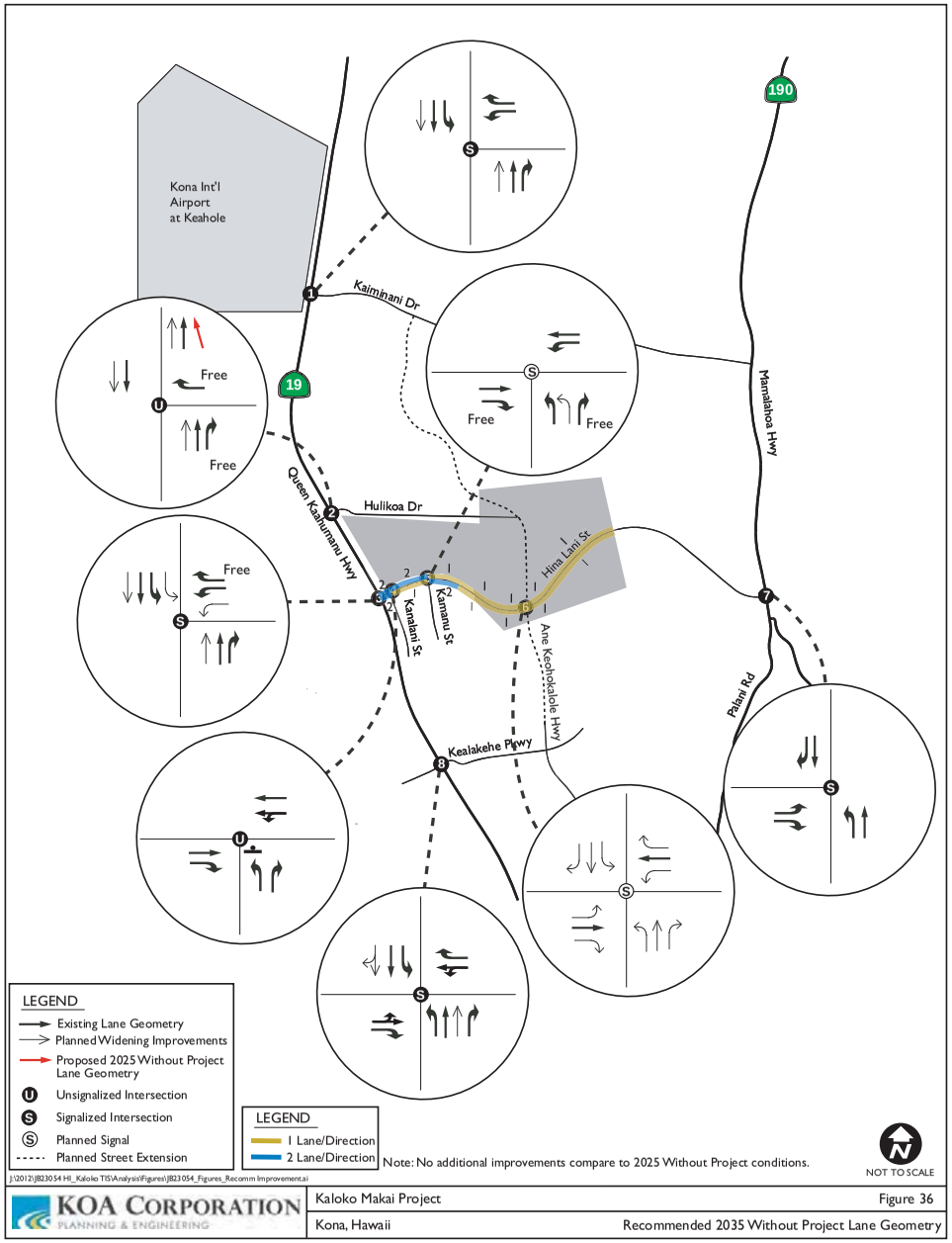
Kona, HI / Kaloko Makai
Traffic Impact Study



7. 2045 Without Project Traffic Conditions

7.1 Future Traffic Volumes for 2045 Without Project Conditions

Future AM and PM peak hour intersection traffic volumes for 2045 Without Project Conditions are shown in Figures 37 and 38. The future traffic forecast is estimated based on the methodologies are presented in Section 4.

7.2 Future Planned Improvements

It should be noted that the 2045 Without Project Conditions have the same planned improvements as the 2025 Without Project Conditions which were listed in previous Section 5.2 of this report.

7.3 Level of Service Analysis for 2045 Without Project Conditions

Table 18 summarizes the results for the 2045 Without Project Conditions intersection level of service analysis, with existing geometry and planned improvements. As shown in Table 18, the following study area intersections are projected to operate at Level of Service "E" or worse for 2045 Without Project Conditions during the peak hours, with existing lane geometry and planned improvements:

- Queen Kaahumanu Highway at Hulikoa Drive (#2)
- Queen Kaahumanu Highway at Kealakehe Parkway (#8)

Appendix N contains the analysis worksheets for 2045 Without Project Conditions, with existing geometry and planned improvements.

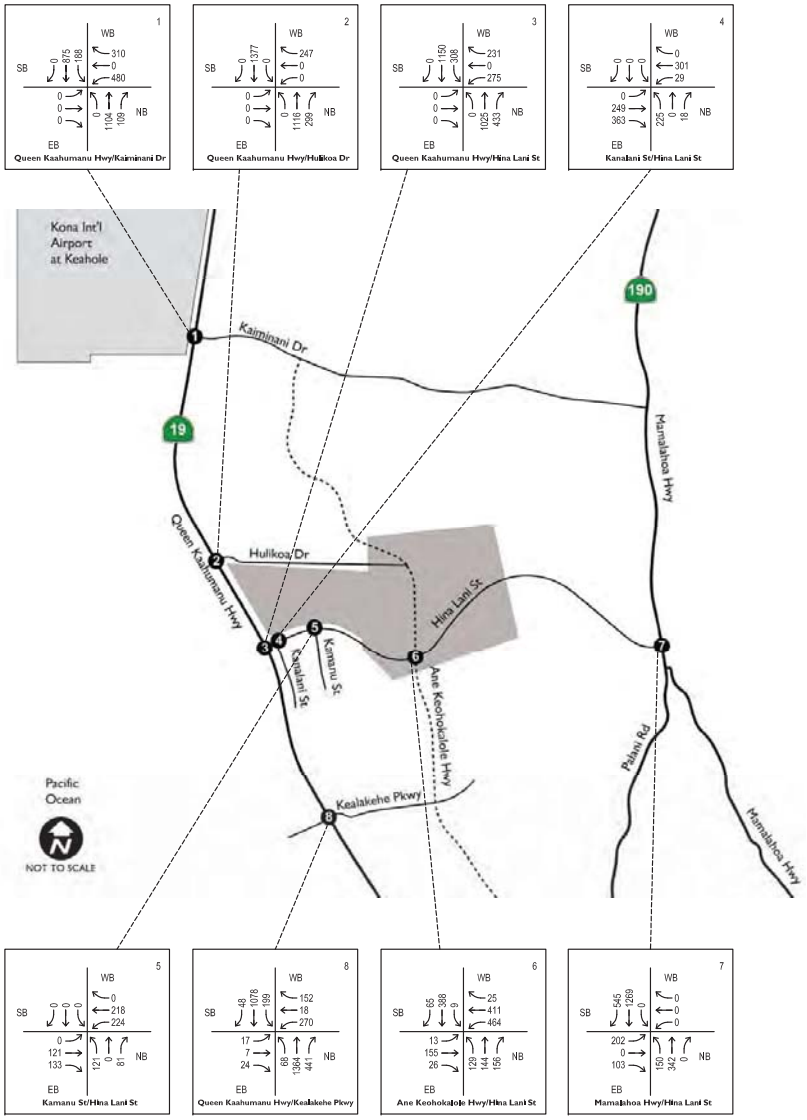
7.4 Recommended Improvements for Year 2045 Without Project Conditions

Figure 39 shows the recommended roadway network and intersection lane geometry for 2045 Without Project Conditions to mitigate the traffic impact. In addition to the recommended 2025 Without Project improvements previously listed in Section 5.4, the following additional improvement is recommended to accommodate 2045 Without Project Conditions:

Queen Kaahumanu Highway at Kealakehe Parkway (#8)

- Add a second Westbound Left-Turn Lane

With recommended 2045 Without Project intersection lane improvements, the study area intersections are projected to be mitigated to Level of Service "D" or better during the peak hours. The intersection operations analysis worksheets for 2045 Without Project Conditions, with recommended mitigation measures, are included in Appendix O of this report.



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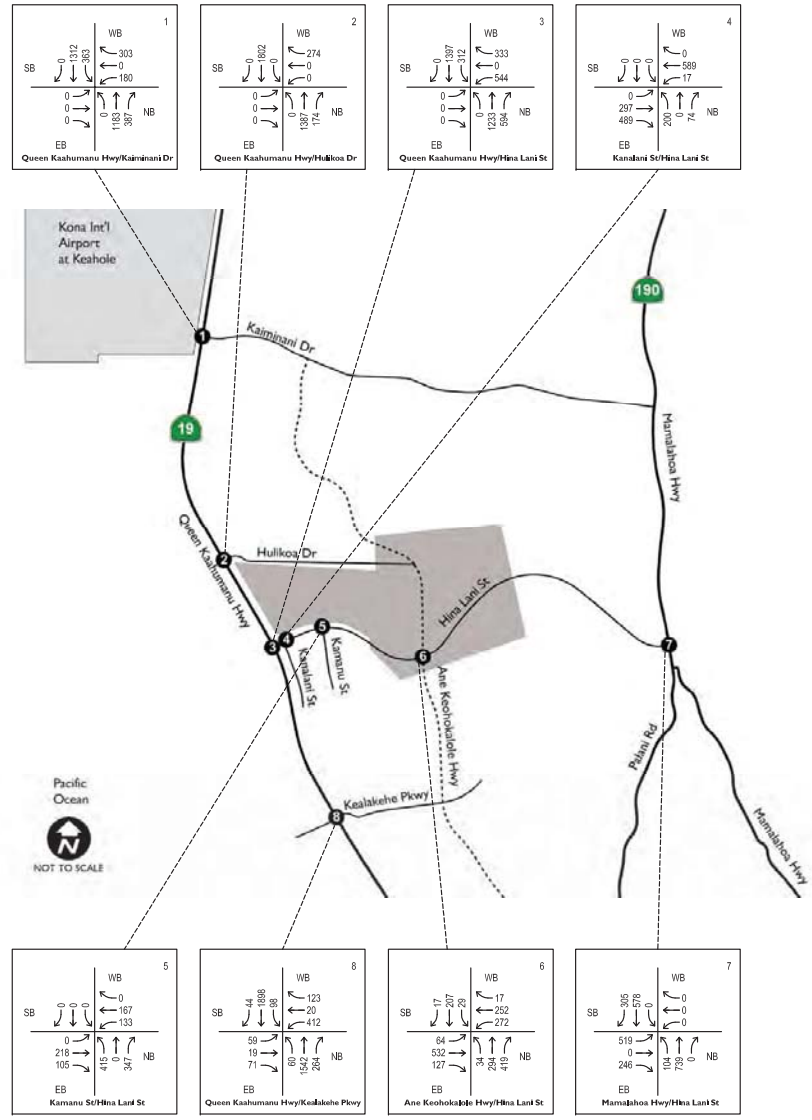
KOA CORPORATION
PLANNING & ENGINEERING

Kaloko Makai Project — Figure 37

Kona, Hawaii — 2045 Without Project AM Peak Hour Intersection Turning Movement Volumes



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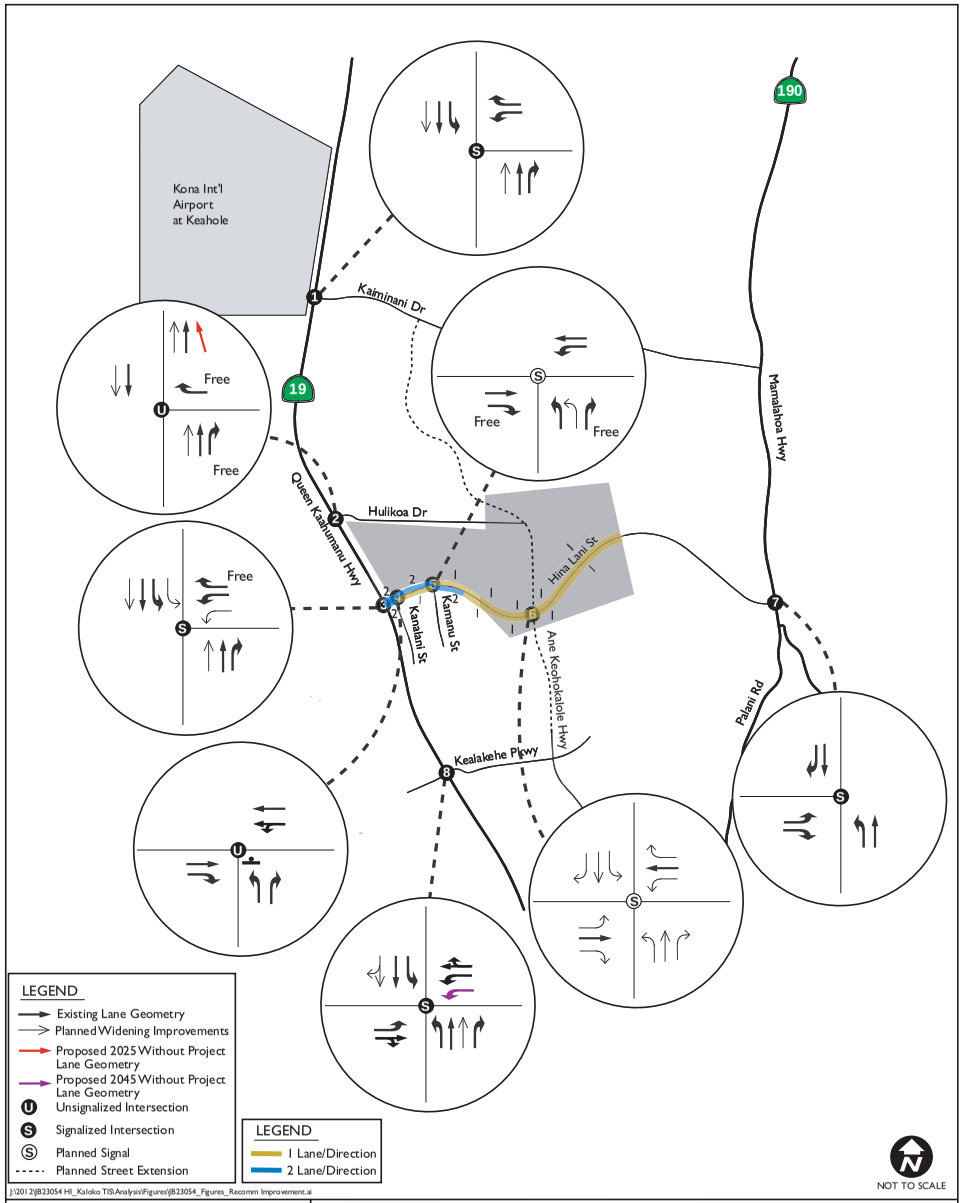
Kaloko Makai Project — Figure 38

Kona, Hawaii — 2045 Without Project PM Peak Hour Intersection Turning Movement Volumes

Table 18 - 2045 Without Project Conditions
Intersection Level of Service Analysis Summary

No.	Intersection	Peak Hour	WITHOUT PROJECT				WITHOUT PROJECT PLUS MITIGATION			
			Delay (Sec)	V/C	LOS	Cum. Impact	Delay (Sec)	V/C	LOS	Cum. Impact
1	Queen Kaahumanu Hwy at Kaiminani Dr	AM	20.0	0.87	C	NO	20.0	0.87	C	NO
		PM	15.9	0.76	B	NO	15.9	0.76	B	NO
2	Queen Kaahumanu Hwy at Hulikoa Dr	AM	25.2	0.61	D	NO	0.1	0.01	A	NO
		PM	52.1	0.85	F	YES	0.1	0.01	A	NO
3	Queen Kaahumanu Hwy at Hina Lani St	AM	11.1	0.65	B	NO	11.1	0.65	B	NO
		PM	15.7	0.82	B	NO	15.7	0.82	B	NO
4	Kanalani St at Hina Lani St	AM	19.2	0.51	C	NO	19.2	0.51	C	NO
		PM	22.8	0.58	C	NO	22.8	0.58	C	NO
5	Kamanu St at Hina Lani St	AM	3.7	0.42	A	NO	3.7	0.42	A	NO
		PM	4.3	0.40	A	NO	4.3	0.40	A	NO
6	Ane Keohokalole Hwy at Hina Lani St	AM	24.5	0.74	C	NO	24.5	0.74	C	NO
		PM	24.3	0.81	C	NO	24.3	0.81	C	NO
7	Mamalahoa Hwy at Hina Lani St	AM	44.8	1.01	D	NO	44.8	1.01	D	NO
		PM	22.2	0.86	C	NO	22.2	0.86	C	NO
8	Queen Kaahumanu Hwy at Kealakehe Pkwy	AM	19.7	0.90	B	NO	23.7	0.76	C	NO
		PM	63.2	1.11	E	YES	37.2	0.87	D	NO



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KOA CORPORATION PLANNING & ENGINEERING | Kaloko Makai Project | Figure 39
Kona, Hawaii | Recommended 2045 Without Project Lane Geometry

8. 2025 With Project Phase 1 Traffic Conditions

8.1 Future Traffic Volumes for 2025 With Project Phase 1 Conditions

Future AM and PM peak hour intersection traffic volumes for 2025 With Project Phase 1 Conditions are shown in Figures 40 and 41. The future traffic forecast is estimated based on the methodologies are presented in Section 4. It should be noted that in addition to the project-only traffic, the 2025 With Project Phase 1 Conditions also includes cumulative development traffic in the vicinity of the project site as well as ambient background growth to account for other unidentified projects and general population growth. The project is only one of the many contributors to the overall traffic growth.

8.2 Future Planned Improvements

It should be noted that the 2025 With Project Phase 1 Conditions have the same planned improvements as the 2025 Without Project Conditions which were listed in previous Section 5.2 of this report.

8.3 Level of Service Analysis for 2025 With Project Phase 1 Conditions

Table 19 summarizes the results for the 2025 With Project Phase 1 Conditions intersection level of service analysis, with existing geometry and planned improvements. As shown in Table 19, the following study area intersections are projected to operate at Level of Service "E" or worse for 2025 With Project Phase 1 Conditions during the peak hours, with existing lane geometry and planned improvements:

- Queen Kaahumanu Highway at Hulikoa Drive (#2)
- Kanalani Street at Hina Lani Street (#4)
- Mamalahoa Highway at Hina Lani Street (#7)
- Queen Kaahumanu Highway at Kealakehe Parkway (#8)

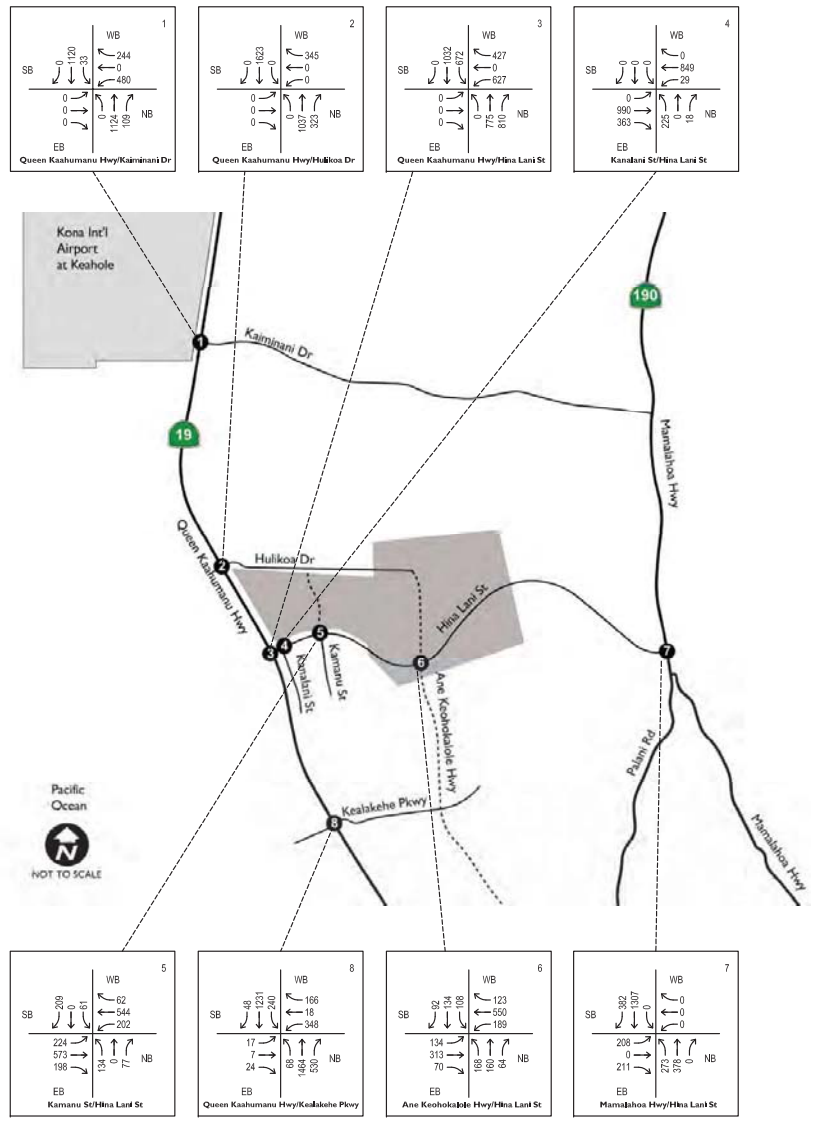
Appendix P contains the analysis worksheets for 2025 With Project Phase 1 Conditions, with existing lane geometry and planned improvements.

8.4 Recommended Improvements for Year 2025 With Project Phase 1 Conditions

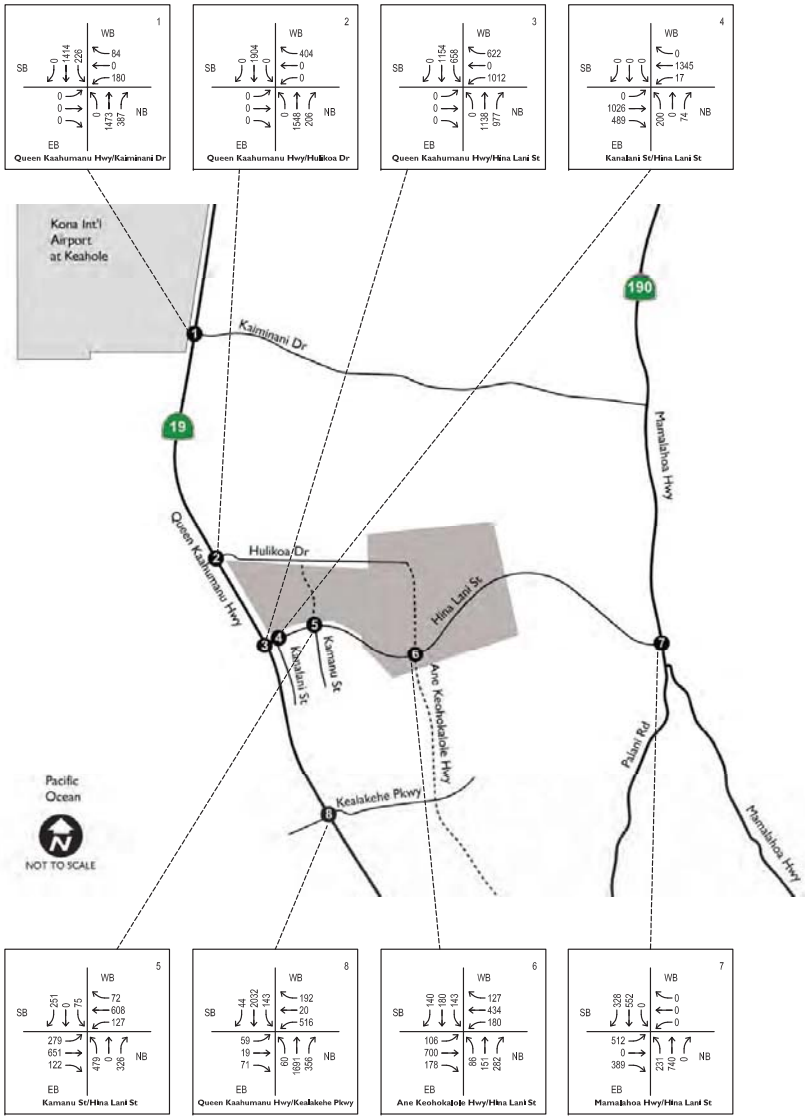
Figure 42 shows the recommended roadway network and intersection lane geometry for 2025 With Project Phase 1 Conditions to mitigate the traffic impact. In addition to the recommended 2025 Without Project improvements previously listed in Section 5.4, the following additional improvement is recommended to accommodate 2025 With Project Phase 1 Conditions:

Kanalani Street at Hina Lani Street (#4)

- Restrict Northbound Left-Turn Movement



KOA Corporation Planning & Engineering
Kaloko Makai Project — Figure 40
Kona, Hawaii — 2025 With Project Phase 1 AM Peak Hour Intersection Turning Movement Volumes



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KOA CORPORATION PLANNING & ENGINEERING

Kaloko Makai Project — Figure 41

Kona, Hawaii — 2025 With Project Phase I PM Peak Hour Intersection Turning Movement Volumes

Table 19 - 2025 With Project Phase I Conditions
Intersection Level of Service Analysis Summary

No.	Intersection	Peak Hour	WITH PROJECT				WITH PROJECT PLUS MITIGATION			
			Delay (Sec)	V / C	LOS	Project Impact	Delay (Sec)	V / C	LOS	Project Impact
1	Queen Kaahumanu Hwy at Kaiminani Dr	AM	16.7	0.87	B	NO	16.7	0.87	B	NO
		PM	12.8	0.81	B	NO	12.8	0.81	B	NO
2	Queen Kaahumanu Hwy at Hulikoa Dr	AM	36.8	0.80	E	YES	0.1	0.01	A	NO
		PM	>100	1.43	F	YES	0.1	0.01	A	NO
3	Queen Kaahumanu Hwy at Hina Lani St	AM	24.6	0.91	C	NO	24.6	0.91	C	NO
		PM	53.9	1.07	D	NO	53.9	1.07	D	NO
4	Kanalani St at Hina Lani St	AM	>100	>2	F	YES	23.5	0.09	C	NO
		PM	>100	>2	F	YES	34.3	0.40	D	NO
5	Kamanu St at Hina Lani St	AM	13.5	0.55	B	NO	32.5	0.70	C	NO
		PM	35.7	0.85	D	NO	40.8	0.78	D	NO
6	Ane Keohokalole Hwy at Hina Lani St	AM	19.0	0.7	B	NO	19.0	0.70	B	NO
		PM	21.8	0.80	C	NO	21.8	0.80	C	NO
7	Mamalahoa Hwy at Hina Lani St	AM	74.9	1.14	E	YES	47.6	1.00	D	NO
		PM	25.5	0.90	C	NO	15.1	0.78	B	NO
8	Queen Kaahumanu Hwy at Kealakehe Pkwy	AM	32.3	0.98	C	NO	29.8	0.82	C	NO
		PM	>100	1.27	F	YES	54.0	0.94	D	NO

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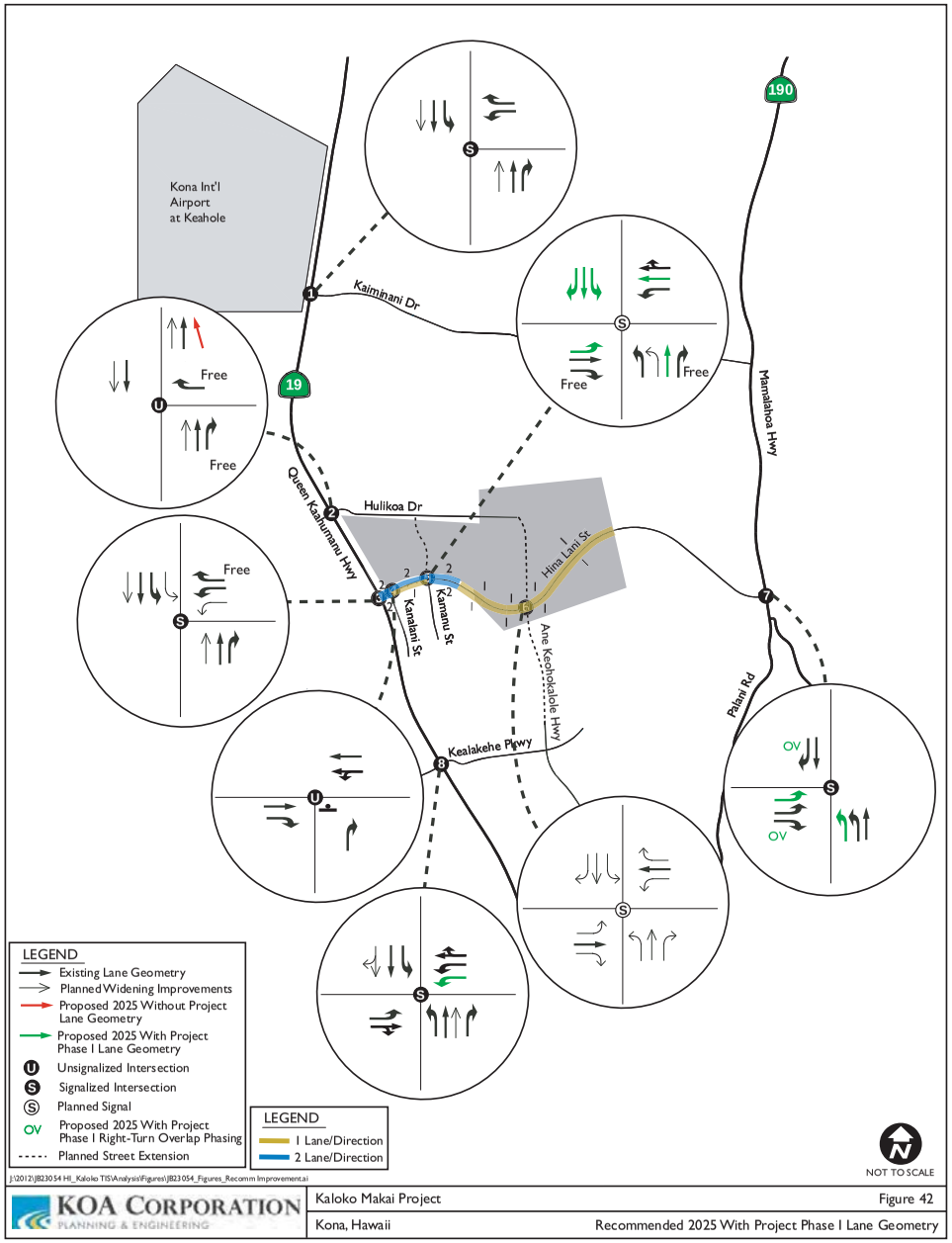
Kona, HI / Kaloko Makai
Traffic Impact Study



Kamanu Street at Hina Lani Street (#5)

- Add a Northbound Through Lane
- Add Southbound Left-Turn, Through, and Right-Turn Lanes
- Add an Eastbound Left-Turn Lane
- Add a Second Westbound Through Lane

Mamalahoa Highway at Hina Lani Street (#7)

- Add a Second Northbound Left-Turn Lane
- Provide Southbound Right-Turn Overlap Signal Phasing
- Add a Second Eastbound Left-Turn Lane
- Provide Eastbound Right-Turn Overlap Signal Phasing

Queen Kaahumanu Highway at Kealakehe Parkway (#8)

- Add a Second Westbound Left-Turn Lane

With recommended 2025 With Project Phase I intersection lane improvements, the study area intersections are projected to be mitigated to Level of Service "D" or better during the peak hours. The intersection operations analysis worksheets for 2025 With Project Phase I Conditions, with recommended mitigation measures, are included in Appendix Q of this report.

9. 2035 With Project Phase 2 Traffic Conditions

9.1 Future Traffic Volumes for 2035 With Project Phase 2 Conditions

Future AM and PM peak hour intersection traffic volumes for 2035 With Project Phase 2 Conditions are shown in Figures 43 and 44. The future traffic forecast is estimated based on the methodologies are presented in Section 4. It should be noted that in addition to the project-only traffic, the 2035 With Project Phase 2 Conditions also includes cumulative development traffic in the vicinity of the project site as well as ambient background growth to account for other unidentified projects and general population growth. The project is only one of the many contributors to the overall traffic growth.

9.2 Future Planned Improvements

It should be noted that the 2035 With Project Phase 2 Conditions have the same planned improvements as the 2025 Without Project Conditions which were listed in previous Section 5.2 of this report.

9.3 Level of Service Analysis for 2035 With Project Phase 2 Conditions

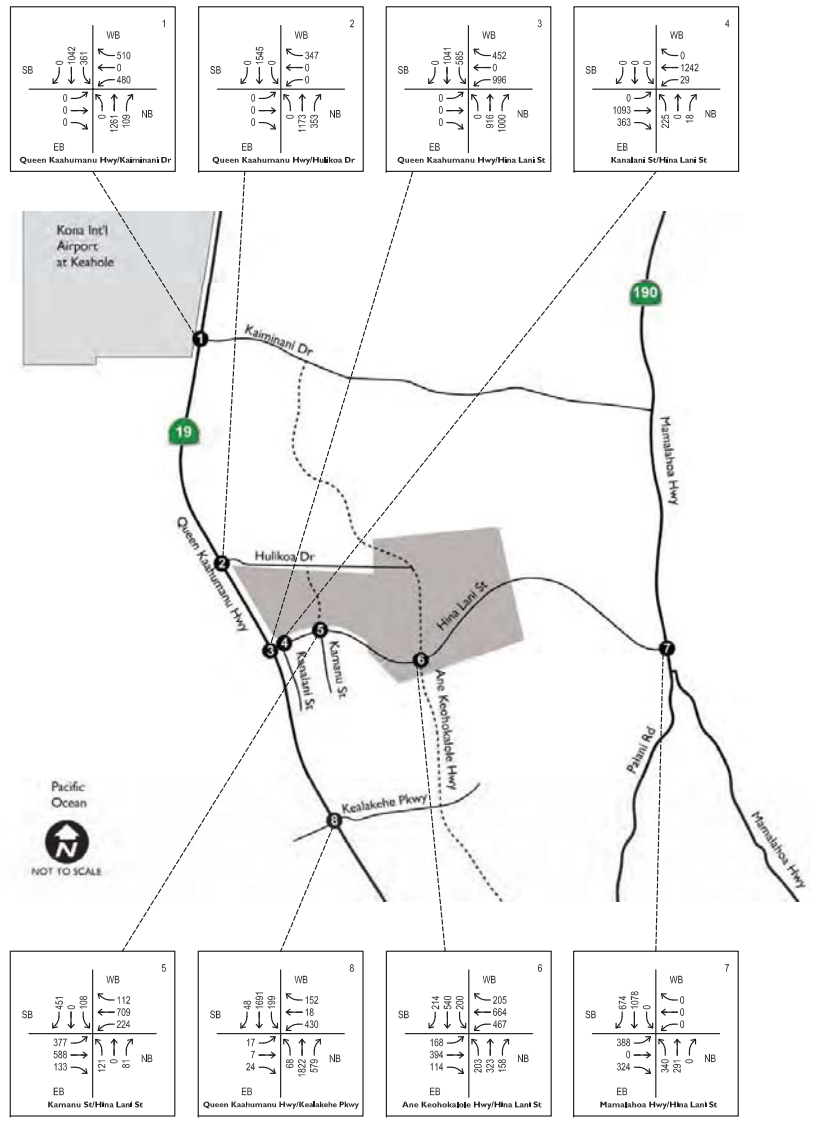
Table 20 summarizes the results for the 2035 With Project Phase 2 Conditions intersection level of service analysis, with existing geometry and planned improvements. As shown in Table 20, the following study area intersections are projected to operate at Level of Service "E" or worse for 2035 With Project Phase 2 Conditions during the peak hours, with existing lane geometry and planned improvements:

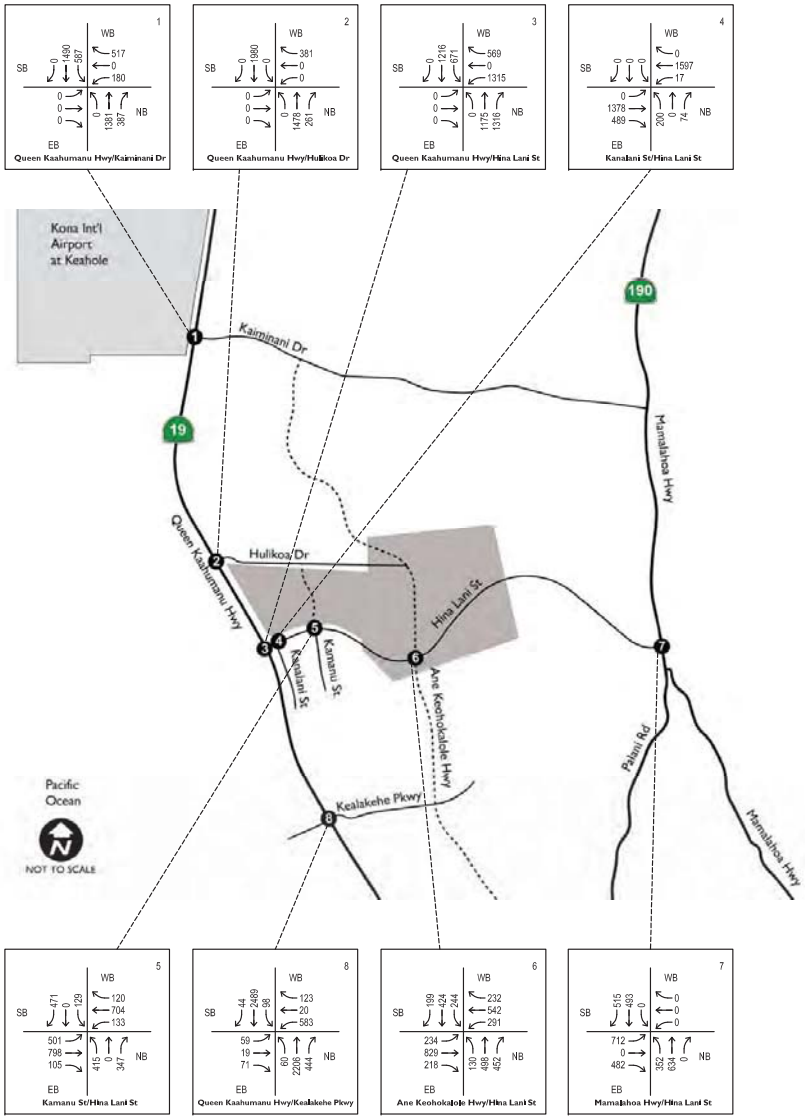
- Queen Kaahumanu Highway at Hulikoa Drive (#2)
- Queen Kaahumanu Highway at Hina Lani Street (#3)
- Kanalani Street at Hina Lani Street (#4)
- Kamanu Street at Hina Lani Street (#5)
- Ane Keohokalole Highway at Hina Lani Street (#6)
- Mamalahoa Highway at Hina Lani Street (#7)
- Queen Kaahumanu Highway at Kealakehe Parkway (#8)

Appendix R contains the analysis worksheets for 2035 With Project Phase 2 Conditions, with existing lane geometry and planned improvements.

9.4 Recommended Improvements for Year 2035 With Project Phase 2 Conditions

Figure 45 shows the recommended roadway network and intersection lane geometry for 2035 With Project Phase 2 Conditions to mitigate the traffic impact. In addition to the recommended 2025 With Project Phase 1 improvements previously listed in Section 8.4, the following additional improvements are recommended to accommodate 2035 With Project Phase 2 Conditions:





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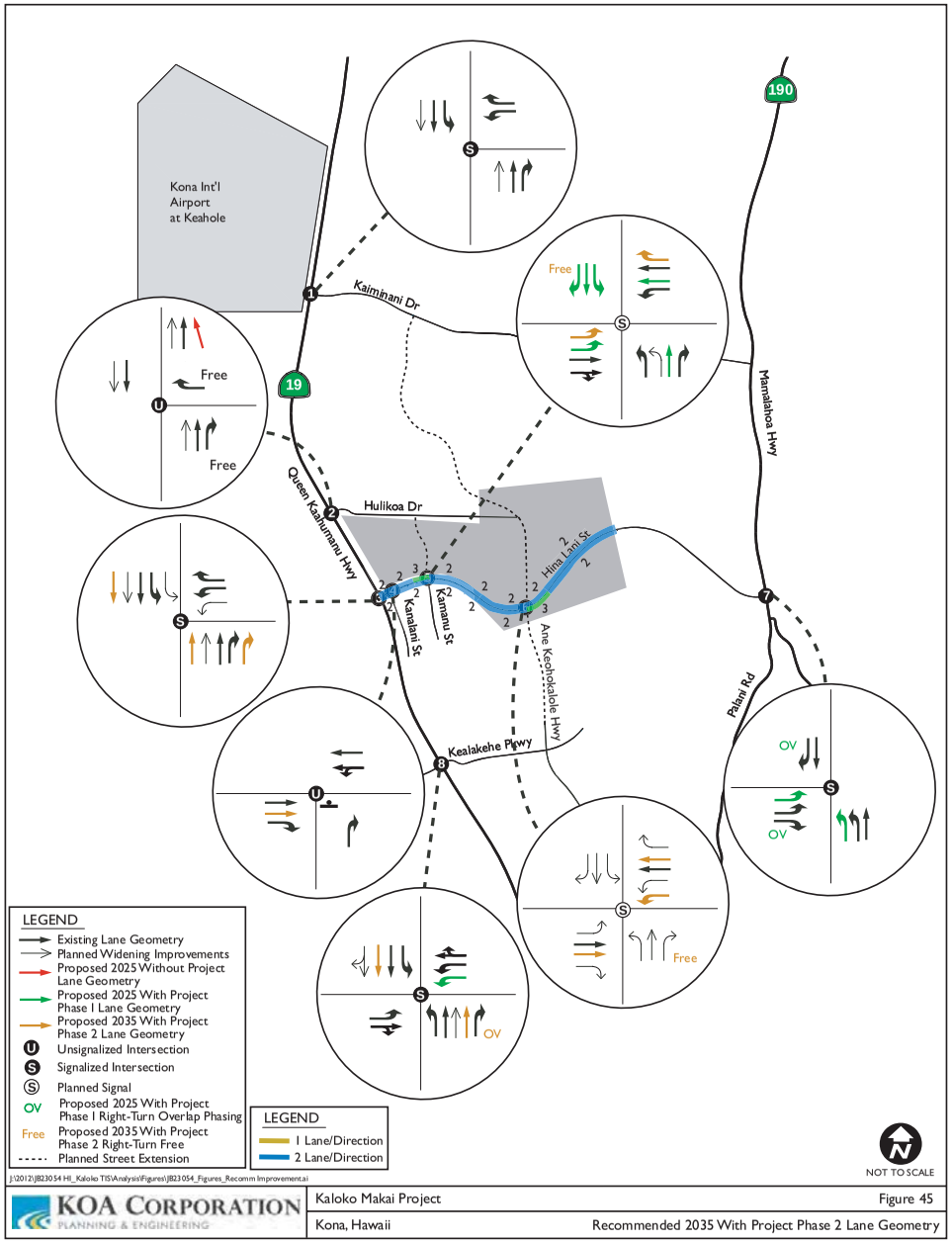
KOA CORPORATION PLANNING & ENGINEERING

Kaloko Makai Project — Figure 44

Kona, Hawaii — 2035 With Project Phase 2 PM Peak Hour Intersection Turning Movement Volumes

Table 20 - 2035 With Project Phase 2 Conditions
Intersection Level of Service Analysis Summary

No.	Intersection	Peak Hour	WITH PROJECT				WITH PROJECT PLUS MITIGATION			
			Delay (Sec)	V / C	LOS	Project Impact	Delay (Sec)	V / C	LOS	Project Impact
1	Queen Kaahumanu Hwy at Kaiminani Dr	AM	37.6	1.01	D	NO	37.6	1.01	D	NO
		PM	36.2	0.96	D	NO	36.2	0.96	D	NO
2	Queen Kaahumanu Hwy at Hulikoa Dr	AM	54.0	0.90	F	YES	0.1	0.01	A	NO
		PM	>100	1.27	F	YES	0.1	0.01	A	NO
3	Queen Kaahumanu Hwy at Hina Lani St	AM	50.2	1.07	D	NO	22.7	0.85	C	NO
		PM	>100	1.42	F	YES	43.2	1.00	D	NO
4	Kanalani St at Hina Lani St	AM	>100	>2.00	F	YES	13.4	0.04	B	NO
		PM	>100	>2.00	F	YES	18.2	0.23	C	NO
5	Kamanu St at Hina Lani St	AM	83.7	1.42	F	YES	21.7	0.63	C	NO
		PM	>100	>2.00	F	YES	26.0	0.70	C	NO
6	Ane Keohokalole Hwy at Hina Lani St	AM	78.3	1.35	E	YES	43.3	0.89	D	NO
		PM	>100	1.46	F	YES	44.7	1.02	D	NO
7	Mamalahoa Hwy at Hina Lani St	AM	81.2	1.17	F	YES	38.7	0.98	D	NO
		PM	47.9	1.04	D	NO	16.7	0.82	B	NO
8	Queen Kaahumanu Hwy at Kealakehe Pkwy	AM	66.1	1.16	E	YES	24.4	0.78	C	NO
		PM	>100	1.46	F	YES	36.8	0.88	D	NO



Queen Kaahumanu Highway at Hina Lani Street (#3)

- Add a Third Northbound Through Lane
- Add a Second Northbound Right-Turn Lane
- Add a Third Southbound Through Lane

Kanalani Street at Hina Lani Street (#4)

- Add a Second Eastbound Through Lane

Kamanu Street at Hina Lani Street (#5)

- Add a Southbound Free-Right Turn Lane
- Add a Second Eastbound Left-Turn Lane
- Add a Westbound Right-Turn Lane

Ane Keohokalole Highway at Hina Lani Street (#6)

- Add a Northbound Free-Right Turn Lane
- Add a Second Eastbound Through Lane
- Add a Second Westbound Through Lane
- Add a Second Westbound Left-Turn Lane

Queen Kaahumanu Highway at Kealakehe Parkway (#8)

- Add a Third Northbound Through Lane
- Provide Northbound Right-Turn Overlap Signal Phasing
- Add a Third Southbound Through Lane

With recommended 2035 With Project Phase 2 intersection lane improvements, the study area intersections are projected to be mitigated to Level of Service "D" or better during the peak hours. The intersection operations analysis worksheets for 2035 With Project Phase 2 Conditions, with recommended mitigation measures, are included in Appendix S of this report.

10. 2045 With Project Phase 3 Traffic Conditions

10.1 Future Traffic Volumes for 2045 With Project Phase 3 Conditions

Future AM and PM peak hour intersection traffic volumes for 2045 With Project Phase 3 Conditions are shown in Figures 46 and 47. The future traffic forecast is estimated based on the methodologies are presented in Section 4. It should be noted that in addition to the project-only traffic, the 2045 With Project Phase 3 Conditions also includes cumulative development traffic in the vicinity of the project site as well as ambient background growth to account for other unidentified projects and general population growth. The project is only one of the many contributors to the overall traffic growth.

10.2 Future Planned Improvements

It should be noted that the 2045 With Project Phase 3 Conditions have the same planned improvements as the 2025 Without Project Conditions which were listed in previous Section 5.2 of this report.

10.3 Level of Service Analysis for 2045 With Project Phase 3 Conditions

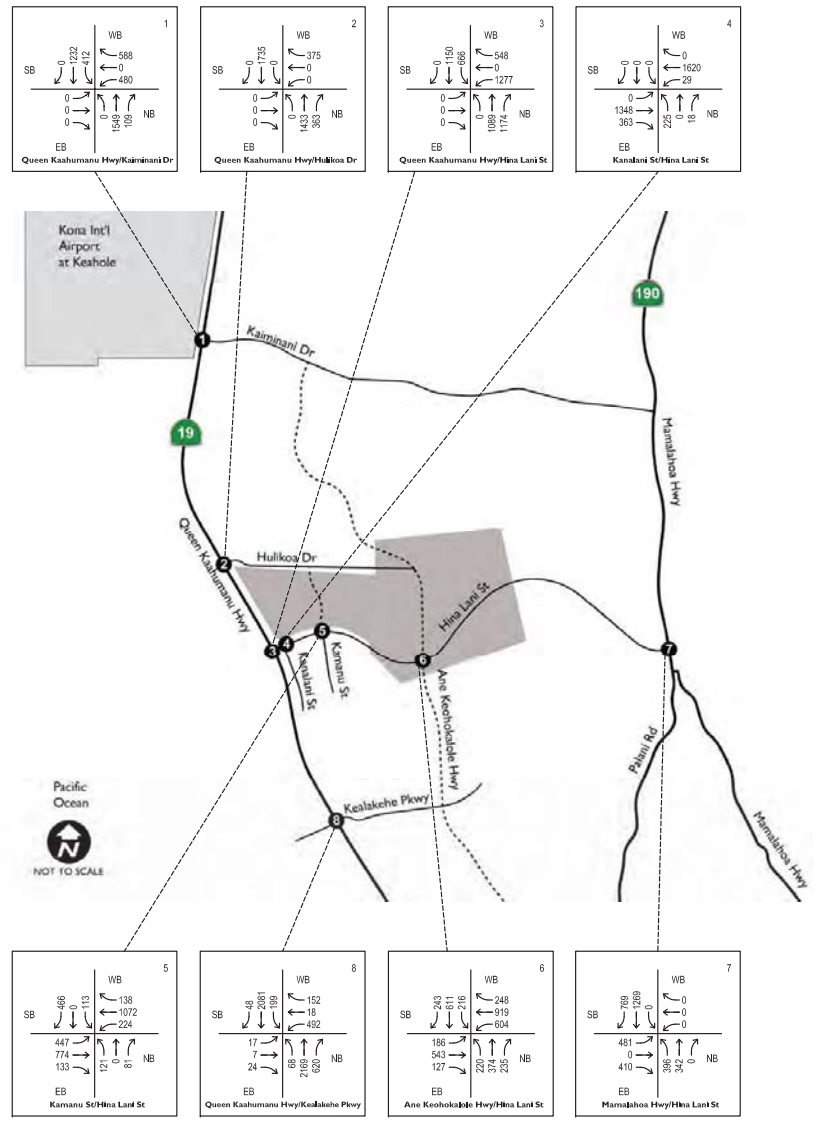
Table 21 summarizes the results for the 2045 With Project Phase 3 Conditions intersection level of service analysis, with existing geometry and planned improvements. As shown in Table 21, the following study area intersections are projected to operate at Level of Service "E" or worse for 2045 With Project Phase 3 Conditions during the peak hours, with existing lane geometry and planned improvements:

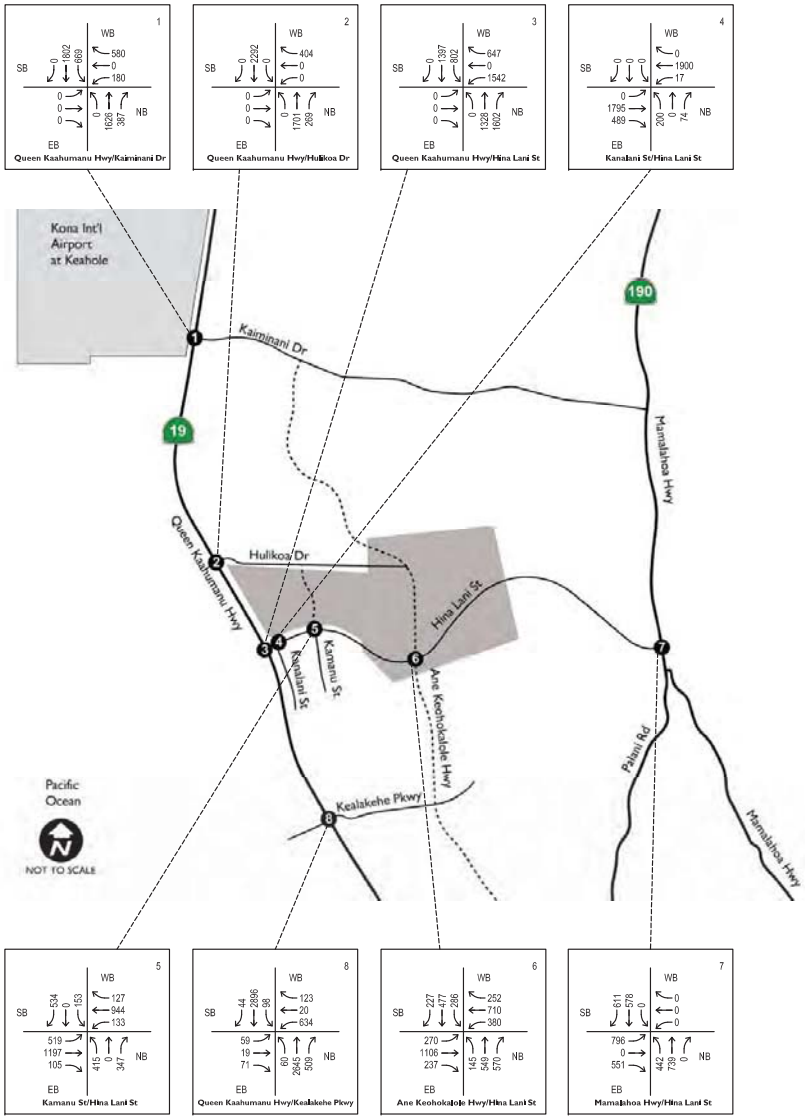
- Queen Kaahumanu Highway at Kaiminani Drive (#1)
- Queen Kaahumanu Highway at Hulikoa Drive (#2)
- Queen Kaahumanu Highway at Hina Lani Street (#3)
- Kanalani Street at Hina Lani Street (#4)
- Kamanu Street at Hina Lani Street (#5)
- Ane Keohokalole Highway at Hina Lani Street (#6)
- Mamalahoa Highway at Hina Lani Street (#7)
- Queen Kaahumanu Highway at Kealakehe Parkway (#8)

Appendix T contains the analysis worksheets for 2045 With Project Phase 3 Conditions, with existing lane geometry and planned improvements.

10.4 Recommended Improvements for Year 2045 With Project Phase 3 Conditions

Figure 48 shows the recommended roadway network and intersection lane geometry for 2045 With Project Phase 3 Conditions to mitigate the traffic impact. In addition to the recommended 2035 With Project Phase 2 improvements previously listed in Section 9.4, the following additional improvements are recommended to accommodate 2045 With Project Phase 3 Conditions:





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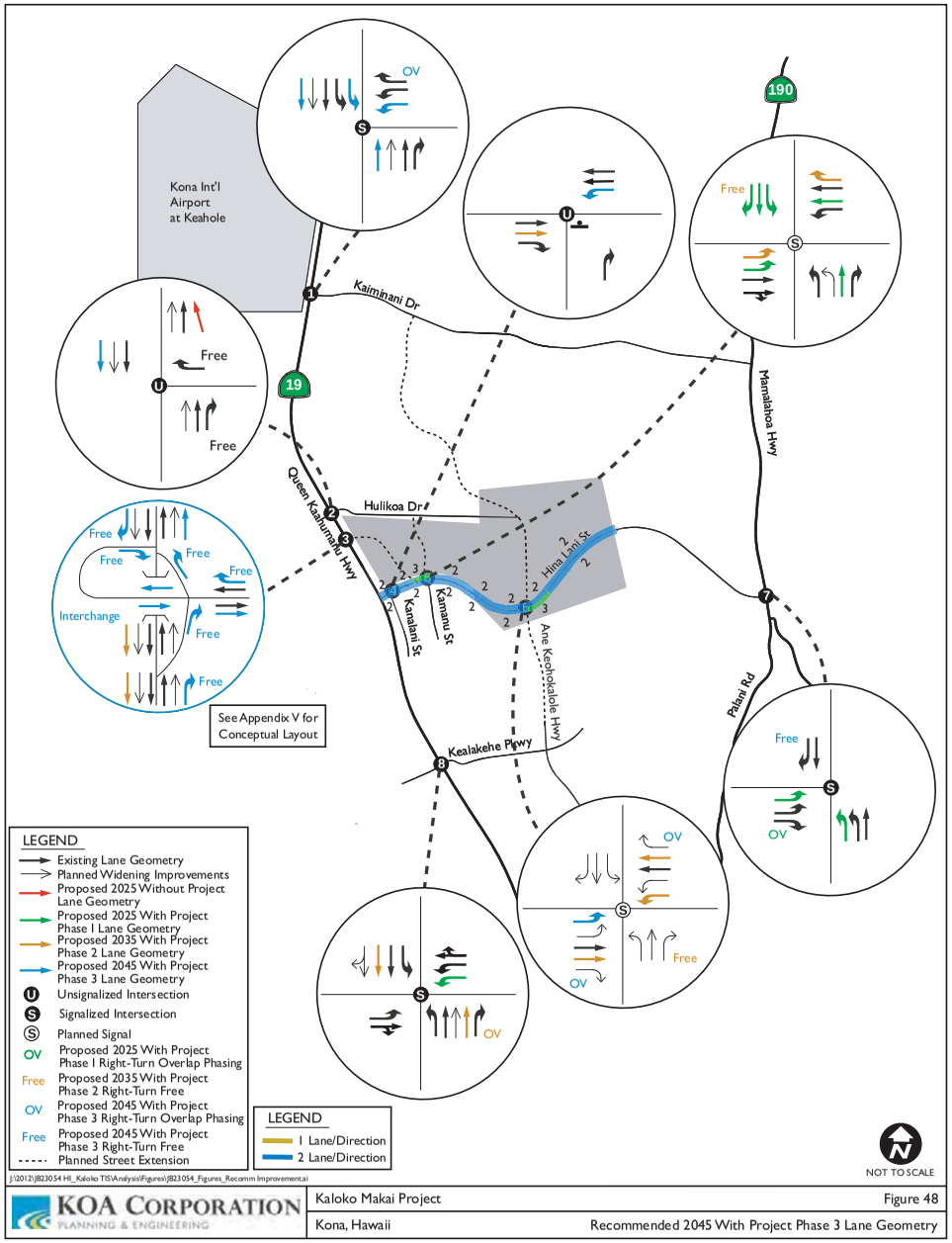
Kaloko Makai Project — Figure 47

Kona, Hawaii — 2045 With Project Phase 3 PM Peak Hour Intersection Turning Movement Volumes

Table 21 - 2045 With Project Phase 3 Conditions
Intersection Level of Service Analysis Summary

No.	Intersection	Peak Hour	WITH PROJECT				WITH PROJECT PLUS MITIGATION			
			Delay (Sec)	V / C	LOS	Project Impact	Delay (Sec)	V / C	LOS	Project Impact
1	Queen Kaahumanu Hwy at Kaiminani Dr	AM	65.9	1.13	E	YES	17.6	0.84	B	NO
		PM	69.9	1.11	E	YES	16.2	0.85	B	NO
2	Queen Kaahumanu Hwy at Hulikoa Dr	AM	>100	1.20	F	YES	0.1	0.01	A	NO
		PM	>100	1.62	F	YES	0.1	0.01	A	NO
3	Queen Kaahumanu Hwy at Hina Lani St	AM	>100	1.29	F	YES	Interchange			
		PM	>100	1.76	F	YES				
4	Kanalani St at Hina Lani St	AM	>100	>2.00	F	YES	15.5	0.05	C	NO
		PM	>100	>2.00	F	YES	26.1	0.32	D	NO
5	Kamanu St at Hina Lani St	AM	>100	>2.00	F	YES	26.5	0.72	C	NO
		PM	>100	>2.00	F	YES	37.3	0.80	D	NO
6	Ane Keohokalole Hwy at Hina Lani St	AM	>100	1.96	F	YES	46.5	0.89	D	NO
		PM	>100	>2.00	F	YES	54.4	0.99	D	NO
7	Mamalahoa Hwy at Hina Lani St	AM	>100	1.35	F	YES	51.5	1.03	D	NO
		PM	86.3	1.23	F	YES	22.2	0.90	C	NO
8	Queen Kaahumanu Hwy at Kealakehe Pkwy	AM	>100	1.28	F	YES	30.5	0.85	C	NO
		PM	>100	1.64	F	YES	41.7	0.93	D	NO



Queen Kaahumanu Highway at Kaiminani Drive (#1)

- Add a Third Northbound Through Lane
- Add a Second Southbound Left-Turn Lane
- Add a Third Southbound Through Lane
- Add a Second Westbound Left-Turn Lane
- Provide Westbound Right-Turn Overlap Signal Phasing

Queen Kaahumanu Highway at Hulikoa Drive (#2)

- Add a Third Southbound Through Lane

Queen Kaahumanu Highway at Hina Lani Street (#3)

- Construct a grade-separated interchange

Kanalani Street at Hina Lani Street (#4)

- Add a Westbound Left-Turn Lane

Ane Keohokalole Highway at Hina Lani Street (#6)

- Add a Second Eastbound Left-Turn Lane
- Provide Eastbound Right-Turn Overlap Signal Phasing
- Provide Westbound Right-Turn Overlap Signal Phasing

Mamalahoa Highway at Hina Lani Street (#7)

- Add a Southbound Free Right-Turn Lane

With recommended 2045 With Project Phase 3 intersection lane improvements, the study area intersections are projected to be mitigated to Level of Service "D" or better during the peak hours. The intersection operations analysis worksheets for 2045 With Project Phase 3 Conditions, with recommended mitigation measures, are included in Appendix U of this report.

11. Recommended Improvements

Under future traffic scenarios, the study area intersections are expected to have poor levels of service. Improvement measures have been evaluated for all future with project scenarios. The purpose of the recommended improvements is to improve traffic operations for the study area intersections. It should be noted that the recommended improvements for each horizon year are needed to serve overall traffic growth which includes the project-only traffic and cumulative development traffic as well as ambient background traffic growth. This accounts for other unidentified projects and general population growth. The project is only one of the many contributors to the overall traffic growth.

It is recommended that the traffic study be updated periodically every 5 years to monitor the actual traffic growth and provide appropriate mitigation measures.

Recommended improvement measures and intersection operation performance improvements are reported in this section. Figure 49 summarizes the recommended intersection lane geometry to mitigate the traffic impact for the following analysis conditions:

- 2025 Without Project conditions, with existing lane geometry and planned widening
- 2035 Without Project conditions, with existing lane geometry and planned widening
- 2045 Without Project conditions, with recommended intersection improvements
- 2025 With Project Phase 1 conditions, with recommended intersection improvements
- 2035 With Project Phase 2 conditions, with recommended intersection improvements
- 2045 With Project Phase 3 conditions, with recommended intersection improvements

Table 22 summarizes the intersection level of service analysis results with existing lane geometry and planned improvements. Table 23 summarizes the expected levels of service for the study area intersections with additional mitigation measures in place.

11.1 Year 2025 and 2035 Without Project Improvements

It should be noted that the two "Without Project" scenarios for 2025 and 2035 conditions have the same recommended improvements.

For 2025 and 2035 Without Project Conditions, the list of recommended improvements includes planned improvements that are anticipated to be completed by agencies and other cumulative developments. The planned improvements include the widening of Queen Kaahumanu Highway and the new construction of a Mid-Level Road (Ane Keohokalole Highway) that will run in a north-south direction between Queen Kaahumanu Highway and Mamalahoa Highway. Figures 33 and 36 illustrate the recommended roadway network and intersection lane geometry for the 2025 and 2035 Without Project Conditions.

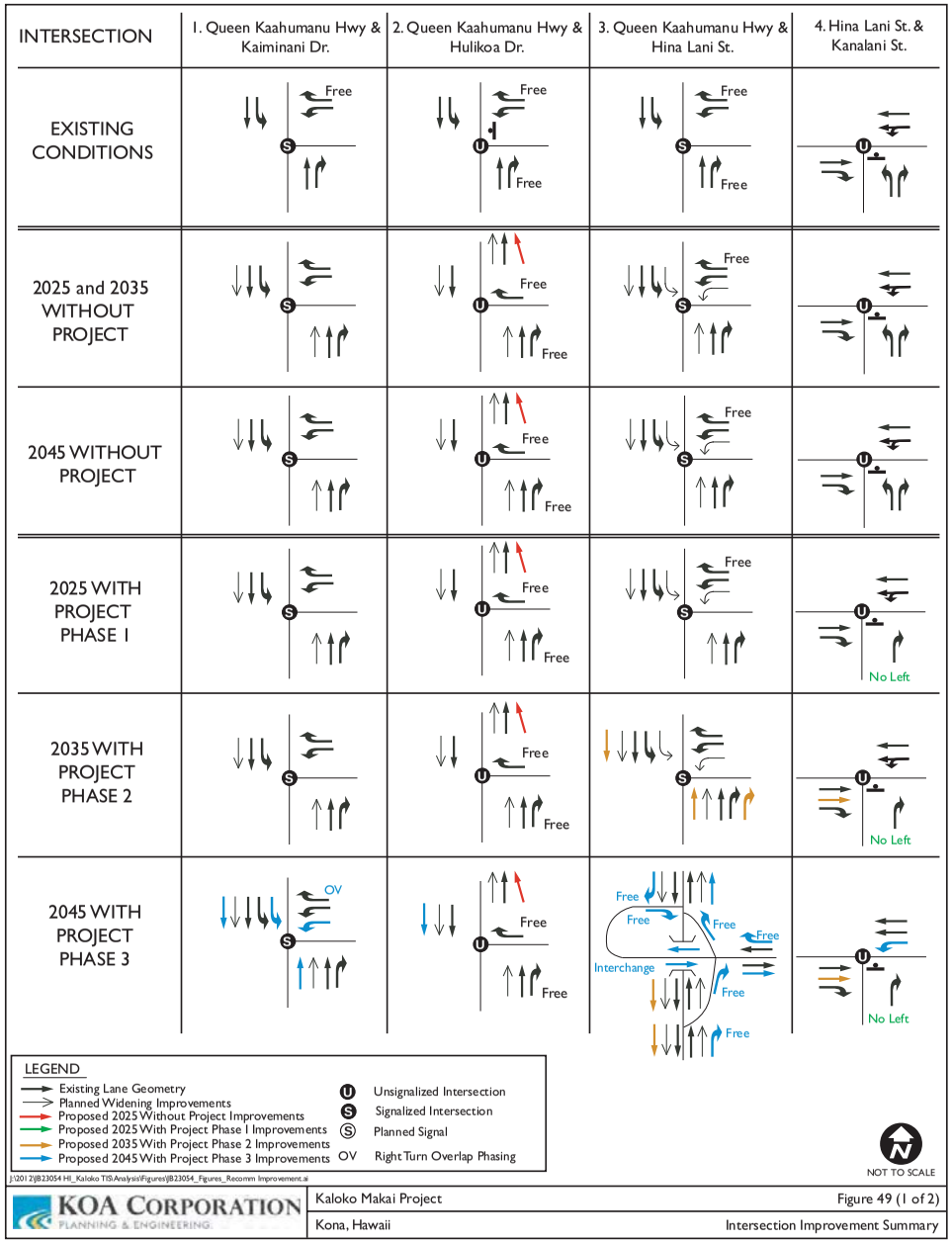


Table 22 - Intersection Level of Service Analysis Summary, Without Recommended Mitigations

No.	Intersection	Peak Hour	Existing		2025 Without Project		2035 Without Project		2045 Without Project		2025 With Project Phase 1		2035 With Project Phase 2		2045 With Project Phase 3	
			Delay (Sec)	LOS	Delay (Sec)	LOS	Delay (Sec)	LOS	Delay (Sec)	LOS	Delay (Sec)	LOS	Delay (Sec)	LOS	Delay (Sec)	LOS
1	Queen Kaahumanu Hwy at Kaiminani Dr	AM	16.9	B	14.0	B	17.1	B	20.0	C	16.7	B	37.6	D	65.9	E
		PM	8.6	A	9.7	A	14.5	B	15.9	B	12.8	B	36.2	D	69.9	E
2	Queen Kaahumanu Hwy at Hulikoa Dr	AM	25.2	C	18.4	C	20.1	C	25.2	D	36.8	E	54.0	F	>100	F
		PM	52.1	C	46.2	E	36.9	E	52.1	F	>100	F	>100	F	>100	F
3	Queen Kaahumanu Hwy at Hina Lani St	AM	11.1	B	10.6	B	10.6	B	11.1	B	24.6	C	50.2	D	>100	F
		PM	15.7	C	14.8	B	14.2	B	15.7	B	53.9	D	>100	F	>100	F
4	Kanalani St at Hina Lani St	AM	19.2	B	24.2	C	19.2	C	19.2	C	>100	F	>100	F	>100	F
		PM	22.8	C	29.2	D	22.8	C	22.8	C	>100	F	>100	F	>100	F
5	Kamanu St at Hina Lani St	AM	10.7	B	4.1	A	3.7	A	3.7	A	13.5	B	83.7	F	>100	F
		PM	14.1	B	4.6	A	4.3	A	4.3	A	35.7	D	>100	F	>100	F
6	Ane Keohokalole Hwy at Hina Lani St	AM	--	--	9.3	A	25.9	C	24.5	C	19.0	B	78.3	E	>100	F
		PM	--	--	15.4	B	22.6	C	24.3	C	21.8	C	>100	F	>100	F
7	Mamalahoa Hwy at Hina Lani St	AM	44.8	B	40.7	D	26.7	C	44.8	D	74.9	E	81.2	F	>100	F
		PM	22.2	A	15.9	B	18.2	B	22.2	C	25.5	C	47.9	D	86.3	F
8	Queen Kaahumanu Hwy at Kealakehe Pkwy	AM	15.7	B	17.5	B	17.8	B	19.7	B	32.3	C	66.1	E	>100	F
		PM	26.5	C	43.3	D	50.4	D	63.2	E	>100	F	>100	F	>100	F

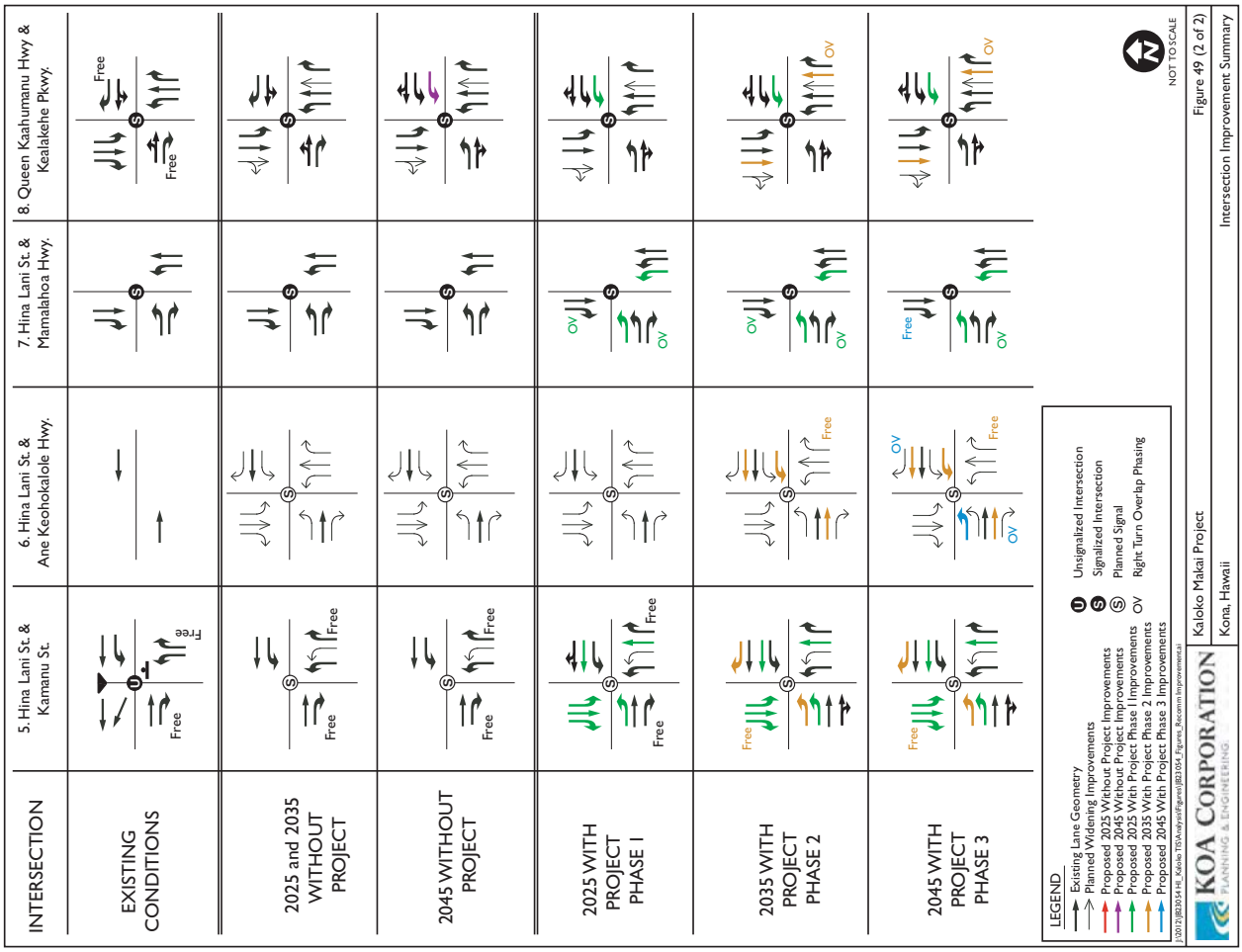


Figure 49 (2 of 2)
Intersection Improvement Summary

11.1.1 Planned Roadway Widening Along Queen Kaahumanu Highway

Queen Kaahumanu Highway is currently a two-lane roadway, and it is anticipated to be widening to a four-lane roadway prior to Year 2025. The planned roadway widening along Queen Kaahumanu Highway will provide additional northbound and southbound travel lane improvements to the following study area intersections:

Queen Kaahumanu Highway at Kaiminani Drive (#1)

- Add a Second Northbound Through Lane
- Add a Second Southbound Through Lane

Queen Kaahumanu Highway at Hulikoa Drive (#2)

- Add a Second Northbound Through Lane
- Add a Second Southbound Through Lane
- Restrict southbound and westbound left turn movements – this intersection is anticipated to remain unsignalized

Queen Kaahumanu Highway at Hina Lani Street (#3)

- Add a Second Northbound Through Lane
- Add a Second Southbound Through Lane
- Add a Second Southbound Left-Turn Lane
- Add a second Westbound Left-Turn Lane

Queen Kaahumanu Highway at Kealakehe Parkway (#8)

- Add a Second Northbound Through Lane
- Convert Southbound Right-Turn Lane to a shared (Second) Through/Right-Turn Lane

11.1.2 Planned Mid-Level Road (Ane Keohokalole Highway)

The future Ane Keohokalole Highway will be a two-lane Mid-Level Road that is planned to be constructed in a north-south direction between Queen Kaahumanu Highway and Mamalahoa Highway. By the first horizon year of this traffic study (Year 2025), Ane Keohokalole Highway is anticipated to be completed between Hulikoa Drive and Palani Road to the south. As of June 2012, Ane Keohokalole Highway has been completed between Hina Lani Street and Kealakehe Parkway. The northerly extension of Ane Keohokalole Highway to Kaiminani Drive will be completed by 2028 (or near the beginning of Project Phase 2). The completion of Ane Keohokalole Highway will serve as a parallel corridor to relief traffic congestion on Queen Kaahumanu Highway and Mamalahoa Highway. The planned Mid-Level Road will provide lane improvements to the following study area intersection:

Table 23 - Intersection Level of Service Analysis Summary, With Recommended Mitigations

No.	Intersection	Peak Hour	2025 Without Project		2035 Without Project		2045 Without Project		2025 With Project Phase 1		2035 With Project Phase 2		2045 With Project Phase 3	
			Delay (Sic)	LOS	Delay (Sic)	LOS	Delay (Sic)	LOS	Delay (Sic)	LOS	Delay (Sic)	LOS	Delay (Sic)	LOS
1	Queen Kaahumanu Hwy at Kaiminani Dr	AM	14.0	B	17.1	B	20.0	C	16.7	B	37.6	D	17.6	B
		PM	9.7	A	14.5	B	15.9	B	12.8	B	36.2	D	16.2	B
2	Queen Kaahumanu Hwy at Hulikoa Dr	AM	0.1	A	0.1	A	0.1	A	0.1	A	0.1	A	0.1	A
		PM	0.1	A	0.1	A	0.1	A	0.1	A	0.1	A	0.1	A
3	Queen Kaahumanu Hwy at Hina Lani St	AM	10.6	B	10.6	B	11.1	B	24.6	C	22.7	C	Interchange	
		PM	14.8	B	14.2	B	15.7	B	53.9	D	43.2	D		
4	Kanalani St at Hina Lani St	AM	24.2	C	19.2	C	19.2	C	23.5	C	13.4	B	15.5	C
		PM	29.2	D	22.8	C	22.8	C	34.3	D	18.2	C	26.1	D
5	Kamanu St at Hina Lani St	AM	4.1	A	3.7	A	3.7	A	32.5	C	21.7	C	26.5	C
		PM	4.6	A	4.3	A	4.3	A	40.8	D	26.0	C	37.3	D
6	Ane Keohokalole Hwy at Hina Lani St	AM	9.3	A	25.9	C	24.5	C	19.0	B	43.3	D	46.5	D
		PM	15.4	B	22.6	C	24.3	C	21.8	C	44.7	D	54.4	D
7	Mamalahoa Hwy at Hina Lani St	AM	40.7	D	26.7	C	44.8	D	47.6	D	38.7	D	51.5	D
		PM	15.9	B	18.2	B	22.2	C	15.1	B	16.7	B	22.2	C
8	Queen Kaahumanu Hwy at Kealakehe Pkwy	AM	17.5	B	17.8	B	23.7	C	29.8	C	24.4	C	30.5	C
		PM	43.3	D	50.4	D	37.2	D	54.0	D	36.8	D	41.7	D

Ane Keohokalole Highway at Hina Lani Street (#6)

- Ane Keohokalole Highway will be constructed as a new Mid-Level Road, and it will run in a generally north-south direction through the project site.
- Construct new intersection: Provide Left-Turn, Through, and Right-Turn for all approaches
- Install a new traffic signal

11.1.3 Additional Planned Intersection Improvements by Other Cumulative Developments

By 2025, there are planned improvements to the study area intersections that will be implemented by other surrounding developments to accommodate the overall traffic growth due to background ambient growth and new cumulative developments. The following planned intersection improvements are anticipated:

Kamanu Street at Hina Lani Street (#5)

- Install a New Traffic Signal
- Add a Northbound Left-Turn Lane

11.2 Year 2045 Without Project Improvements

In addition to the planned improvements mentioned in Section 11.1, the following additional improvement is recommended to accommodate 2045 Without Project Conditions:

Queen Kaahumanu Highway at Kealakehe Parkway (#8)

- Add a Second Westbound Left-Turn Lane

Figure 39 illustrates the recommended roadway network and intersection lane geometry for the 2045 Without Project Conditions.

11.3 Year 2025 With Project Phase 1 Improvements

Four study area intersections are expected to experience significant traffic impacts from the Kaloko Makai project in Year 2025. These intersections are expected to have poor levels of service due to the combination of background traffic growth and traffic generated by the project. The following intersections are expected to be impacted by the project. Recommended mitigation measures are described for each intersection. Figure 42 illustrates the recommended roadway network and intersection lane geometry for the 2025 With Project Phase 1 Conditions, showing the recommended improvement measures designed to mitigate the traffic impacts at the study intersections.

11.3.1 Kanalani Street at Hina Lani Street (#4)

The intersection of Kanalani Street at Hina Lani Street is expected to have a poor level of service (LOS F) due to long delays and queues for the northbound left movement. The number of vehicles making this move is relatively high (225 PM peak hour vehicles). The intersection is located too close to the

intersection of Queen Kaahumanu Highway at Hina Lani Street to be signalized. It is therefore recommended that the northbound left turn movement be restricted, either through signage and striping, or by installation of a "pork-chop" island. The northbound left turn traffic will be diverted to the adjacent Kamanu Street. The intersection of Kanalani Street at Hina Lani Street will remain stop-controlled for the northbound approach, and the following improvements are recommended:

- Restrict Northbound Left-Turn Movement

11.3.2 Kamanu Street at Hina Lani Street (#5)

The addition of project traffic to/from the north leg of the intersection of Kamanu Street at Hina Lani Street will result in the need for improvements at this intersection. In particular, the intersection must be improved for the eastbound left turn, northbound through, westbound through and all southbound movements. The following improvement measures are therefore recommended to accommodate Project Phase 1 traffic at this intersection:

- Add a Northbound Through Lane
- Add Southbound Left-Turn, Through, and Right-Turn Lanes
- Add an Eastbound Left-Turn Lane
- Add a Second Westbound Through Lane

11.3.3 Mamalahoa Highway at Hina Lani Street (#7)

The intersection of Mamalahoa Highway at Hina Lani Street currently experiences Level of Service B or better during the AM and PM peak hours. For 2025 conditions, a combination of additional traffic from the proposed project and background traffic growth will result in a decline in level of service at this intersection to Level of Service E during the AM peak hour. The Project Phase 1 impact at this intersection can be mitigated by increasing intersection capacity through a combination of overlap signal phasing and two additional left-turn lanes:

- Add a Second Northbound Left-Turn Lane
- Provide Southbound Right-Turn Overlap Signal Phasing
- Add a Second Eastbound Left-Turn Lane
- Provide Eastbound Right-Turn Overlap Signal Phasing

11.3.4 Queen Kaahumanu Highway at Kealakehe Parkway (#8)

The intersection of Queen Kaahumanu Highway at Kealakehe Parkway is currently operating at Level of Service C or better during the AM and PM peak hours. For 2025 conditions, level of service is expected to decline to LOS F during the PM peak hour due to increases in north-south traffic and westbound left

turn traffic from the proposed project and background traffic growth. The following improvement measures for this intersection are recommended to mitigate the 2025 Project Phase 1 impacts:

- Add a Second Westbound Left-Turn Lane

11.4 Year 2035 With Project Phase 2 Improvements

Four study area intersections are expected to experience significant traffic impacts from the Kaloko Makai project in Year 2035. These intersections are expected to have poor levels of service due to the combination of traffic generated by the proposed project and area background traffic growth. The following intersections are expected to be impacted by the project in 2035. Recommended mitigation measures are described for each intersection. Figure 45 shows the recommended roadway network and intersection lane geometry for the 2035 With Project Phase 2 Conditions to mitigate the traffic impact at the study intersections.

11.4.1 Queen Kaahumanu Highway at Hina Lani Street (#3)

The intersection of Queen Kaahumanu Highway at Hina Lani Street is expected to have moderate increases in traffic from the proposed project and from background traffic in 2035, particularly for the northbound right turn and westbound left turn movements. An additional northbound right-turn lane and additional eastbound and westbound through lanes will be required to accommodate the expected increase in traffic volume and mitigate project impacts. The following improvement measure for this intersection is therefore recommended to mitigate the Project Phase 2 impacts in 2035:

- Add a Third Northbound Through Lane
- Add a Second Northbound Right-Turn Lane
- Add a Third Southbound Through Lane

11.4.2 Kanalani Street at Hina Lani Street (#4)

The intersection of Kanalani Street at Hina Lani Street will experience a significant increase in east-west through traffic by 2035. Intersection LOS will decline to Level F, due primarily to increases in Project Phase 2 traffic. It is recommended that the project traffic impact be mitigated by the addition of an eastbound through lane:

- Add a Second Eastbound Through Lane

11.4.3 Kamanu Street at Hina Lani Street (#5)

The intersection of Kamanu Street at Hina Lani Street will have additional project traffic impacts due to Phase 2 of the proposed project. Additional project traffic to/from the north leg of the intersection is expected to result in the need for additional improvements. In particular, capacity must be increased

for the eastbound left turn and westbound right turn movements. The following improvements are recommended to accommodate the additional project traffic:

- Add a Southbound Free-Right Turn Lane
- Add a Second Eastbound Left-Turn Lane
- Add a Westbound Right-Turn Lane

11.4.4 Ane Keohokalole Highway at Hina Lani Street (#6)

Phase 2 of the project will require improvements to this intersection. Project traffic increases will be primarily to east-west through traffic, and traffic between the east leg and south leg of the intersection. Level of service is expected to decline to LOS F due to these traffic increases. The project impact at this intersection can be mitigated through a combination of increasing east-west through capacity and improving the northbound right-turn lane. The recommended improvements are:

- Add a Northbound Free-Right Turn Lane
- Add a Second Eastbound Through Lane
- Add a Second Westbound Through Lane
- Add a Second Westbound Left-Turn Lane

11.4.5 Queen Kaahumanu Highway at Kealakehe Parkway (#8)

The intersection of Queen Kaahumanu Highway at Kealakehe Parkway is currently operating at Level of Service C or better during the AM and PM peak hours. For 2035 conditions, level of service is expected to decline to LOS F during the PM peak hour due to increases in north-south traffic from the proposed project and background traffic growth. Additional north-south through traffic capacity is therefore required to return the intersection to desirable operating conditions. The following improvement measures for this intersection are recommended to mitigate the 2035 Project Phase 2 impacts:

- Add a Third Northbound Through Lane
- Provide Northbound Right-Turn Overlap Signal Phasing
- Add a Third Southbound Through Lane

11.5 Year 2045 With Project Phase 3 Improvements

Six study area intersections are expected to require additional improvements by 2045 to accommodate the combination of traffic generated by the proposed Project Phase 3 and background traffic growth. The following traffic mitigation measures are required for these intersections to accommodate these traffic increases. Figure 48 shows the recommended roadway network and intersection lane geometry for the 2045 With Project Phase 3 Conditions to mitigate the traffic impact within the study area. The most significant improvement to the area roadway network will be the grade-separated interchange recommended for the intersection of Queen Kaahumanu Highway at Hina Lani Street to mitigate traffic

impacts. A conceptual configuration of the grade-separated interchange is included in Appendix V of this report. The interchange will be located north of Hina Lani Street because it needs additional space to accommodate the ramps. The intersection of Hina Lani Street with Queen Kaahumanu Highway will be moved north to a location where the interchange will not conflict with any existing development.

11.5.1 Queen Kaahumanu Highway at Kaiminani Drive (#1)

The intersection of Queen Kaahumanu Highway at Kaiminani Drive currently operates at Level of Service B or better during the AM and PM peak hours. Level of Service is expected to decline to Level E with the addition of project traffic and background traffic growth. All legs of the intersection must be improved to accommodate the anticipated growth. The following improvement measures are recommended to accommodate project traffic growth at this intersection:

- Add a Third Northbound Through Lane
- Add a Second Southbound Left-Turn Lane
- Add a Third Southbound Through Lane
- Add a Second Westbound Left-Turn Lane
- Provide Westbound Right-Turn Overlap Signal Phasing

11.5.2 Queen Kaahumanu Highway at Hulikoa Drive (#2)

Phase 3 of the project will require lane improvements at this intersection. Project traffic increases will be primarily to north-south through traffic. Level of service is expected to decline to Level F due to these traffic increases. The Project Phase 3 impact at this intersection can be mitigated by increasing southbound through capacity with the following recommended improvements:

- Add a Third Southbound Through Lane

11.5.3 Queen Kaahumanu Highway at Hina Lani Street (#3)

The intersection of Queen Kaahumanu Highway at Hina Lani Street is expected to have significant increases in traffic from the proposed project and from background traffic by 2045. These increases will be for all approaches. A grade-separated interchange is proposed to accommodate the projected traffic volume increases and mitigate impacts from Phase 3 of the project. The grade separation will be constructed north of the current intersection location, and it will include free right-turn lanes (ramps) for all three approaches. Additional north-south through lanes will be added to accommodate traffic increases for those movements. The grade separation will configure the intersection with Hina Lani Street as the overpass street and Queen Kaahumanu Highway as the underpass street. A conceptual layout of the grade-separated interchange is included in Appendix V of this report. The interchange will be located north of Hina Lani Street because it needs additional space to accommodate the ramps. The intersection of Hina Lani Street with Queen Kaahumanu Highway will be moved north to a location where the interchange will not conflict with any existing development.

11.5.4 Kanalani Street at Hina Lani Street (#4)

Increases in east-west traffic volumes will require improvements at the intersection of Kanalani Street at Hina Lani Street by 2045. Intersection LOS will decline to Level F, due primarily to increases in Project Phase 3 traffic. Additional westbound left-turn capacity is required to mitigate project impacts at this intersection. It is therefore recommended that the project traffic impact be mitigated by the following improvement:

- Add a Westbound Left-Turn Lane

11.5.5 Ane Keohokalole Highway at Hina Lani Street (#6)

Phase 3 of the project will require additional improvements to the intersection of Ane Keohokalole Highway at Hina Lani Street. Level of service is expected to decline to LOS F due to project traffic increases, primarily to the eastbound left and westbound right movements. The project impact at this intersection can be mitigated through a combination of increasing eastbound left capacity and improving existing traffic signal phasing. The recommended improvements are as follows:

- Add a Second Eastbound Left-Turn Lane
- Provide Eastbound Right-Turn Overlap Signal Phasing
- Provide Westbound Right-Turn Overlap Signal Phasing

11.5.6 Mamalahoa Highway at Hina Lani Street (#7)

Additional traffic to/from the west leg of the Mamalahoa Highway/Hina Lani Street intersection will require improvements to the north leg of the intersection to accommodate the southbound right-turn movement. The recommended improvement is to convert the southbound right-turn lane to a free-right lane, eliminating the conflict between this movement and the northbound left-turn movement. This improvement will mitigate project impacts at this intersection.

- Add a Southbound Free Right-Turn Lane

12. Conclusions

The purpose of this study is to assess the overall traffic impact of the proposed Kaloko Makai project, which will be developed in 3 phases, for 2025, 2035 and 2045 conditions.

This study used the existing traffic volumes and the surrounding land use and geographic conditions to determine the project trip distribution patterns. ITE trip rates are used to estimate the site-only project traffic volumes, and trip reduction adjustments have been made to the overall project traffic generation to account for pass-by trips, internal trip capture and transit trip discount. The reduction percentage assumptions have been based on past experience for this type of development and other reference information.

Future traffic increases also consider additional traffic that are generated by other cumulative developments that either are under construction, approved, planned, or proposed for development near the study area based on the available information obtained by the project team. In addition to cumulative development traffic, other unidentified projects and general population growth contribute to ambient background traffic growth. Ambient growth is calculated as an annual growth percentage increase from existing traffic count volumes, based on a comparison of the historic traffic count data from 1996 through 2010 for the segment of Queen Kaahumanu Highway north of OTEC Access Road (Station T8M), at which an average annual growth rate of 1.74% is calculated as shown in Appendix H.

Synchro models were developed to conduct intersection level of service analyses. Analysis methodologies and parameters are presented in Section 2 of this report.

The document presents the recommended mitigation improvements to the study area intersections. Figure 49 graphically summarizes the recommended roadway network and intersection lane geometry for the various analysis scenarios. Table 24 summarizes the recommended intersection improvements in a tabular format. The recommended intersection improvements are described in previous Section 11 of this report.

It is recommended that the traffic study be updated periodically every 5 years to monitor the actual traffic growth and provide appropriate mitigation.

Table 24 (1 of 2) - Intersection Mitigation Summary

Intersection	Recommended Intersection Improvements				
	2025 & 2035 Without Project	2045 Without Project	Year 2025 Project Phase 1	Year 2035 Project Phase 2	Year 2045 Project Phase 3
1 Queen Kaahumanu Hwy at Kaiminani Dr	• Add a 2nd NB Thru Lane • Add a 2nd SB Thru Lane	• No additional improvements	• No additional improvements	• No additional improvements	• Add a 3rd NB Thru Lane • Add a 2nd SB Left-Turn Lane • Add a 3rd SB Thru Lane • Add a 2nd WB Left-Turn Lane • Provide WB Right-Turn Overlap Signal Phasing
2 Queen Kaahumanu Hwy at Hulikoa Dr	• Add a 2nd NB Thru Lane • Add a 2nd SB Thru Lane • Retain WB Free Right-Turn Lane • Restrict SB and WB Left Turn Movements	• No additional improvements	• No additional improvements	• No additional improvements	• Add a 3rd SB Thru Lane
3 Queen Kaahumanu Hwy at Hina Lani St	• Add a 2nd NB Thru Lane • Add a 2nd SB Thru Lane • Add a 2nd SB Left-Turn Lane • Add a 2nd WB Left-Turn Lane	• No additional improvements	• No additional improvements	• Add a 3rd NB Thru Lane • Add a 2nd NB Right-Turn Lane • Add a 3rd SB Thru Lane	• Construct a Grade Separation (See Appendix V for conceptual layout)
4 Kanalani St at Hina Lani St	• No additional improvements	• No additional improvements	• Restrict NB Left-Turn Movement	• Add a 2nd EB Thru Lane	• Add a WB Left-Turn Lane
5 Kamanu St at Hina Lani Street	• Install a New Traffic Signal • Add a 2nd NB Left-Turn Lane	• No additional improvements	• Add a NB Thru Lane • Add SB Left-Turn, Thru, and Right-Turn Lanes • Add an EB Left-Turn Lane • Add a 2nd WB Thru Lane	• Add a SB Free-Right Turn Lane • Add a 2nd EB Left-Turn Lane • Add a WB Right-Turn Lane	• No additional improvements

Table 24 (2 of 2) - Intersection Mitigation Summary

Intersection	Recommended Intersection Improvements				
	2025 & 2035 Without Project	2045 Without Project	Year 2025 Project Phase 1	Year 2035 Project Phase 2	Year 2045 Project Phase 3
6 Ane Keohokalole Hwy at Hina Lani St	• Provide Left-Turn, Thru, and Right-Turn for all approaches • Install a new traffic signal	• No additional improvements	• No additional improvements	• Add a NB Free-Right Turn Lane • Add a 2nd EB Thru Lane • Add a 2nd WB Thru Lane • Add a 2nd WB Left-Turn Lane	• Add a 2nd EB Left-Turn Lane • Provide EB Right-Turn Overlap Signal Phasing • Provide WB Right-Turn Overlap Signal Phasing
7 Mamalahoa Hwy at Hina Lani St	• No additional improvements	• No additional improvements	• Add a 2nd NB Left-Turn Lane • Provide SB Right-Turn Overlap Signal Phasing • Add a 2nd EB Left-Turn Lane • Provide EB Right-Turn Overlap Signal Phasing	• No additional improvements	• Add a SB Free Right-Turn Lane
8 Queen Kaahumanu Hwy at Kealakehe Pkwy	• Add a 2nd NB Thru Lane • Convert SB Right-Turn Lane to a shared (2nd) Thru/Right-Turn Lane	• Add a 2nd WB Left-Turn Lane	• Add a 2nd WB Left-Turn Lane	• Add a 3rd NB Thru Lane • Provide NB Right-Turn Overlap Signal Phasing • Add a 3rd SB Thru Lane	• No additional improvements

KALOKO MAKAI - LAND USE SUMMARY

Parcel I.D.	Land Use	Land Use Description	Parcel Size (Acres)	Density of Parcel (D.U./Acre)	Maximum Density (D.U./Acre)	# of Units	*SF Units*	*MF Units*	# of Aff. Units	# of Aff. Units (lower AMI's)	Retail Space	Office Space
PHASE 1												
INDUSTRIAL	Industrial	Light Industrial	25.0									
WWTP	WWTP	Waste Water Treatment Plant	20.0									
ELEC. SUB	ESS	Electrical Substation	1.0									
P-4	Park	District Sized Park &Drainage Retention	25.0									
T4-16	Res./MU	MF, Affordable Housing	13.1	9.0	12	118	*88*	*30*	118	118		
T4-15	Res./MU	Live-Work, MF, & SF	15.4	9.0	12	139	*104*	*35*	139	139	10,000	10,000
T3-11	SF	Single Family	11.6	5.0	6	58	*58*	*0*				
T3-10	SF	Single Family	7.4	5.0	6	37	*37*	*0*				
T4-11	Res./MU	Mixed SF and MF	9.4	9.0	12	85	*63*	*22*				
T4-10	Res./MU	Live-Work, MF, & SF	18.0	9.0	12	162	*121*	*41*			7,500	7,500
T5-10	Res./MU	Shopping Center, Legal Offices, MF, Transit Station, Senior Independent Living	39.1	10.8	30	423	*0*	*423*			75,000	80,000
T5-13	Res./MU	Mixed Use, Aff. Housing, Retail, Office,	14.3	15.0	30	215	*0*	*215*	100	50	45,000	15,000
P-2	Park		10.0			0	*0*	*0*				
SCHOOL	School		18.0			0	*0*	*0*				
T5-9	Res./MU	Mixed Use, MF	7.7	15.0	30	116	*0*	*116*			20,000	
T5-5	Res.	Long Term Care, Medical Offices	11.9	15.0	30	179	*0*	*179*			15,000	15,000
T5-6	Res.	Long Term Care	5.5	15.0	30	83	*0*	*83*			15,000	15,000
T5-7	Res./MU	Lodge, Business Center, Medical Offices	5.3	0.0	30	0	*0*	*0*			10,000	30,000
T5-8	Res./MU	Transit Station, TOD Square, Medical Offices, MF, Senior	9.1	15.0	30	137	*0*	*137*			20,000	40,000
HOSPITAL	Medical		40.0									
TOTAL PHASE 1 UNITS			**306.8**			**1752**	**471**	**1281**	**357**	**307**	**217,500**	**212,500**
									20%	18%		
PHASE 2												
INDUSTRIAL	Industrial	Light Industrial	25.0									
T4-14	Res./MU	MF, Live-Work, Affordable	18.8	9.0	12	170	*127*	*43*	50	25	7,500	7,500
T3-12	SF	Single Family	28.5	6.0	6	171	*171*	*0*				
T3-13	SF	Single Family	9.9	6.0	6	60	*60*	*0*				
P-3	Park		10.0			0						
SCHOOL	School		12.0			0						
T4-12	Res.	Multi Family & Single Family	6.5	8.0	12	52	*39*	*13*				
T4-13	Res.	Multi Family & Single Family	17.1	8.0	12	137	*102*	*35*			7,500	7,500
T5-11	Res./MU	MF, Senior, Live-Work	6.0	15.0	30	90	*0*	*90*	90	90	7,500	7,500
T5-12	Res./MU	Mixed Use	6.7	15.0	30	101	*0*	*101*	100	75	10,000	10,000
T5-14	Res./MU	Mixed Use, Affordable Housing	10.6	14.6	30	155	*0*	*155*	73	73	10,000	10,000
T4-1	Res./MU	Mixed SF and MF	12.7	8.0	12	102	*76*	*26*	70	30		
T4-2	Res./MU	Mixed SF and MF	10.7	8.0	12	86	*64*	*22*				
T4-3	Res./MU	Mixed SF and MF	15.4	8.0	12	124	*93*	*31*				

Appendix A - Project Land Use Description

Appendix B - Traffic Count Data Sheets

KALOKO MAKAI - LAND USE SUMMARY

Parcel I.D.	Land Use	Land Use Description	Parcel Size (Acres)	Density of Parcel (D.U./Acre)	Maximum Density (D.U./Acre)	# of Units	*SF Units*	*MF Units*	# of Aff. Units	# of Aff. Units (lower AMI's)	Retail Space	Office Space
T4-4	Res./MU	Mixed SF and MF	5.6	8.0	12	45	*33*	*12*				
T4-5	Res./MU	Mixed SF and MF	9.5	9.0	12	86	*64*	*22*			20,000	
T5-1	Res./MU	Mixed Use	10.7	15.0	30	161	*0*	*161*				
T5-2	Res./MU	Mixed Use	7.2	16.0	30	116	*0*	*116*				
T5-3	Res./MU	MF, Senior	7.4	16.0	30	119	*0*	*119*				
T5-4	Res./MU	Multi Family	10.9	16.0	30	175	*0*	*175*			25,000	
TOTAL PHASE 2 UNITS			**241.2**			**1950**	**829**	**1121**	**383**	**293**	**87,500**	**42,500**
									20%	15%		
PHASE 3												
INDUSTRIAL	Industrial	Light Industrial	25.0									
T3-1	SF	Large Lot Single Family	5.5	3.0	6	17	*17*	*0*				
T3-2	SF	Large Lot Single Family	1.8	3.0	6	6	*6*	*0*				
T3-3	SF	Large Lot Single Family	1.4	3.0	6	5	*5*	*0*				
T3-4	SF	Large Lot Single Family	25.1	3.0	6	76	*76*	*0*				
T3-5	SF	Single Family	22.3	5.0	6	112	*112*	*0*				
T3-6	SF	Single Family	14.1	5.0	6	71	*71*	*0*				
T3-7	SF	Single Family	23.4	5.0	6	117	*117*	*0*				
T3-8	SF	Single Family	12.6	5.0	6	63	*63*	*0*				
T4-6	Res./MU	Mixed SF and MF	11.8	10.0	12	118	*83*	*35*			15,000	
P-1	Park		11.2			0						
SCHOOL	School		12.0			0						
T4-7	Res./MU	Mixed SF and MF	9.1	10.0	12	91	*54*	*37*				
T3-9	SF	Single Family	38.5	5.0	6	193	*193*	*0*				
T4-8	Res./MU	Mixed Use, MF, Affordable	20.3	11.0	12	224	*134*	*90*	100	50		
T4-9	Res./MU	Live-Work & Affordable	18.6	11.0	12	205	*123*	*82*	160	50	15,000	10,000
FIRE STATION	Fire	Fire Station	5.5									
DESAL. PLANT	Desa Facility	Desalinization Plant	1.7									
TOTAL PHASE 3 UNITS			**234.9**			**1298**	**1054**	**244**	**260**	**100**	**30,000**	**10,000**
									20%	9%		
DRY FOREST	OS	Dryland Forest	150.0									
OPEN SPACE	OS	Open Space	72.2									
ROADWAYS	Roads	Roadways & Buffers	107.7									
TOTAL ALL 3 PHASES			**1112.8**			**5000**	**2354**	**2646**	**1000**	**700**	**335,000**	**265,000**
COMMERCIAL COMPONENT TOTAL											**600,000**	

T3	202.1
T4	212.0
T5	152.4

Wilson Okamoto Corporation

1907 S. Beretania Street Suite 400
Honolulu, Hi 96826

Counter:D4-5673, D4-5676
Counted By:SM, MM
Weather:Clear

File Name : QueKai PM
Site Code : 00000002
Start Date : 9/21/2010
Page No : 1

Groups Printed- Unshifted

	Queen Kaahumanu Highway Southbound					Kaiminani Drive Westbound					Queen Kaahumanu Highway Northbound					Eastbound	
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	App. Total	Int. Total
03:00 PM	23	133	0	0	156	56	0	12	0	68	0	129	47	0	176	0	400
03:15 PM	33	176	0	0	209	44	0	19	0	63	0	113	66	0	179	0	451
03:30 PM	55	156	0	0	211	51	0	15	0	66	0	127	102	0	229	0	506
03:45 PM	47	163	0	0	210	33	0	17	0	50	0	137	84	0	221	0	481
Total	158	628	0	0	786	184	0	63	0	247	0	506	299	0	805	0	1838
04:00 PM	47	156	0	0	203	43	0	17	0	60	0	105	82	0	187	0	450
04:15 PM	51	148	0	0	199	53	0	20	0	73	0	128	112	0	240	0	512
04:30 PM	30	132	0	0	162	39	0	11	0	50	0	126	97	0	223	0	435
04:45 PM	43	161	0	0	204	40	0	22	0	62	0	141	97	0	238	0	504
Total	171	597	0	0	768	175	0	70	0	245	0	500	388	0	888	0	1901
05:00 PM	28	120	0	0	148	39	0	23	0	62	0	122	95	0	217	0	427
05:15 PM	32	121	0	0	153	32	0	11	0	43	0	124	93	0	217	0	413
05:30 PM	27	118	0	0	145	36	0	20	0	56	0	115	98	0	213	0	414
05:45 PM	29	107	0	0	136	35	0	10	0	45	0	134	91	0	225	0	406
Total	116	466	0	0	582	142	0	64	0	206	0	495	377	0	872	0	1660
Grand Total	445	1691	0	0	2136	501	0	197	0	698	0	1501	1064	0	2565	0	5399
Apprch %	20.8	79.2	0	0		71.8	0	28.2	0		0	58.5	41.5	0			
Total %	8.2	31.3	0	0	39.6	9.3	0	3.6	0	12.9	0	27.8	19.7	0	47.5	0	

	Queen Kaahumanu Highway Southbound				Kaiminani Drive Westbound				Queen Kaahumanu Highway Northbound				Eastbound	
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1														
Peak Hour for Entire Intersection Begins at 03:30 PM														
03:30 PM	**55**	156	0	**211**	51	0	15	66	0	127	102	229	0	506
03:45 PM	47	**163**	0	210	33	0	17	50	0	**137**	84	221	0	481
04:00 PM	47	156	0	203	43	0	17	60	0	105	82	187	0	450
04:15 PM	51	148	0	199	**53**	0	**20**	**73**	0	128	**112**	**240**	0	**512**
Total Volume	200	623	0	823	180	0	69	249	0	497	380	877	0	1949
% App. Total	24.3	75.7	0		72.3	0	27.7		0	56.7	43.3			
PHF	.909	.956	.000	.975	.849	.000	.863	.853	.000	.907	.848	.914	.000	.952

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	Queen Kaahumanu Highway Southbound					Kaiminani drive Westbound					Queen Kaahumanu Highway Northbound					Eastbound	
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	App. Total	Int. Total
06:00 AM	3	56	0	0	59	42	0	29	0	71	0	73	16	0	89	0	219
06:15 AM	6	46	0	0	52	69	0	40	0	109	0	88	21	0	109	0	270
06:30 AM	8	77	0	0	85	81	0	50	0	131	0	116	34	0	150	0	366
06:45 AM	7	86	0	0	93	122	0	68	0	190	0	134	21	0	155	0	438
Total	24	265	0	0	289	314	0	187	0	501	0	411	92	0	503	0	1293
07:00 AM	8	86	0	0	94	106	0	58	0	164	0	150	24	0	174	0	432
07:15 AM	4	96	0	0	100	127	0	59	0	186	0	137	27	0	164	0	450
07:30 AM	6	106	0	0	112	125	0	36	0	161	0	141	30	0	171	0	444
07:45 AM	6	113	0	0	119	114	0	56	0	170	0	105	31	0	136	0	425
Total	24	401	0	0	425	472	0	209	0	681	0	533	112	0	645	0	1751
08:00 AM	13	91	0	0	104	86	0	31	0	117	0	103	40	0	143	0	364
08:15 AM	4	109	0	0	113	61	0	23	0	84	0	134	36	0	170	0	367
08:30 AM	9	130	0	0	139	59	0	31	0	90	0	118	25	0	143	0	372
08:45 AM	10	125	0	0	135	68	0	28	0	96	0	148	30	0	178	0	409
Total	36	455	0	0	491	274	0	113	0	387	0	503	131	0	634	0	1512
Grand Total	84	1121	0	0	1205	1060	0	509	0	1569	0	1447	335	0	1782	0	4556
Apprch %	7	93	0	0		67.6	0	32.4	0		0	81.2	18.8	0			
Total %	1.8	24.6	0	0	26.4	23.3	0	11.2	0	34.4	0	31.8	7.4	0	39.1	0	

	Queen Kaahumanu Highway Southbound				Kaiminani drive Westbound				Queen Kaahumanu Highway Northbound				Eastbound	
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1														
Peak Hour for Entire Intersection Begins at 06:45 AM														
06:45 AM	7	86	0	93	122	0	**68**	**190**	0	134	21	155	0	438
07:00 AM	**8**	86	0	94	106	0	58	164	0	**150**	24	**174**	0	432
07:15 AM	4	96	0	100	**127**	0	59	186	0	137	27	164	0	**450**
07:30 AM	6	**106**	0	**112**	125	0	36	161	0	**141**	**30**	171	0	444
Total Volume	25	374	0	399	480	0	221	701	0	562	102	664	0	1764
% App. Total	6.3	93.7	0		68.5	0	31.5		0	84.6	15.4			
PHF	.781	.882	.000	.891	.945	.000	.813	.922	.000	.937	.850	.954	.000	.980

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1907 S. Beretania Street Suite 400
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Counter:D4-3888, D4-3890
Counted By:AW, JW
Weather:Clear

File Name : QueHul PM
Site Code : 00000003
Start Date : 9/21/2010
Page No : 1

Groups Printed- Unshifted

	Queen Kaahumanu Highway Southbound					Hulikoa Drive Westbound					Queen Kaahumanu Highway Northbound					Eastbound	
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	App. Total	Int. Total
03:00 PM	17	236	0	0	253	20	0	22	0	42	0	148	12	0	160	0	455
03:15 PM	8	236	0	0	244	20	0	20	0	40	0	154	24	0	178	0	462
03:30 PM	17	206	0	3	226	23	0	26	0	49	0	167	19	0	186	0	461
03:45 PM	16	173	0	1	190	27	0	28	0	55	0	166	24	0	190	0	435
Total	58	851	0	4	913	90	0	96	0	186	0	635	79	0	714	0	1813
04:00 PM	17	216	0	0	233	31	0	30	0	61	0	159	15	0	174	0	468
04:15 PM	19	233	0	0	252	32	0	24	0	56	0	176	18	0	194	0	502
04:30 PM	7	226	0	0	233	27	0	20	0	47	0	197	17	0	214	0	494
04:45 PM	14	216	0	0	230	30	0	11	0	41	0	187	15	0	202	0	473
Total	57	891	0	0	948	120	0	85	0	205	0	719	65	0	784	0	1937
05:00 PM	18	180	0	0	198	14	0	28	0	42	0	191	14	0	205	0	445
05:15 PM	11	168	0	0	179	19	0	30	0	49	0	171	13	0	184	0	412
05:30 PM	17	169	0	0	186	13	0	11	0	24	0	213	10	0	223	0	433
05:45 PM	8	173	0	0	181	15	0	14	0	29	0	183	12	0	195	0	405
Total	54	690	0	0	744	61	0	83	0	144	0	758	49	0	807	0	1695
Grand Total	169	2432	0	4	2605	271	0	264	0	535	0	2112	193	0	2305	0	5445
Apprch %	6.5	93.4	0	0.2		50.7	0	49.3	0		0	91.6	8.4	0			
Total %	3.1	44.7	0	0.1	47.8	5	0	4.8	0	9.8	0	38.8	3.5	0	42.3	0	

	Queen Kaahumanu Highway Southbound				Hulikoa Drive Westbound				Queen Kaahumanu Highway Northbound				Eastbound	
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1														
Peak Hour for Entire Intersection Begins at 04:00 PM														
04:00 PM	17	216	0	233	31	0	**30**	**61**	0	159	15	174	0	468
04:15 PM	**19**	**233**	0	**252**	**32**	0	24	56	0	176	**18**	194	0	**502**
04:30 PM	7	226	0	233	27	0	20	47	0	**197**	17	**214**	0	494
04:45 PM	14	216	0	230	30	0	11	41	0	187	15	202	0	473
Total Volume	57	891	0	948	120	0	85	205	0	719	65	784	0	1937
% App. Total	6	94	0		58.5	0	41.5		0	91.7	8.3			
PHF	.750	.956	.000	.940	.938	.000	.708	.840	.000	.912	.903	.916	.000	.965

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	Queen Kaahumanu Highway Southbound					Hulikoa Drive Westbound					Queen Kaahumanu Highway Northbound					Eastbound	
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	App. Total	Int. Total
06:00 AM	14	76	0	0	90	3	0	8	1	12	0	89	19	0	108	0	210
06:15 AM	22	88	0	0	110	5	0	20	1	26	0	125	15	0	140	0	276
06:30 AM	15	132	0	0	147	2	0	18	0	20	0	130	53	0	183	0	350
06:45 AM	30	160	0	0	190	6	0	25	0	31	0	160	44	0	204	0	425
Total	81	456	0	0	537	16	0	71	2	89	0	504	131	0	635	0	1261
07:00 AM	18	151	0	0	169	32	0	32	0	64	0	135	36	0	171	0	404
07:15 AM	18	150	0	0	168	19	0	22	0	41	0	154	29	0	183	0	392
07:30 AM	11	218	0	0	229	22	0	24	0	46	0	141	32	0	173	0	448
07:45 AM	10	195	0	0	205	18	0	25	0	43	0	134	31	0	165	0	413
Total	57	714	0	0	771	91	0	103	0	194	0	564	128	0	692	0	1657
08:00 AM	17	145	0	0	162	20	0	21	0	41	0	152	32	0	184	0	387
08:15 AM	22	146	0	0	168	16	0	28	0	44	0	145	37	0	182	0	394
08:30 AM	36	147	0	0	183	22	0	24	0	46	0	130	22	0	152	0	381
08:45 AM	24	171	0	0	195	27	0	25	0	52	0	147	34	0	181	0	428
Total	99	609	0	0	708	85	0	98	0	183	0	574	125	0	699	0	1590
Grand Total	237	1779	0	0	2016	192	0	272	2	466	0	1642	384	0	2026	0	4508
Apprch %	11.8	88.2	0	0		41.2	0	58.4	0.4		0	81	19	0			
Total %	5.3	39.5	0	0	44.7	4.3	0	6	0	10.3	0	36.4	8.5	0	44.9	0	

	Queen Kaahumanu Highway Southbound				Hulikoa Drive Westbound				Queen Kaahumanu Highway Northbound				Eastbound	
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1														
Peak Hour for Entire Intersection Begins at 06:45 AM														
06:45 AM	**30**	160	0	190	6	0	25	31	0	**160**	**44**	**204**	0	425
07:00 AM	18	151	0	169	**32**	0	**32**	**64**	0	135	36	171	0	404
07:15 AM	18	150	0	168	19	0	22	41	0	154	29	183	0	392
07:30 AM	11	**218**	0	**229**	22	0	24	46	0	141	32	173	0	**448**
Total Volume	77	679	0	756	79	0	103	182	0	590	141	731	0	1669
% App. Total	10.2	89.8	0		43.4	0	56.6		0	80.7	19.3			
PHF	.642	.779	.000	.825	.617	.000	.805	.711	.000	.922	.801	.896	.000	.931

Wilson Okamoto Corporation

1907 S. Beretania Street Suite 400
Honolulu, Hi 96826

Counter:
Counted By:
Weather:

File Name : QueHin PM
Site Code : 00000004
Start Date : 9/21/2010
Page No : 1

Groups Printed- Unshifted

	Queen Kaahumanu Highway Southbound					Hina Lani Street Westbound					Queen Kaahumanu Highway Northbound					Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
03:00 PM	62	173	0	0	235	145	0	65	1	211	0	120	124	0	244	0	0	0	0	0	690
03:15 PM	62	188	0	3	253	116	0	61	2	179	0	140	143	0	283	0	0	0	0	0	715
03:30 PM	59	174	0	3	236	112	0	42	5	159	0	163	130	4	297	0	0	0	0	0	692
03:45 PM	50	185	0	4	239	106	0	62	7	175	0	156	124	3	283	0	0	0	0	0	697
Total	233	720	0	10	963	479	0	230	15	724	0	579	521	7	1107	0	0	0	0	0	2794
04:00 PM	45	183	0	3	231	113	0	69	8	190	0	111	136	1	248	0	0	0	0	0	669
04:15 PM	44	183	0	2	229	128	0	75	0	203	0	157	120	0	277	0	0	0	0	0	709
04:30 PM	61	166	0	2	229	115	0	70	8	193	0	166	130	0	296	0	0	0	0	0	718
04:45 PM	64	172	0	4	240	113	0	61	4	178	0	150	141	0	291	0	0	0	0	0	709
Total	214	704	0	11	929	469	0	275	20	764	0	584	527	1	1112	0	0	0	0	0	2805
05:00 PM	35	152	0	0	187	100	0	47	0	147	0	161	108	0	269	0	0	0	0	0	603
05:15 PM	35	130	0	5	170	114	0	67	1	182	0	132	97	0	229	0	0	0	0	0	581
05:30 PM	34	129	0	0	163	104	0	54	1	159	0	158	93	0	251	0	0	0	0	0	573
05:45 PM	50	118	0	0	168	78	0	49	1	128	0	132	67	1	200	0	0	0	0	0	496
Total	154	529	0	5	688	396	0	217	3	616	0	583	365	1	949	0	0	0	0	0	2253
Grand Total	601	1953	0	26	2580	1344	0	722	38	2104	0	1746	1413	9	3168	0	0	0	0	0	7852
Apprch %	23.3	75.7	0	1		63.9	0	34.3	1.8		0	55.1	44.6	0.3		0	0	0	0		
Total %	7.7	24.9	0	0.3	32.9	17.1	0	9.2	0.5	26.8	0	22.2	18	0.1	40.3	0	0	0	0	0	

	Queen Kaahumanu Highway Southbound					Hina Lani Street Westbound					Queen Kaahumanu Highway Northbound					Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:00 PM																					
04:00 PM	45	**183**	0	3	231	113	0	69	**8**	190	0	111	136	**1**	248	0	0	0	0	0	669
04:15 PM	44	183	0	2	229	**128**	0	**75**	0	**203**	0	157	120	0	277	0	0	0	0	0	709
04:30 PM	61	166	0	2	229	115	0	70	8	193	0	**166**	130	0	**296**	0	0	0	0	0	**718**
04:45 PM	**64**	172	0	**4**	**240**	113	0	61	4	178	0	150	**141**	0	291	0	0	0	0	0	709
Total Volume	214	704	0	11	929	469	0	275	20	764	0	584	527	1	1112	0	0	0	0	0	2805
% App. Total	23	75.8	0	1.2		61.4	0	36	2.6		0	52.5	47.4	0.1		0	0	0	0		
PHF	.836	.962	.000	.688	.968	.916	.000	.917	.625	.941	.000	.880	.934	.250	.939	.000	.000	.000	.000	.000	.977

Wilson Okamoto Corporation

1907 S. Beretania Street Suite 400
Honolulu, Hi 96826

Counter:D1-3889,
Counted By:JH, MO
Weather:Clear

File Name : QueHin AM
Site Code : 00000004
Start Date : 9/21/2010
Page No : 1

Groups Printed- Unshifted

	Queen Kaahumanu Highway Southbound					Hina Lani Street Westbound					Queen Kaahumanu Highway Northbound					Eastbound	
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	App. Total	Int. Total
06:00 AM	17	71	0	1	89	28	0	18	1	47	0	83	29	2	114	0	250
06:15 AM	16	77	0	0	93	23	0	40	0	63	0	111	31	0	142	0	298
06:30 AM	29	109	0	0	138	34	0	49	10	93	0	143	57	0	200	0	431
06:45 AM	26	117	0	0	143	34	0	54	3	91	0	161	82	0	243	0	477
Total	88	374	0	1	463	119	0	161	14	294	0	498	199	2	699	0	1456
07:00 AM	48	159	0	0	207	37	0	41	5	83	0	123	67	1	191	0	481
07:15 AM	37	174	0	0	211	53	0	47	5	105	0	121	67	2	190	0	506
07:30 AM	32	198	0	1	231	50	0	44	2	96	0	126	84	2	212	0	539
07:45 AM	50	188	0	0	238	46	0	40	9	95	0	102	96	1	199	0	532
Total	167	719	0	1	887	186	0	172	21	379	0	472	314	6	792	0	2058
08:00 AM	41	148	0	0	189	61	0	51	2	114	0	116	109	2	227	0	530
08:15 AM	36	146	0	0	182	60	0	63	1	124	0	128	84	3	215	0	521
08:30 AM	39	140	0	0	179	78	0	47	0	125	0	125	69	2	196	0	500
08:45 AM	55	154	0	0	209	58	0	47	0	105	0	141	95	0	236	0	550
Total	171	588	0	0	759	257	0	208	3	468	0	510	357	7	874	0	2101
Grand Total	426	1681	0	2	2109	562	0	541	38	1141	0	1480	870	15	2365	0	5615
Apprch %	20.2	79.7	0	0.1		49.3	0	47.4	3.3		0	62.6	36.8	0.6			
Total %	7.6	29.9	0	0	37.6	10	0	9.6	0.7	20.3	0	26.4	15.5	0.3	42.1	0	

	Queen Kaahumanu Highway Southbound				Hina Lani Street Westbound				Queen Kaahumanu Highway Northbound				Eastbound	
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1														
Peak Hour for Entire Intersection Begins at 07:30 AM														
07:30 AM	32	**198**	0	230	50	0	44	94	0	126	84	210	0	**534**
07:45 AM	**50**	188	0	**238**	46	0	40	86	0	102	96	198	0	522
08:00 AM	41	148	0	189	**61**	0	51	112	0	116	**109**	**225**	0	526
08:15 AM	36	146	0	182	60	0	**63**	**123**	0	**128**	84	212	0	517
Total Volume	159	680	0	839	217	0	198	415	0	472	373	845	0	2099
% App. Total	19	81	0		52.3	0	47.7		0	55.9	44.1			
PHF	.795	.859	.000	.881	.889	.000	.786	.843	.000	.922	.856	.939	.000	.983

Wilson Okamoto Corporation

1907 S. Beretania Street Suite 400
Honolulu, Hi 96826

Counter:D4-5671, D4-5672
Counted By:PL, SP
Weather:Clear

File Name : HinKan PM
Site Code : 00000005
Start Date : 9/21/2010
Page No : 1

Groups Printed- Unshifted

	Southbound	Hina Lani Street Westbound					Kanalani Street Northbound					Hina Lani Street Eastbound					
Start Time	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
03:00 PM	0	3	113	0	0	116	52	0	10	0	62	0	54	122	0	176	354
03:15 PM	0	0	116	0	2	118	43	0	9	0	52	0	58	109	0	167	337
03:30 PM	0	1	110	0	0	111	56	0	15	0	71	0	42	139	1	182	364
03:45 PM	0	0	110	0	0	110	47	0	13	0	60	0	49	120	0	169	339
Total	0	4	449	0	2	455	198	0	47	0	245	0	203	490	1	694	1394
04:00 PM	0	5	120	0	0	125	54	0	19	0	73	0	53	121	3	177	375
04:15 PM	0	5	98	0	0	103	59	0	10	0	69	0	52	103	0	155	327
04:30 PM	0	7	102	0	1	110	42	0	19	0	61	0	33	124	0	157	328
04:45 PM	0	7	78	0	0	85	41	0	10	0	51	0	78	116	1	195	331
Total	0	24	398	0	1	423	196	0	58	0	254	0	216	464	4	684	1361
05:00 PM	0	3	83	0	0	86	55	0	12	0	67	0	40	99	0	139	292
05:15 PM	0	3	80	0	0	83	28	0	10	0	38	0	31	88	0	119	240
05:30 PM	0	2	71	0	0	73	56	0	6	0	62	0	45	82	0	127	262
05:45 PM	0	1	59	0	0	60	39	0	2	0	41	0	34	75	0	109	210
Total	0	9	293	0	0	302	178	0	30	0	208	0	150	344	0	494	1004
Grand Total	0	37	1140	0	3	1180	572	0	135	0	707	0	569	1298	5	1872	3759
Apprch %		3.1	96.6	0	0.3		80.9	0	19.1	0		0	30.4	69.3	0.3		
Total %	0	1	30.3	0	0.1	31.4	15.2	0	3.6	0	18.8	0	15.1	34.5	0.1	49.8	

	Southbound	Hina Lani Street Westbound				Kanalani Street Northbound				Hina Lani Street Eastbound				
Start Time	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1														
Peak Hour for Entire Intersection Begins at 03:15 PM														
03:15 PM	0	0	116	0	116	43	0	9	52	0	58	109	167	335
03:30 PM	0	1	110	0	111	56	0	15	71	0	42	139	181	363
03:45 PM	0	0	110	0	110	47	0	13	60	0	49	120	169	339
04:00 PM	0	5	120	0	125	54	0	19	73	0	53	121	174	372
Total Volume	0	6	456	0	462	200	0	56	256	0	202	489	691	1409
% App. Total		1.3	98.7	0		78.1	0	21.9		0	29.2	70.8		
PHF	.000	.300	.950	.000	.924	.893	.000	.737	.877	.000	.871	.879	.954	.947

Wilson Okamoto Corporation

1907 S. Beretania Street Suite 400
Honolulu, Hi 96826

Counter: D4-5671, D4-5672
Counted By:PL, SP
Weather:Clear

File Name : HinKan AM
Site Code : 00000005
Start Date : 9/21/2010
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Groups Printed- Unshifted

	Southbound	Hina Lani Street Westbound					Kanalani Street Northbound					Hina Lani Street Eastbound					
Start Time	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
06:00 AM	0	6	19	0	1	26	27	0	2	0	29	0	12	35	0	47	102
06:15 AM	0	4	35	0	0	39	30	0	4	0	34	0	12	36	0	48	121
06:30 AM	0	7	53	0	0	60	31	0	3	0	34	0	9	76	0	85	179
06:45 AM	0	11	59	0	0	70	27	0	2	0	29	0	18	87	0	105	204
Total	0	28	166	0	1	195	115	0	11	0	126	0	51	234	0	285	606
07:00 AM	0	9	47	0	0	56	46	0	1	0	47	0	20	94	1	115	218
07:15 AM	0	5	48	0	1	54	45	0	2	0	47	0	33	70	6	109	210
07:30 AM	0	6	49	0	0	55	46	0	3	0	49	0	32	85	0	117	221
07:45 AM	0	11	45	0	1	57	44	0	3	0	47	0	33	101	1	135	239
Total	0	31	189	0	2	222	181	0	9	0	190	0	118	350	8	476	888
08:00 AM	0	8	53	0	0	61	59	0	4	0	63	0	33	105	0	138	262
08:15 AM	0	1	58	0	0	59	50	0	5	0	55	0	35	81	0	116	230
08:30 AM	0	4	50	0	0	54	63	0	1	0	64	0	32	66	2	100	218
08:45 AM	0	0	49	0	0	49	53	0	3	0	56	0	37	111	0	148	253
Total	0	13	210	0	0	223	225	0	13	0	238	0	137	363	2	502	963
Grand Total	0	72	565	0	3	640	521	0	33	0	554	0	306	947	10	1263	2457
Apprch %		11.2	88.3	0	0.5		94	0	6	0		0	24.2	75	0.8		
Total %	0	2.9	23	0	0.1	26	21.2	0	1.3	0	22.5	0	12.5	38.5	0.4	51.4	

	Southbound	Hina Lani Street Westbound				Kanalani Street Northbound				Hina Lani Street Eastbound				
Start Time	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1														
Peak Hour for Entire Intersection Begins at 08:00 AM														
08:00 AM	0	8	53	0	61	59	0	4	63	0	33	105	138	262
08:15 AM	0	1	58	0	59	50	0	5	55	0	35	81	116	230
08:30 AM	0	4	50	0	54	63	0	1	64	0	32	66	98	216
08:45 AM	0	0	49	0	49	53	0	3	56	0	37	111	148	253
Total Volume	0	13	210	0	223	225	0	13	238	0	137	363	500	961
% App. Total		5.8	94.2	0		94.5	0	5.5		0	27.4	72.6		
PHF	.000	.406	.905	.000	.914	.893	.000	.650	.930	.000	.926	.818	.845	.917

Wilson Okamoto Corporation

1907 S. Beretania Street Suite 400
Honolulu, Hi 96826

Counter:D4-5674, D4-5675
Counted By:CN, JM
Weather:Clear

File Name : HinKam PM
Site Code : 00000006
Start Date : 9/21/2010
Page No : 1

Groups Printed- Unshifted

	Southbound	Hina Lani Street Westbound					Kamanu Street Northbound					Hina Lani Street Eastbound					
Start Time	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
03:00 PM	0	26	12	0	0	38	97	0	46	0	143	0	13	25	0	38	219
03:15 PM	0	18	11	0	0	29	95	0	48	0	143	0	20	27	0	47	219
03:30 PM	0	26	19	0	0	45	94	0	52	0	146	0	26	26	0	52	243
03:45 PM	0	23	22	0	0	45	77	0	52	0	129	0	26	20	0	46	220
Total	0	93	64	0	0	157	363	0	198	0	561	0	85	98	0	183	901
04:00 PM	0	25	11	0	0	36	108	0	57	0	165	0	32	21	0	53	254
04:15 PM	0	20	14	0	0	34	94	0	62	0	156	0	32	27	0	59	249
04:30 PM	0	23	19	0	0	42	90	0	52	0	142	0	19	15	0	34	218
04:45 PM	0	15	8	0	0	23	73	0	49	0	122	0	37	34	0	71	216
Total	0	83	52	0	0	135	365	0	220	0	585	0	120	97	0	217	937
05:00 PM	0	19	12	0	0	31	76	0	46	1	123	0	25	20	0	45	199
05:15 PM	0	24	14	0	0	38	77	0	47	0	124	0	16	22	0	38	200
05:30 PM	0	15	9	0	0	24	62	0	34	0	96	0	26	25	0	51	171
05:45 PM	0	15	10	0	0	25	42	0	32	0	74	0	18	10	0	28	127
Total	0	73	45	0	0	118	257	0	159	1	417	0	85	77	0	162	697
Grand Total	0	249	161	0	0	410	985	0	577	1	1563	0	290	272	0	562	2535
Apprch %		60.7	39.3	0	0		63	0	36.9	0.1		0	51.6	48.4	0		
Total %	0	9.8	6.4	0	0	16.2	38.9	0	22.8	0	61.7	0	11.4	10.7	0	22.2	

	Southbound	Hina Lani Street Westbound				Kamanu Street Northbound				Hina Lani Street Eastbound				
Start Time	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1														
Peak Hour for Entire Intersection Begins at 03:30 PM														
03:30 PM	0	**26**	19	0	**45**	94	0	52	146	0	26	26	52	243
03:45 PM	0	23	**22**	0	45	77	0	52	129	0	26	20	46	220
04:00 PM	0	25	11	0	36	**108**	0	57	**165**	0	**32**	21	53	**254**
04:15 PM	0	20	14	0	34	94	0	**62**	156	0	32	**27**	**59**	249
Total Volume	0	94	66	0	160	373	0	223	596	0	116	94	210	966
% App. Total		58.8	41.2	0		62.6	0	37.4		0	55.2	44.8		
PHF	.000	.904	.750	.000	.889	.863	.000	.899	.903	.000	.906	.870	.890	.951

Wilson Okamoto Corporation

1907 S. Beretania Street Suite 400
Honolulu, Hi 96826

Counter:D4-5674, D4-5675
Counted By:CN, JM
Weather:Clear

File Name : HinKam AM
Site Code : 00000006
Start Date : 9/21/2010
Page No : 1

Groups Printed- Unshifted

	Southbound	Hina Lani Street Westbound					Kamanu Street Northbound					Hina Lani Street Eastbound					
Start Time	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
06:00 AM	0	14	16	0	0	30	5	0	2	0	7	0	7	7	0	14	51
06:15 AM	0	14	31	0	0	45	5	0	1	1	7	0	4	7	0	11	63
06:30 AM	0	22	47	0	0	69	13	0	6	0	19	0	6	5	1	12	100
06:45 AM	0	32	57	0	0	89	14	0	3	0	17	0	4	12	0	16	122
Total	0	82	151	0	0	233	37	0	12	1	50	0	21	31	1	53	336
07:00 AM	0	19	31	0	0	50	20	0	9	0	29	0	7	15	0	22	101
07:15 AM	0	28	35	0	0	63	18	0	4	0	22	0	15	19	0	34	119
07:30 AM	0	21	28	0	0	49	20	0	10	0	30	0	13	11	0	24	103
07:45 AM	0	29	37	0	0	66	20	0	12	0	32	0	12	20	0	32	130
Total	0	97	131	0	0	228	78	0	35	0	113	0	47	65	0	112	453
08:00 AM	0	39	34	0	0	73	30	0	11	0	41	0	9	25	0	34	148
08:15 AM	0	13	27	0	0	40	37	0	16	0	53	0	14	27	0	41	134
08:30 AM	0	19	22	0	0	41	25	0	15	0	40	0	12	18	0	30	111
08:45 AM	0	26	21	0	0	47	29	0	6	0	35	0	12	27	0	39	121
Total	0	97	104	0	0	201	121	0	48	0	169	0	47	97	0	144	514
Grand Total	0	276	386	0	0	662	236	0	95	1	332	0	115	193	1	309	1303
Apprch %		41.7	58.3	0	0		71.1	0	28.6	0.3		0	37.2	62.5	0.3		
Total %	0	21.2	29.6	0	0	50.8	18.1	0	7.3	0.1	25.5	0	8.8	14.8	0.1	23.7	

	Southbound	Hina Lani Street Westbound				Kamanu Street Northbound				Hina Lani Street Eastbound				
Start Time	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1														
Peak Hour for Entire Intersection Begins at 07:45 AM														
07:45 AM	0	29	**37**	0	66	20	0	12	32	0	12	20	32	130
08:00 AM	0	**39**	34	0	**73**	30	0	11	41	0	9	25	34	**148**
08:15 AM	0	13	27	0	40	**37**	0	**16**	**53**	0	**14**	**27**	**41**	134
08:30 AM	0	19	22	0	41	25	0	15	40	0	12	18	30	111
Total Volume	0	100	120	0	220	112	0	54	166	0	47	90	137	523
% App. Total		45.5	54.5	0		67.5	0	32.5		0	34.3	65.7		
PHF	.000	.641	.811	.000	.753	.757	.000	.844	.783	.000	.839	.833	.835	.883

Wilson Okamoto Corporation

1907 S. Beretania Street Suite 400
Honolulu, Hi 96826

Counter:D4-5671, D4-5672
Counted By:PL, SP
Weather:Clear

File Name : MamHin PM
Site Code : 00000012
Start Date : 9/22/2010
Page No : 1

Groups Printed- Unshifted

	Mamalahoa Highway Southbound					Westbound	Mamalahoa Highway Northbound					Hina Lani Street Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
03:00 PM	0	117	12	0	129	0	29	105	0	0	134	47	0	36	0	83	346
03:15 PM	0	94	13	0	107	0	20	112	0	0	132	48	0	41	0	89	328
03:30 PM	0	85	27	0	112	0	20	132	0	0	152	50	0	54	0	104	368
03:45 PM	0	92	25	0	117	0	26	122	0	0	148	42	0	52	0	94	359
Total	0	388	77	0	465	0	95	471	0	0	566	187	0	183	0	370	1401
04:00 PM	0	92	10	0	102	0	23	132	0	0	155	43	0	42	0	85	342
04:15 PM	0	122	24	0	146	0	8	125	0	0	133	55	0	62	0	117	396
04:30 PM	0	110	11	0	121	0	13	136	0	0	149	49	0	35	0	84	354
04:45 PM	0	100	8	0	108	0	20	131	0	0	151	42	0	49	0	91	350
Total	0	424	53	0	477	0	64	524	0	0	588	189	0	188	0	377	1442
05:00 PM	0	85	15	0	100	0	13	115	0	0	128	53	0	51	0	104	332
05:15 PM	0	118	12	0	130	0	11	128	0	0	139	40	0	24	0	64	333
05:30 PM	0	95	6	0	101	0	17	142	0	0	159	43	0	16	0	59	319
05:45 PM	0	101	14	0	115	0	9	113	0	0	122	40	0	16	0	56	293
Total	0	399	47	0	446	0	50	498	0	0	548	176	0	107	0	283	1277
Grand Total	0	1211	177	0	1388	0	209	1493	0	0	1702	552	0	478	0	1030	4120
Apprch %	0	87.2	12.8	0			12.3	87.7	0	0		53.6	0	46.4	0		
Total %	0	29.4	4.3	0	33.7	0	5.1	36.2	0	0	41.3	13.4	0	11.6	0	25	

	Mamalahoa Highway Southbound				Westbound	Mamalahoa Highway Northbound				Hina Lani Street Eastbound				
Start Time	Left	Thru	Right	App. Total	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1														
Peak Hour for Entire Intersection Begins at 03:30 PM														
03:30 PM	0	85	**27**	112	0	20	**132**	0	152	50	0	54	104	368
03:45 PM	0	92	25	117	0	**26**	122	0	148	42	0	52	94	359
04:00 PM	0	92	10	102	0	23	132	0	**155**	43	0	42	85	342
04:15 PM	0	**122**	24	**146**	0	8	125	0	133	**55**	0	**62**	**117**	**396**
Total Volume	0	391	86	477	0	77	511	0	588	190	0	210	400	1465
% App. Total	0	82	18			13.1	86.9	0		47.5	0	52.5		
PHF	.000	.801	.796	.817	.000	.740	.968	.000	.948	.864	.000	.847	.855	.925

Wilson Okamoto Corporation

1907 S. Beretania Street Suite 400
Honolulu, Hi 96826

Counter:D4-5671, D4-5672
Counted By:PL, SP
Weather:Clear

File Name : MamHin AM
Site Code : 00000012
Start Date : 9/22/2010
Page No : 1

Groups Printed- Unshifted

	Mamalahoa Highway Southbound					Westbound	Mamalahoa Highway Northbound					Hina Lani Street Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
06:00 AM	0	53	17	0	70	0	20	35	0	0	55	5	0	4	0	9	134
06:15 AM	0	85	19	0	104	0	20	44	0	0	64	12	0	3	0	15	183
06:30 AM	0	107	32	0	139	0	19	46	0	0	65	7	0	4	0	11	215
06:45 AM	0	192	53	0	245	0	29	56	0	0	85	3	0	13	0	16	346
Total	0	437	121	0	558	0	88	181	0	0	269	27	0	24	0	51	878
07:00 AM	0	241	29	0	270	0	22	66	0	0	88	7	0	14	0	21	379
07:15 AM	0	249	36	0	285	0	36	61	0	0	97	6	0	27	0	33	415
07:30 AM	0	244	25	0	269	0	23	62	0	0	85	22	0	22	0	44	398
07:45 AM	0	222	41	0	263	0	38	85	0	0	123	22	0	16	0	38	424
Total	0	956	131	0	1087	0	119	274	0	0	393	57	0	79	0	136	1616
08:00 AM	0	155	31	0	186	0	33	98	0	0	131	14	0	19	0	33	350
08:15 AM	0	115	25	0	140	0	27	89	0	0	116	14	0	10	0	24	280
08:30 AM	0	104	27	0	131	0	16	67	0	0	83	16	0	18	0	34	248
08:45 AM	0	99	36	0	135	0	19	60	0	0	79	17	0	6	0	23	237
Total	0	473	119	0	592	0	95	314	0	0	409	61	0	53	0	114	1115
Grand Total	0	1866	371	0	2237	0	302	769	0	0	1071	145	0	156	0	301	3609
Apprch %	0	83.4	16.6	0			28.2	71.8	0	0		48.2	0	51.8	0		
Total %	0	51.7	10.3	0	62	0	8.4	21.3	0	0	29.7	4	0	4.3	0	8.3	

	Mamalahoa Highway Southbound				Westbound	Mamalahoa Highway Northbound				Hina Lani Street Eastbound				
Start Time	Left	Thru	Right	App. Total	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1														
Peak Hour for Entire Intersection Begins at 07:00 AM														
07:00 AM	0	241	29	270	0	22	66	0	88	7	0	14	21	379
07:15 AM	0	**249**	36	**285**	0	36	61	0	97	6	0	**27**	33	415
07:30 AM	0	244	25	269	0	23	62	0	85	**22**	0	22	**44**	398
07:45 AM	0	222	**41**	263	0	**38**	**85**	0	**123**	22	0	16	38	**424**
Total Volume	0	956	131	1087	0	119	274	0	393	57	0	79	136	1616
% App. Total	0	87.9	12.1			30.3	69.7	0		41.9	0	58.1		
PHF	.000	.960	.799	.954	.000	.783	.806	.000	.799	.648	.000	.731	.773	.953

Wilson Okamoto Corporation

1907 S. Beretania Street Suite 400
Honolulu, Hi 96826

Counter:D4-3891, D4-0768
Counted By:PP, JK
Weather:Clear

File Name : QueKea PM
Site Code : 00000007
Start Date : 9/21/2010
Page No : 1

Groups Printed- Unshifted

	Queen Kaahumanu Highway Southbound					Kealakehe Parkway Westbound					Queen Kaahumanu Highway Northbound					Kealakehe Parkway Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
03:00 PM	23	224	20	0	267	18	1	14	0	33	15	206	72	0	293	12	4	18	0	34	627
03:15 PM	19	235	16	0	270	68	3	13	0	84	11	180	46	0	237	16	3	9	0	28	619
03:30 PM	15	221	11	0	247	83	5	13	0	101	16	193	50	0	259	6	4	12	0	22	629
03:45 PM	10	248	10	0	268	41	4	21	0	66	18	214	41	0	273	25	2	21	0	48	655
Total	67	928	57	0	1052	210	13	61	0	284	60	793	209	0	1062	59	13	60	0	132	2530
04:00 PM	12	255	13	0	280	46	5	15	0	66	14	219	38	0	271	19	6	26	0	51	668
04:15 PM	15	267	10	0	292	40	6	5	0	51	12	225	27	0	264	9	7	12	0	28	635
04:30 PM	23	226	11	0	260	31	7	12	0	50	18	235	23	0	276	15	3	16	0	34	620
04:45 PM	16	206	14	0	236	36	0	17	0	53	5	204	26	0	235	12	3	25	0	40	564
Total	66	954	48	0	1068	153	18	49	0	220	49	883	114	0	1046	55	19	79	0	153	2487
05:00 PM	17	211	9	0	237	15	0	17	0	32	16	215	50	0	281	13	2	7	0	22	572
05:15 PM	15	176	14	0	205	33	4	11	0	48	18	179	46	0	243	14	4	13	0	31	527
05:30 PM	15	195	7	0	217	36	4	13	1	54	10	188	32	0	230	19	3	15	0	37	538
05:45 PM	9	170	6	0	185	29	6	16	0	51	5	164	28	0	197	16	5	8	1	30	463
Total	56	752	36	0	844	113	14	57	1	185	49	746	156	0	951	62	14	43	1	120	2100
Grand Total	189	2634	141	0	2964	476	45	167	1	689	158	2422	479	0	3059	176	46	182	1	405	7117
Apprch %	6.4	88.9	4.8	0		69.1	6.5	24.2	0.1		5.2	79.2	15.7	0		43.5	11.4	44.9	0.2		
Total %	2.7	37	2	0	41.6	6.7	0.6	2.3	0	9.7	2.2	34	6.7	0	43	2.5	0.6	2.6	0	5.7	

	Queen Kaahumanu Highway Southbound				Kealakehe Parkway Westbound				Queen Kaahumanu Highway Northbound				Kealakehe Parkway Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 03:00 PM to 05:45 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 03:30 PM																	
03:30 PM	**15**	221	11	247	**83**	5	13	**101**	16	193	**50**	259	6	4	12	22	629
03:45 PM	10	248	10	268	41	4	**21**	66	**18**	214	41	**273**	**25**	2	21	48	655
04:00 PM	12	255	**13**	280	46	5	15	66	14	219	38	271	19	6	**26**	**51**	**668**
04:15 PM	15	**267**	10	**292**	40	**6**	5	51	12	**225**	27	264	9	**7**	12	28	635
Total Volume	52	991	44	1087	210	20	54	284	60	851	156	1067	59	19	71	149	2587
% App. Total	4.8	91.2	4		73.9	7	19		5.6	79.8	14.6		39.6	12.8	47.7		
PHF	.867	.928	.846	.931	.633	.833	.643	.703	.833	.946	.780	.977	.590	.679	.683	.730	.968

Wilson Okamoto Corporation

1907 S. Beretania Street Suite 400
Honolulu, Hi 96826

Counter:D4-3891, D4-0768
Counted By:PP, JK
Weather:Clear

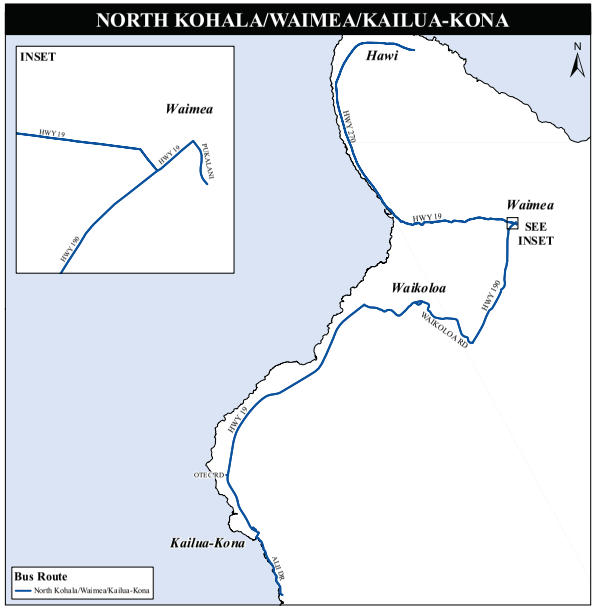
File Name : QueKea AM
Site Code : 00000007
Start Date : 9/21/2010
Page No : 1

Groups Printed- Unshifted

	Queen Kaahumanu Highway Southbound					Kealakehe Parkway Westbound					Queen Kaahumanu Highway Northbound					Kealakehe Parkway Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
06:00 AM	9	50	21	1	81	8	2	15	0	25	7	128	10	0	145	2	2	7	0	11	262
06:15 AM	10	71	9	0	90	14	2	19	0	35	5	143	16	2	166	0	1	6	0	7	298
06:30 AM	19	84	8	1	112	17	3	28	0	48	15	170	31	0	216	5	0	2	0	7	383
06:45 AM	16	97	14	0	127	27	2	27	0	56	15	207	47	1	270	5	2	1	0	8	461
Total	54	302	52	2	410	66	9	89	0	164	42	648	104	3	797	12	5	16	0	33	1404
07:00 AM	25	137	6	0	168	28	2	23	0	53	11	169	39	0	219	3	0	3	0	6	446
07:15 AM	34	155	12	1	202	38	1	48	0	87	13	157	54	0	224	6	2	1	0	9	522
07:30 AM	40	166	13	1	220	55	7	25	0	87	17	153	66	0	236	4	1	11	0	16	559
07:45 AM	45	167	11	0	223	64	3	27	0	94	24	165	90	0	279	2	2	9	0	13	609
Total	144	625	42	2	813	185	13	123	0	321	65	644	249	0	958	15	5	24	0	44	2136
08:00 AM	39	131	12	0	182	72	7	38	0	117	14	153	84	2	253	5	2	3	0	10	562
08:15 AM	16	156	14	0	186	51	5	26	0	82	10	165	11	0	186	6	3	11	0	20	474
08:30 AM	7	178	8	0	193	21	0	14	0	35	27	175	24	0	226	1	4	13	0	18	472
08:45 AM	12	172	22	0	206	18	4	16	0	38	27	193	23	0	243	7	1	14	0	22	509
Total	74	637	56	0	767	162	16	94	0	272	78	686	142	2	908	19	10	41	0	70	2017
Grand Total	272	1564	150	4	1990	413	38	306	0	757	185	1978	495	5	2663	46	20	81	0	147	5557
Apprch %	13.7	78.6	7.5	0.2		54.6	5	40.4	0		6.9	74.3	18.6	0.2		31.3	13.6	55.1	0		
Total %	4.9	28.1	2.7	0.1	35.8	7.4	0.7	5.5	0	13.6	3.3	35.6	8.9	0.1	47.9	0.8	0.4	1.5	0	2.6	

	Queen Kaahumanu Highway Southbound					Kealakehe Parkway Westbound					Queen Kaahumanu Highway Northbound					Kealakehe Parkway Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:15 AM																					
07:15 AM	34	155	12	**1**	202	38	1	**48**	0	87	13	157	54	0	224	**6**	**2**	1	0	9	522
07:30 AM	40	166	**13**	1	220	55	**7**	25	0	87	17	153	66	0	236	4	1	**11**	0	**16**	559
07:45 AM	**45**	**167**	11	0	**223**	64	3	27	0	94	**24**	**165**	**90**	0	**279**	2	2	9	0	13	**609**
08:00 AM	39	131	12	0	182	**72**	7	38	0	**117**	14	153	84	**2**	253	5	2	3	0	10	562
Total Volume	158	619	48	2	827	229	18	138	0	385	68	628	294	2	992	17	7	24	0	48	2252
% App. Total	19.1	74.8	5.8	0.2		59.5	4.7	35.8	0		6.9	63.3	29.6	0.2		35.4	14.6	50	0		
PHF	.878	.927	.923	.500	.927	.795	.643	.719	.000	.823	.708	.952	.817	.250	.889	.708	.875	.545	.000	.750	.924

Appendix C – Bus Route Map and Schedule



COUNTY OF HAWAII
MASS TRANSIT AGENCY
961-8744
NORTH KOHALA/
WAIMEA/KAILUA-KONA
BUS SCHEDULE

In consideration of others and for your safety:

1. Shirts and footwear are required.
2. No flammable, explosive or toxic material.
3. No smoking, consumption of food or beverage.
4. Discarding of litter.
5. Expectorating or spitting.
6. The playing of radios, tape players, dvd players, and cell phones are prohibited without headphones.
7. Refrain from horseplaying, yelling or talking loudly.
8. The following items are prohibited unless prior permission is granted:
   a. Bodyboards
9. **$1.00 charge for pets (except service animals) provided they are kept in an enclosed container or cage**
10. **$1.00 charge per item larger than 16" x 18"or more than one item that cannot fit underneath your seat. $1.00 charge for bicycle.**
11. Please utilize designated bus stop zones whenever possible.

How to board the bus:

1. Wait on the proper side of the roadway for the bus.
2. Flag the bus (please call for bus stop information).
3. Wait until the bus makes a complete stop.
4. Boarding will be denied if passengers appear to be intoxicated on liquor or drugs; engaged in activities that violate any other law or ordinance.

How to exit the bus:

1. Before reaching your desired "get off" spot, pull cord located by the window of the bus.
2. Remain seated until the bus comes to a complete stop.
3. Exit from front of bus.

DISCLAIMER: The County of Hawaii will not be responsible for any inconvenience, expense, or damages resulting from the failure to depart or arrive at stated times or for any items brought on the bus.

For more information visit www.heleonbus.org

County of Hawaii is an Equal Opportunity Employer and Provider

NORTH KOHALA/WAIMEA/KAILUA-KONA

Effective 7/01/2010

Operates Monday through Friday

North Kohala/Waimea/Keauhou

Kapuau Dispensary	Hawi Intersection	Kawaihae Road	Highway 19 & Highway 250 Intersection	Parker Square	Parker School (across by church)	Parker Ranch Shopping Center (back)	Waimea Park	Waikoloa Village Post Office	Kmart	Ali Drive	Keauhou Shopping Center
6:45	**6:50**	**7:15**	**7:30**	**7:35**	**7:40**	**7:45**	**8:20**	**8:45**	**9:30**	**9:40**	**9:50**

Keauhou/Waimea/North Kohala

***BOLD = MORNINGS

Keauhou Shopping Center	Ali Drive	Kmart	Waikoloa Village Post Office	Parker Ranch Shopping Center (back)	Parker School	Waimea Park	HPA Lower Campus	Highway 19 & Highway 250 Intersection	Kawaihae Road	Hawi Intersection	Kapuau Dispensary
1:35	1:50	2:00	2:45	3:25	3:30	3:35	3:40	3:45	4:00	4:50	4:55

******SCHEDULE BELOW OPERATES SATURDAY ONLY******

North Kohala to Keauhou shopping Center

Kapuau Dispensary	Hawi Intersection	Waikoloa Village	Kmart	Walmart	Ali Drive	Keauhou Shopping Center
9:15	**9:20**	**10:05**	**11:15**	**11:25**	**11:30**	**11:45**

***BOLD = MORNINGS

Keauhou to North Kohala Shopping Center

Keauhou Shopping Center	Ali Drive	Walmart	Kmart	Waikoloa Post Office	Hawi Intersection	Kapuau Dispensary
2:30	2:40	3:00	3:10	3:55	4:30	4:35

For more information call Mass Transit @ 961-8744

Appendix D – Intersection Operations Analysis Worksheets for Existing Traffic Conditions

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	1863	1583	1770	1863
Flt Permitted	0.95	1.00	1.00	1.00	0.17	1.00
Satd. Flow (perm)	1770	1583	1863	1583	317	1863
Volume (vph)	480	221	562	102	25	374
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	522	240	611	111	27	407
RTOR Reduction (vph)	0	0	0	68	0	0
Lane Group Flow (vph)	522	240	611	43	27	407
Turn Type		Free		Perm	pm+pt	
Protected Phases	8		2		1	6
Permitted Phases		Free		2	6	
Actuated Green, G (s)	17.9	50.7	19.5	19.5	24.8	24.8
Effective Green, g (s)	17.9	50.7	19.5	19.5	24.8	24.8
Actuated g/C Ratio	0.35	1.00	0.38	0.38	0.49	0.49
Clearance Time (s)	4.0		4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0		3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	625	1583	717	609	192	911
v/s Ratio Prot	c0.29		c0.33		0.00	c0.22
v/s Ratio Perm		0.15		0.03	0.07	
v/c Ratio	0.84	0.15	0.85	0.07	0.14	0.45
Uniform Delay, d1	15.0	0.0	14.3	9.9	9.3	8.5
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	9.4	0.2	9.6	0.0	0.3	0.4
Delay (s)	24.5	0.2	23.9	9.9	9.7	8.8
Level of Service	C	A	C	A	A	A
Approach Delay (s)	16.8		21.7			8.9
Approach LOS	B		C			A

Intersection Summary			
HCM Average Control Delay	16.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.85		
Actuated Cycle Length (s)	50.7	Sum of lost time (s)	12.0
Intersection Capacity Utilization	62.8%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	79	103	590	141	77	679
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	86	112	641	153	84	738
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)		20				
Median type	TWLTL					
Median storage veh)	5					
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1547	641			641	
vC1, stage 1 conf vol	641					
vC2, stage 2 conf vol	905					
vCu, unblocked vol	1547	641			641	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)	5.4					
tF (s)	3.5	3.3			2.2	
p0 queue free %	76	76			91	
cM capacity (veh/h)	351	475			943	

Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	198	641	153	84	738
Volume Left	86	0	0	84	0
Volume Right	112	0	153	0	0
cSH	810	1700	1700	943	1700
Volume to Capacity	0.24	0.38	0.09	0.09	0.43
Queue Length 95th (ft)	24	0	0	7	0
Control Delay (s)	16.5	0.0	0.0	9.2	0.0
Lane LOS	C			A	
Approach Delay (s)	16.5	0.0		0.9	
Approach LOS	C				

Intersection Summary			
Average Delay	2.2		
Intersection Capacity Utilization	49.7%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frpb, ped/bikes	1.00	0.98	1.00	0.97	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1546	1863	1534	1768	1863
Flt Permitted	0.95	1.00	1.00	1.00	0.28	1.00
Satd. Flow (perm)	1770	1546	1863	1534	524	1863
Volume (vph)	217	198	472	373	159	680
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	236	215	513	405	173	739
RTOR Reduction (vph)	0	174	0	223	0	0
Lane Group Flow (vph)	236	41	513	182	173	739
Confl. Peds. (#/hr)		14		8	8	
Turn Type		Perm		Perm	pm+pt	
Protected Phases	8		2		1	6
Permitted Phases		8		2	6	
Actuated Green, G (s)	8.6	8.6	20.2	20.2	28.3	28.3
Effective Green, g (s)	8.6	8.6	20.2	20.2	28.3	28.3
Actuated g/C Ratio	0.19	0.19	0.45	0.45	0.63	0.63
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	339	296	838	690	444	1174
v/s Ratio Prot	c0.13		0.28		0.04	c0.40
v/s Ratio Perm		0.03		0.12	0.21	
v/c Ratio	0.70	0.14	0.61	0.26	0.39	0.63
Uniform Delay, d1	16.9	15.1	9.4	7.7	4.7	5.1
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	6.1	0.2	1.3	0.2	0.6	1.1
Delay (s)	23.0	15.3	10.7	7.9	5.3	6.2
Level of Service	C	B	B	A	A	A
Approach Delay (s)	19.3		9.5			6.0
Approach LOS	B		A			A

Intersection Summary			
HCM Average Control Delay	10.0	HCM Level of Service	B
HCM Volume to Capacity ratio	0.64		
Actuated Cycle Length (s)	44.9	Sum of lost time (s)	8.0
Intersection Capacity Utilization	56.2%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	137	363	13	210	225	13
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	149	395	14	228	245	14
Pedestrians					2	
Lane Width (ft)					12.0	
Walking Speed (ft/s)					4.0	
Percent Blockage					0	
Right turn flare (veh)						6
Median type					None	
Median storage veh)						
Upstream signal (ft)	475					
pX, platoon unblocked						
vC, conflicting volume			545		293	151
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			545		293	151
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			99		63	98
cM capacity (veh/h)			1018		663	867

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	149	395	90	152	259
Volume Left	0	0	14	0	245
Volume Right	0	395	0	0	14
cSH	1700	1700	1018	1700	702
Volume to Capacity	0.09	0.23	0.01	0.09	0.37
Queue Length 95th (ft)	0	0	1	0	42
Control Delay (s)	0.0	0.0	1.4	0.0	13.3
Lane LOS			A		B
Approach Delay (s)	0.0		0.5		13.3
Approach LOS					B

Intersection Summary			
Average Delay	3.4		
Intersection Capacity Utilization	35.5%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	47	90	100	120	112	54
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	51	98	109	130	122	59
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						14
Median type					TWLTL	
Median storage veh)					5	
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			51		399	51
vC1, stage 1 conf vol					51	
vC2, stage 2 conf vol					348	
vCu, unblocked vol			51		399	51
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)					5.4	
tF (s)			2.2		3.5	3.3
p0 queue free %			93		82	94
cM capacity (veh/h)			1555		665	1017

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	51	98	109	130	180
Volume Left	0	0	109	0	122
Volume Right	0	98	0	0	59
cSH	1700	1700	1555	1700	985
Volume to Capacity	0.03	0.06	0.07	0.08	0.18
Queue Length 95th (ft)	0	0	6	0	17
Control Delay (s)	0.0	0.0	7.5	0.0	10.7
Lane LOS			A		B
Approach Delay (s)	0.0		3.4		10.7
Approach LOS					B

Intersection Summary			
Average Delay	4.8		
Intersection Capacity Utilization	25.1%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1770	1583	1770	1863	1863	1583
Flt Permitted	0.95	1.00	0.11	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	202	1863	1863	1583
Volume (vph)	57	79	119	274	956	131
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	62	86	129	298	1039	142
RTOR Reduction (vph)	0	78	0	0	0	25
Lane Group Flow (vph)	62	8	129	298	1039	117
Turn Type		Perm	pm+pt			Perm
Protected Phases	4		5	2	6	
Permitted Phases		4	2			6
Actuated Green, G (s)	5.9	5.9	50.1	50.1	42.6	42.6
Effective Green, g (s)	5.9	5.9	50.1	50.1	42.6	42.6
Actuated g/C Ratio	0.09	0.09	0.78	0.78	0.67	0.67
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	163	146	244	1458	1240	1054
v/s Ratio Prot	c0.04		c0.03	0.16	c0.56	
v/s Ratio Perm		0.01	0.39			0.07
v/c Ratio	0.38	0.05	0.53	0.20	0.84	0.11
Uniform Delay, d1	27.3	26.5	10.4	1.8	8.1	3.9
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.5	0.2	2.1	0.1	5.1	0.0
Delay (s)	28.8	26.7	12.5	1.9	13.2	3.9
Level of Service	C	C	B	A	B	A
Approach Delay (s)	27.6			5.1	12.1	
Approach LOS	C			A	B	

Intersection Summary			
HCM Average Control Delay	11.7	HCM Level of Service	B
HCM Volume to Capacity ratio	0.77		
Actuated Cycle Length (s)	64.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	70.2%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frpb, ped/bikes		1.00	1.00		1.00	1.00	1.00	1.00	0.98	1.00	1.00	0.98
Flpb, ped/bikes		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		1.00	0.85		1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected		0.97	1.00		0.96	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)		1800	1583		1780	1583	1769	1863	1548	1770	1863	1548
Flt Permitted		0.78	1.00		0.72	1.00	0.21	1.00	1.00	0.16	1.00	1.00
Satd. Flow (perm)		1458	1583		1347	1583	398	1863	1548	298	1863	1548
Volume (vph)	17	7	24	229	18	138	68	628	294	158	619	48
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	18	8	26	249	20	150	74	683	320	172	673	52
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	178	0	0	27
Lane Group Flow (vph)	0	26	26	0	269	150	74	683	142	172	673	25
Confl. Peds. (#/hr)							2		2	2		2
Turn Type	Perm		Free	Perm		Free	pm+pt		Perm	pm+pt		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		Free	8		Free	2		2	6		6
Actuated Green, G (s)		13.9	53.0		13.9	53.0	25.6	23.5	23.5	28.6	25.0	25.0
Effective Green, g (s)		13.9	53.0		13.9	53.0	25.6	23.5	23.5	28.6	25.0	25.0
Actuated g/C Ratio		0.26	1.00		0.26	1.00	0.48	0.44	0.44	0.54	0.47	0.47
Clearance Time (s)		4.0			4.0		4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)		3.0			3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)		382	1583		353	1583	247	826	686	261	879	730
v/s Ratio Prot							0.01	c0.37		c0.04	0.36	
v/s Ratio Perm		0.02	0.02		c0.20	c0.09	0.13		0.09	0.31		0.02
v/c Ratio		0.07	0.02		0.76	0.09	0.30	0.83	0.21	0.66	0.77	0.03
Uniform Delay, d1		14.7	0.0		18.0	0.0	8.7	13.0	9.0	9.1	11.6	7.5
Progression Factor		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2		0.1	0.0		9.4	0.1	0.7	6.8	0.2	5.9	4.0	0.0
Delay (s)		14.8	0.0		27.4	0.1	9.4	19.8	9.2	15.0	15.6	7.5
Level of Service		B	A		C	A	A	B	A	B	B	A
Approach Delay (s)		7.4			17.6			15.9			15.0	
Approach LOS		A			B			B			B	

Intersection Summary			
HCM Average Control Delay	15.7	HCM Level of Service	B
HCM Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	53.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	72.1%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	1863	1583	1770	1863
Flt Permitted	0.95	1.00	1.00	1.00	0.26	1.00
Satd. Flow (perm)	1770	1583	1863	1583	483	1863
Volume (vph)	180	69	497	380	200	623
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	196	75	540	413	217	677
RTOR Reduction (vph)	0	0	0	228	0	0
Lane Group Flow (vph)	196	75	540	185	217	677
Turn Type		Free		Perm	pm+pt	
Protected Phases	8		2		1	6
Permitted Phases		Free		2	6	
Actuated Green, G (s)	8.0	45.0	20.2	20.2	29.0	29.0
Effective Green, g (s)	8.0	45.0	20.2	20.2	29.0	29.0
Actuated g/C Ratio	0.18	1.00	0.45	0.45	0.64	0.64
Clearance Time (s)	4.0		4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0		3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	315	1583	836	711	449	1201
v/s Ratio Prot	c0.11		c0.29		0.05	c0.36
v/s Ratio Perm		0.05		0.12	0.26	
v/c Ratio	0.62	0.05	0.65	0.26	0.48	0.56
Uniform Delay, d1	17.1	0.0	9.6	7.7	4.9	4.5
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	3.8	0.1	1.7	0.2	0.8	0.6
Delay (s)	20.9	0.1	11.3	7.9	5.7	5.1
Level of Service	C	A	B	A	A	A
Approach Delay (s)	15.1		9.9			5.2
Approach LOS	B		A			A

Intersection Summary			
HCM Average Control Delay	8.6	HCM Level of Service	A
HCM Volume to Capacity ratio	0.65		
Actuated Cycle Length (s)	45.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	57.2%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	120	85	719	65	57	891
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	130	92	782	71	62	968
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)		20				
Median type	TWLTL					
Median storage veh)	5					
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1874	782			782	
vC1, stage 1 conf vol	782					
vC2, stage 2 conf vol	1092					
vCu, unblocked vol	1874	782			782	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)	5.4					
tF (s)	3.5	3.3			2.2	
p0 queue free %	55	77			93	
cM capacity (veh/h)	290	395			836	

Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	223	782	71	62	968
Volume Left	130	0	0	62	0
Volume Right	92	0	71	0	0
cSH	496	1700	1700	836	1700
Volume to Capacity	0.45	0.46	0.04	0.07	0.57
Queue Length 95th (ft)	57	0	0	6	0
Control Delay (s)	22.9	0.0	0.0	9.6	0.0
Lane LOS	C			A	
Approach Delay (s)	22.9	0.0		0.6	
Approach LOS	C				

Intersection Summary			
Average Delay	2.7		
Intersection Capacity Utilization	60.2%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frpb, ped/bikes	1.00	0.96	1.00	0.98	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1526	1863	1548	1770	1863
Flt Permitted	0.95	1.00	1.00	1.00	0.13	1.00
Satd. Flow (perm)	1770	1526	1863	1548	251	1863
Volume (vph)	469	275	584	527	214	704
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	510	299	635	573	233	765
RTOR Reduction (vph)	0	203	0	350	0	0
Lane Group Flow (vph)	510	96	635	223	233	765
Confl. Peds. (#/hr)		20		1	1	
Turn Type		Perm		Perm	pm+pt	
Protected Phases	8		2		1	6
Permitted Phases		8		2	6	
Actuated Green, G (s)	21.2	21.2	25.7	25.7	36.8	36.8
Effective Green, g (s)	21.2	21.2	25.7	25.7	36.8	36.8
Actuated g/C Ratio	0.32	0.32	0.39	0.39	0.56	0.56
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	569	490	725	603	303	1039
v/s Ratio Prot	c0.29		c0.34		0.08	c0.41
v/s Ratio Perm		0.06		0.14	0.35	
v/c Ratio	0.90	0.20	0.88	0.37	0.77	0.74
Uniform Delay, d1	21.4	16.2	18.7	14.4	12.3	11.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	16.6	0.2	11.5	0.4	11.1	2.8
Delay (s)	38.0	16.4	30.2	14.8	23.4	13.7
Level of Service	D	B	C	B	C	B
Approach Delay (s)	30.0		22.9			16.0
Approach LOS	C		C			B

Intersection Summary			
HCM Average Control Delay	22.5	HCM Level of Service	C
HCM Volume to Capacity ratio	0.89		
Actuated Cycle Length (s)	66.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	78.6%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	202	489	6	456	200	56
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	220	532	7	496	217	61
Pedestrians					4	
Lane Width (ft)					12.0	
Walking Speed (ft/s)					4.0	
Percent Blockage					0	
Right turn flare (veh)						6
Median type					None	
Median storage veh)						
Upstream signal (ft)	475					
pX, platoon unblocked						
vC, conflicting volume			755		484	224
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			755		484	224
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			99		57	92
cM capacity (veh/h)			848		506	777

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	220	532	172	330	278
Volume Left	0	0	7	0	217
Volume Right	0	532	0	0	61
cSH	1700	1700	848	1700	647
Volume to Capacity	0.13	0.31	0.01	0.19	0.43
Queue Length 95th (ft)	0	0	1	0	54
Control Delay (s)	0.0	0.0	0.4	0.0	15.8
Lane LOS			A		C
Approach Delay (s)	0.0		0.1		15.8
Approach LOS					C

Intersection Summary			
Average Delay	2.9		
Intersection Capacity Utilization	50.2%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	116	94	94	66	373	223
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	126	102	102	72	405	242
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						14
Median type					TWLTL	
Median storage veh)					5	
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			126		402	126
vC1, stage 1 conf vol					126	
vC2, stage 2 conf vol					276	
vCu, unblocked vol			126		402	126
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)					5.4	
tF (s)			2.2		3.5	3.3
p0 queue free %			93		43	74
cM capacity (veh/h)			1460		715	924

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	126	102	102	72	648
Volume Left	0	0	102	0	405
Volume Right	0	102	0	0	242
cSH	1700	1700	1460	1700	1142
Volume to Capacity	0.07	0.06	0.07	0.04	0.57
Queue Length 95th (ft)	0	0	6	0	93
Control Delay (s)	0.0	0.0	7.7	0.0	14.1
Lane LOS			A		B
Approach Delay (s)	0.0		4.5		14.1
Approach LOS					B

Intersection Summary			
Average Delay	9.5		
Intersection Capacity Utilization	39.2%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1770	1583	1770	1863	1863	1583
Flt Permitted	0.95	1.00	0.28	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	521	1863	1863	1583
Volume (vph)	190	210	77	511	391	86
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	207	228	84	555	425	93
RTOR Reduction (vph)	0	174	0	0	0	62
Lane Group Flow (vph)	207	54	84	555	425	31
Turn Type		Perm	pm+pt			Perm
Protected Phases	4		5	2	6	
Permitted Phases		4	2			6
Actuated Green, G (s)	7.6	7.6	16.3	16.3	10.5	10.5
Effective Green, g (s)	7.6	7.6	16.3	16.3	10.5	10.5
Actuated g/C Ratio	0.24	0.24	0.51	0.51	0.33	0.33
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	422	377	337	952	613	521
v/s Ratio Prot	c0.12		0.01	c0.30	0.23	
v/s Ratio Perm		0.03	0.11			0.02
v/c Ratio	0.49	0.14	0.25	0.58	0.69	0.06
Uniform Delay, d1	10.5	9.6	4.8	5.4	9.3	7.3
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.9	0.2	0.4	0.9	3.4	0.0
Delay (s)	11.4	9.8	5.1	6.3	12.7	7.4
Level of Service	B	A	A	A	B	A
Approach Delay (s)	10.5			6.2	11.7	
Approach LOS	B			A	B	

Intersection Summary			
HCM Average Control Delay	9.2	HCM Level of Service	A
HCM Volume to Capacity ratio	0.55		
Actuated Cycle Length (s)	31.9	Sum of lost time (s)	8.0
Intersection Capacity Utilization	45.4%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		1.00	0.85		1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected		0.96	1.00		0.96	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)		1795	1583		1782	1583	1770	1863	1583	1770	1863	1583
Flt Permitted		0.52	1.00		0.68	1.00	0.08	1.00	1.00	0.12	1.00	1.00
Satd. Flow (perm)		964	1583		1275	1583	151	1863	1583	228	1863	1583
Volume (vph)	59	19	71	210	20	54	60	851	156	52	991	44
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	64	21	77	228	22	59	65	925	170	57	1077	48
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	68	0	0	19
Lane Group Flow (vph)	0	85	77	0	250	59	65	925	102	57	1077	29
Turn Type	Perm		Free	Perm		Free	pm+pt		Perm	pm+pt		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		Free	8		Free	2		2	6		6
Actuated Green, G (s)		18.0	82.4		18.0	82.4	52.4	49.5	49.5	52.4	49.5	49.5
Effective Green, g (s)		18.0	82.4		18.0	82.4	52.4	49.5	49.5	52.4	49.5	49.5
Actuated g/C Ratio		0.22	1.00		0.22	1.00	0.64	0.60	0.60	0.64	0.60	0.60
Clearance Time (s)		4.0			4.0		4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)		3.0			3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)		211	1583		279	1583	153	1119	951	199	1119	951
v/s Ratio Prot							c0.01	0.50		0.01	c0.58	
v/s Ratio Perm		0.09	0.05		c0.20	0.04	0.26		0.06	0.17		0.02
v/c Ratio		0.40	0.05		0.90	0.04	0.42	0.83	0.11	0.29	0.96	0.03
Uniform Delay, d1		27.6	0.0		31.3	0.0	18.5	13.0	7.0	12.0	15.6	6.7
Progression Factor		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2		1.3	0.1		28.5	0.0	1.9	5.1	0.1	0.8	18.5	0.0
Delay (s)		28.9	0.1		59.8	0.0	20.4	18.2	7.1	12.8	34.0	6.7
Level of Service		C	A		E	A	C	B	A	B	C	A
Approach Delay (s)		15.2			48.4			16.7			31.9	
Approach LOS		B			D			B			C	

Intersection Summary			
HCM Average Control Delay	26.5	HCM Level of Service	C
HCM Volume to Capacity ratio	0.92		
Actuated Cycle Length (s)	82.4	Sum of lost time (s)	12.0
Intersection Capacity Utilization	78.2%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Appendix E – Future Diversion for Existing Background Traffic

Table E1 - Diversion Traffic Volumes

Int.	Intersection Name	Peak Hr.	Northbound			Southbound			Eastbound			Westbound			Total
			NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	
1	Queen Kaahumanu Hwy./Kaiminani Dr.	AM	0	0	0	0	0	0	0	0	0	0	0	0	0
		PM	0	0	0	0	0	0	0	0	0	0	0	0	0
2	Queen Kaahumanu Hwy./Hulikoa Dr.	AM	0	0	77	-77	156	0	0	0	0	-79	0	79	156
		PM	0	0	57	-57	177	0	0	0	0	-120	0	120	177
3	Queen Kaahumanu Hwy./Hina Lani St.	AM	0	0	0	77	0	0	0	0	0	0	0	0	77
		PM	0	0	0	57	0	0	0	0	0	0	0	0	57
4	Kanalani St./ Hina Lani St.	AM	0	0	0	0	0	0	0	0	0	0	0	0	0
		PM	0	0	0	0	0	0	0	0	0	0	0	0	0
5	Kamanu St./ Hina Lani St.	AM	0	0	0	0	0	0	0	0	0	0	0	0	0
		PM	0	0	0	0	0	0	0	0	0	0	0	0	0
6	Ane Keohokalole Hwy./Hina Lani St.	AM	0	50	50	0	150	0	0	0	0	150	0	0	400
		PM	0	75	75	0	50	0	0	0	0	50	0	0	250
7	Mamalahoa Hwy./ Hina Lani St.	AM	0	-100	0	0	-300	150	50	0	0	0	0	0	-200
		PM	0	-150	0	0	-100	50	75	0	0	0	0	0	-125
8	Queen Kaahumanu Hwy./Kealakehe Pkwy.	AM	0	0	0	0	0	0	0	0	0	0	0	0	0
		PM	0	0	0	0	0	0	0	0	0	0	0	0	0

Table E2 - Diverted Conditions Peak Hour Intersection Volumes

Int.	Intersection Name	Peak Hr.	Northbound			Southbound			Eastbound			Westbound			Total
			NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR	
1	Queen Kaahumanu Hwy./Kaiminani Dr.	AM	0	562	102	25	374	0	0	0	0	480	0	221	1,764
		PM	0	497	380	200	623	0	0	0	0	180	0	69	1,949
2	Queen Kaahumanu Hwy./Hulikoa Dr.	AM	0	590	218	0	835	0	0	0	0	0	0	182	1,825
		PM	0	719	122	0	1,068	0	0	0	0	0	0	205	2,114
3	Queen Kaahumanu Hwy./Hina Lani St.	AM	0	472	373	236	680	0	0	0	0	217	0	198	2,176
		PM	0	584	527	271	704	0	0	0	0	469	0	275	2,830
4	Kanalani St./ Hina Lani St.	AM	225	0	13	0	0	0	0	137	363	13	210	0	961
		PM	200	0	56	0	0	0	0	202	489	6	456	0	1,409
5	Kamanu St./ Hina Lani St.	AM	112	0	54	0	0	0	0	47	90	100	120	0	523
		PM	373	0	223	0	0	0	0	116	94	94	66	0	966
6	Ane Keohokalole Hwy./Hina Lani St.	AM	0	50	50	0	150	0	0	101	0	150	220	0	721
		PM	0	75	75	0	50	0	0	339	0	50	160	0	749
7	Mamalahoa Hwy./ Hina Lani St.	AM	119	174	0	0	656	281	107	0	79	0	0	0	1,416
		PM	77	361	0	0	291	136	265	0	210	0	0	0	1,340
8	Queen Kaahumanu Hwy./Kealakehe Pkwy.	AM	68	628	294	158	619	48	17	7	24	229	18	138	2,248
		PM	60	851	156	52	991	44	59	19	71	210	20	54	2,587

Appendix F – Internal Trip Capture Calculation Worksheets

KOA CORPORATION PLANNING & ENGINEERING

TABLE C - 32

MULTI-USE DEVELOPMENT

TRIP GENERATION
AND INTERNAL CAPTURE SUMMARY (DAILY)

Project Name: Kaloko Makai Village Project

Analyst JX
Date 5/24/2012

PN: JB23054
Time Period: Daily

Zone: Phase 1, TAZ 1

LAND USE A **Retail**

ITE LU Code	820		
Size (TSF)	10		
	Total	Internal	External
Enter	*214*	28	186
Exit	*214*	30	184
Total	428	58	370
%		14%	86%

184 ⇄ 186

3% 6 Demand → 6 Balanced → *15%* 105 Demand

4% 9 Demand → 9 Balanced → *22%* 155 Demand

11% 24 Demand → 24 Balanced → *33%* 370 Demand

9% 19 Demand → 19 Balanced → *38%* 426 Demand

LAND USE B **Office**

ITE LU Code	–		
Size (TSF)	35.0		
	Total	Internal	External
Enter	*703*	27	676
Exit	*703*	23	680
Total	1,406	50	1,356
%		4%	96%

680 ⇄ 676

Demand *3%* 21 → Balanced 21 → Demand *3%* 34

Demand *2%* 14 → Balanced 14 → Demand *3%* 34

LAND USE C **Residential**

ITE LU Code	–		
Size	257		
	Total	Internal	External
Enter	*1,120*	38	1,082
Exit	*1,120*	40	1,080
Total	2,240	78	2,162
%		3%	97%

1082 ⇄ 1080

Net External Trips fro Multi-Use Development					
	LAND USE A	LAND USE B	LAND USE C	TOTAL	
Enter	186	676	1,082	1,944	
Exit	184	680	1,080	1,944	INTERNAL CAPTURE
Total	370	1,356	2,162	3,888	
Single-Use Trip Gen. Est.	428	1,406	2,240	4,074	5%
Internal Capture	14%	4%	3%		

Input data

Source: ITE Trip Generation Handbook, Chapter 7 - Multi-Use Development

J:\2012\JB23054 HI_Kaloko TIS\Analysis\Trip Generation\Internal Capture\[JB23054 Internalcapture_Phase_1_TAZ1.xls]T -1-1Daily

KOA CORPORATION
PLANNING & ENGINEERING

TABLE C - 33

MULTI-USE DEVELOPMENT

Project Name: Kaloko Makai Village Project

TRIP GENERATION
AND INTERNAL CAPTURE SUMMARY (AM)

Analyst JX
Date 5/24/2012

PN: JB23054
Time Period: AM Peak Hour

Zone: Phase 1, TAZ 1

LAND USE A **Retail**

ITE LU Code		820	
Size (TSF)		10	
	Total	Internal	External
Enter	6	0	6
Exit	4	0	4
Total	10	0	10
%		0%	100%

4 / 6

3% 0 Demand; 0 Balanced; 38% 64 Demand

4% 0 Demand; 0 Balanced; 20% 7 Demand

7% 0 Demand; 0 Balanced; 37% 16 Demand

5% 0 Demand; 0 Balanced; 34% 45 Demand

LAND USE B **Office**

ITE LU Code		--	
Size (TSF)		35.0	
	Total	Internal	External
Enter	169	4	165
Exit	34	0	34
Total	203	4	199
%		2%	98%

34 / 165

Demand 3% 5; Balanced 4; Demand 3% 4

0% 0 Demand; 0 Balanced; 0% 0 Demand

LAND USE C **Residential**

ITE LU Code		--	
Size		257	
	Total	Internal	External
Enter	42	0	42
Exit	133	4	129
Total	175	4	171
%		2%	98%

42 / 129

Net External Trips fro Multi-Use Development					
	LAND USE A	LAND USE B	LAND USE C	TOTAL	
Enter	6	165	42	213	
Exit	4	34	129	167	INTERNAL CAPTURE
Total	10	199	171	380	
Single-Use Trip Gen. Est.	10	203	175	388	2%
Internal Capture	0%	2%	2%		

Input data

Source: ITE Trip Generation Handbook, Chapter 7 - Multi-Use Development

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KOA CORPORATION
PLANNING & ENGINEERING

TABLE C - 34

MULTI-USE DEVELOPMENT

Project Name: Kaloko Makai Village Project

TRIP GENERATION
AND INTERNAL CAPTURE SUMMARY (PM)

Analyst JX
Date 5/24/2012

PN: JB23054
Time Period: PM Peak Hour

Zone: Phase 1, TAZ 1

LAND USE A **Retail**

ITE LU Code		820	
Size (TSF)		10	
	Total	Internal	External
Enter	18	2	16
Exit	19	3	16
Total	37	5	32
%		14%	86%

16 / 16

3% 1 Demand; 1 Balanced; 31% 13 Demand

2% 0 Demand; 0 Balanced; 23% 35 Demand

12% 2 Demand; 2 Balanced; 31% 46 Demand

9% 2 Demand; 2 Balanced; 53% 45 Demand

LAND USE B **Office**

ITE LU Code		--	
Size (TSF)		35.0	
	Total	Internal	External
Enter	43	2	41
Exit	154	3	151
Total	197	5	192
%		3%	97%

151 / 41

3% 1; 1; 3% 3

2% 3; 3; 2% 3

LAND USE C **Residential**

ITE LU Code		--	
Size		257	
	Total	Internal	External
Enter	147	5	142
Exit	84	3	81
Total	231	8	223
%		3%	97%

142 / 81

Net External Trips fro Multi-Use Development					
	LAND USE A	LAND USE B	LAND USE C	TOTAL	
Enter	16	41	142	199	
Exit	16	151	81	248	INTERNAL CAPTURE
Total	32	192	223	447	
Single-Use Trip Gen. Est.	37	197	231	465	4%
Internal Capture	14%	3%	3%		

Input data

Source: ITE Trip Generation Handbook, Chapter 7 - Multi-Use Development

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KOA CORPORATION
PLANNING & ENGINEERING

TABLE C - 32

MULTI-USE DEVELOPMENT

TRIP GENERATION
AND INTERNAL CAPTURE SUMMARY (DAILY)

Project Name: Kaloko Makai Village Project

Analyst JX
Date 5/24/2012

PN: JB23054
Time Period: Daily

Zone: Phase 1, TAZ 2

LAND USE A **Retail**

ITE LU Code		820	
Size (TSF)		10	
	Total	Internal	External
Enter	1,772	230	1,542
Exit	1,772	248	1,524
Total	3,543	478	3,065
%		13%	87%

1523.5 / 1541.5

3% 53 Demand
53 Balanced
15% 72 Demand

4% 71 Demand
71 Balanced
22% 106 Demand

11% 195 Demand
195 Balanced
33% 965 Demand

9% 159 Demand
159 Balanced
38% 1111 Demand

LAND USE B **Office**

ITE LU Code		--	
Size (TSF)		35.0	
	Total	Internal	External
Enter	482	67	415
Exit	482	81	401
Total	963	148	815
%		15%	85%

400.5 / 414.5

Demand 3% 14 — Balanced 14 — Demand 3% 88

Demand 2% 10 — Balanced 10 — Demand 3% 88

LAND USE C **Residential**

ITE LU Code		--	
Size		257	
	Total	Internal	External
Enter	2,925	205	2,720
Exit	2,925	173	2,752
Total	5,849	378	5,471
%		6%	94%

2719.5 / 2751.5

Net External Trips fro Multi-Use Development					
	LAND USE A	LAND USE B	LAND USE C	TOTAL	
Enter	1,542	415	2,720	4,676	
Exit	1,524	401	2,752	4,676	INTERNAL CAPTURE
Total	3,065	815	5,471	9,351	
Single-Use Trip Gen. Est.	3,543	963	5,849	10,355	10%

Internal Capture 13% 15% 6%

Input data

Source: ITE Trip Generation Handbook, Chapter 7 - Multi-Use Development

J:\2012\JB23054 HI_Kaloko TIS\Analysis\Trip Generation\Internal Capture\[JB23054 Internalcapture_Phase_1_TAZ2.xls]T -1-2 Daily

KOA CORPORATION
PLANNING & ENGINEERING

TABLE C - 33

MULTI-USE DEVELOPMENT

TRIP GENERATION
AND INTERNAL CAPTURE SUMMARY (AM)

Project Name: Kaloko Makai Village Project

Analyst JX
Date 5/24/2012

PN: JB23054
Time Period: AM Peak Hour

Zone: Phase 1, TAZ 2

LAND USE A **Retail**

ITE LU Code		820	
Size (TSF)		10	
	Total	Internal	External
Enter	50	5	45
Exit	32	3	29
Total	82	8	74
%		10%	90%

29 / 45

3% 1 Demand
1 Balanced
38% 45 Demand

4% 2 Demand
2 Balanced
20% 3 Demand

7% 2 Demand
2 Balanced
37% 37 Demand

5% 3 Demand
3 Balanced
34% 120 Demand

LAND USE B **Office**

ITE LU Code		--	
Size (TSF)		35.0	
	Total	Internal	External
Enter	119	5	114
Exit	17	2	15
Total	136	7	129
%		5%	95%

15 / 114

Demand 3% 4 — Balanced 4 — Demand 3% 11

Demand 0% 0 — Balanced 0 — Demand 0% 0

LAND USE C **Residential**

ITE LU Code		--	
Size		257	
	Total	Internal	External
Enter	100	2	98
Exit	353	7	346
Total	453	9	444
%		2%	98%

98 / 346

Net External Trips fro Multi-Use Development					
	LAND USE A	LAND USE B	LAND USE C	TOTAL	
Enter	45	114	98	257	
Exit	29	15	346	390	INTERNAL CAPTURE
Total	74	129	444	647	
Single-Use Trip Gen. Est.	82	136	453	671	4%

Internal Capture 10% 5% 2%

Input data

Source: ITE Trip Generation Handbook, Chapter 7 - Multi-Use Development

J:\2012\JB23054 HI_Kaloko TIS\Analysis\Trip Generation\Internal Capture\[JB23054 Internalcapture_Phase_1_TAZ2.xls]T 1-2-AM

KOA CORPORATION
PLANNING & ENGINEERING

TABLE C - 34

MULTI-USE DEVELOPMENT

TRIP GENERATION
AND INTERNAL CAPTURE SUMMARY (PM)

Project Name: Kaloko Makai Village Project

Analyst JX
Date 5/24/2012

PN: JB23054
Time Period: PM Peak Hour

Zone: Phase 1, TAZ 2

LAND USE A **Retail**

ITE LU Code		820	
Size (TSF)		10	
	Total	Internal	External
Enter	*151*	17	134
Exit	*157*	24	133
Total	308	41	267
%		13%	87%

133 / 134

3% 5 Demand; 5 Balanced; 31% 7 Demand

2% 3 Demand; 3 Balanced; 23% 25 Demand

12% 19 Demand; 19 Balanced; 31% 115 Demand

9% 14 Demand; 14 Balanced; 53% 110 Demand

LAND USE B **Office**

ITE LU Code		–	
Size (TSF)		35.0	
	Total	Internal	External
Enter	*22*	6	16
Exit	*109*	5	104
Total	131	11	120
%		8%	92%

104 / 16

3% 1 / 1 / 3% 6

2% 2 / 2 / 2% 7

LAND USE C **Residential**

ITE LU Code		–	
Size		257	
	Total	Internal	External
Enter	*370*	21	349
Exit	*207*	15	192
Total	577	36	541
%		6%	94%

349 / 192

Net External Trips fro Multi-Use Development					
	LAND USE A	LAND USE B	LAND USE C	TOTAL	
Enter	134	16	349	499	
Exit	133	104	192	429	INTERNAL CAPTURE
Total	267	120	541	928	
Single-Use Trip Gen. Est.	308	131	577	1016	9%

Internal Capture 13% 8% 6%

Input data

Source: ITE Trip Generation Handbook, Chapter 7 - Multi-Use Development

J:\2012\JB23054 HI_Kaloko TIS\Analysis\Trip Generation\Internal Capture\[JB23054 Internalcapture_Phase_1_TAZ2.xls]T 1-2-PM

KOA CORPORATION
PLANNING & ENGINEERING

TABLE C - 32

MULTI-USE DEVELOPMENT

TRIP GENERATION
AND INTERNAL CAPTURE SUMMARY (DAILY)

Project Name: Kaloko Makai Village Project

Analyst JX
Date 5/24/2012

PN: JB23054
Time Period: Daily

Zone: Phase 1, TAZ 3

LAND USE A **Retail**

ITE LU Code		820	
Size (TSF)		10	
	Total	Internal	External
Enter	*2,533*	329	2,204
Exit	*2,533*	355	2,178
Total	5,066	684	4,382
%		14%	86%

2178 / 2204

3% 76 Demand; 76 Balanced; 15% 255 Demand

4% 101 Demand; 101 Balanced; 22% 374 Demand

11% 279 Demand; 279 Balanced; 33% 706 Demand

9% 228 Demand; 228 Balanced; 38% 813 Demand

LAND USE B **Office**

ITE LU Code		–	
Size (TSF)		35.0	
	Total	Internal	External
Enter	*1,701*	127	1,574
Exit	*1,701*	135	1,566
Total	3,401	262	3,139
%		8%	92%

1565.5 / 1573.5

Demand 3% 51 / Balanced 51 / Demand 3% 64

Demand 2% 34 / Balanced 34 / Demand 3% 64

LAND USE C **Residential**

ITE LU Code		–	
Size		257	
	Total	Internal	External
Enter	*2,140*	313	1,827
Exit	*2,140*	279	1,861
Total	4,279	592	3,687
%		14%	86%

1826.5 / 1860.5

Net External Trips fro Multi-Use Development					
	LAND USE A	LAND USE B	LAND USE C	TOTAL	
Enter	2,204	1,574	1,827	5,604	
Exit	2,178	1,566	1,861	5,604	INTERNAL CAPTURE
Total	4,382	3,139	3,687	11,208	
Single-Use Trip Gen. Est.	5,066	3,401	4,279	12,746	12%

Internal Capture 14% 8% 14%

Input data

Source: ITE Trip Generation Handbook, Chapter 7 - Multi-Use Development

J:\2012\JB23054 HI_Kaloko TIS\Analysis\Trip Generation\Internal Capture\[JB23054 Internalcapture_Phase_1_TAZ3.xls]T -1-3 Daily

KOA CORPORATION
PLANNING & ENGINEERING

TABLE C - 33

MULTI-USE DEVELOPMENT

Project Name: Kaloko Makai Village Project

TRIP GENERATION
AND INTERNAL CAPTURE SUMMARY (AM)

Analyst JX
Date 5/24/2012

PN: JB23054
Time Period: AM Peak Hour

Zone: Phase 1, TAZ 3

LAND USE A **Retail**

ITE LU Code		820	
Size (TSF)		10	
	Total	Internal	External
Enter	82	7	75
Exit	47	4	43
Total	129	11	118
%		9%	91%

43 / 75

3% 1 Demand; 1 Balanced; 38% 74 Demand

4% 3 Demand; 3 Balanced; 20% 9 Demand

7% 3 Demand; 3 Balanced; 37% 41 Demand

5% 4 Demand; 4 Balanced; 34% 63 Demand

LAND USE B **Office**

ITE LU Code		--	
Size (TSF)		35.0	
	Total	Internal	External
Enter	196	7	189
Exit	47	3	44
Total	243	10	233
%		4%	96%

44 / 189

Demand 3% 6; Balanced 6; Demand 3% 6

Demand 0% 0; Balanced 0; Demand 0% 0

LAND USE C **Residential**

ITE LU Code		--	
Size		257	
	Total	Internal	External
Enter	112	3	109
Exit	186	10	176
Total	298	13	285
%		4%	96%

109 / 176

Net External Trips fro Multi-Use Development					
	LAND USE A	LAND USE B	LAND USE C	TOTAL	
Enter	75	189	109	373	
Exit	43	44	176	263	INTERNAL CAPTURE
Total	118	233	285	636	
Single-Use Trip Gen. Est.	129	243	298	670	5%

Internal Capture 9% 4% 4%

Input data

Source: ITE Trip Generation Handbook, Chapter 7 - Multi-Use Development

J:\2012\JB23054 HI_Kaloko TIS\Analysis\Trip Generation\Internal Capture\[JB23054 Internalcapture_Phase_1_TAZ3.xls]T 1-3-AM

KOA CORPORATION
PLANNING & ENGINEERING

TABLE C - 34

MULTI-USE DEVELOPMENT

Project Name: Kaloko Makai Village Project

TRIP GENERATION
AND INTERNAL CAPTURE SUMMARY (PM)

Analyst JX
Date 5/24/2012

PN: JB23054
Time Period: PM Peak Hour

Zone: Phase 1, TAZ 3

LAND USE A **Retail**

ITE LU Code		820	
Size (TSF)		10	
	Total	Internal	External
Enter	213	23	190
Exit	228	34	194
Total	441	57	384
%		13%	87%

194 / 190

3% 7 Demand; 7 Balanced; 31% 27 Demand

2% 4 Demand; 4 Balanced; 23% 58 Demand

12% 27 Demand; 27 Balanced; 31% 63 Demand

9% 19 Demand; 19 Balanced; 53% 82 Demand

LAND USE B **Office**

ITE LU Code		--	
Size (TSF)		35.0	
	Total	Internal	External
Enter	87	10	77
Exit	252	8	244
Total	339	18	321
%		5%	95%

244 / 77

3% 3; 3; 3% 5

2% 5; 4; 2% 4

LAND USE C **Residential**

ITE LU Code		--	
Size		257	
	Total	Internal	External
Enter	202	31	171
Exit	154	22	132
Total	356	53	303
%		15%	85%

171 / 132

Net External Trips fro Multi-Use Development					
	LAND USE A	LAND USE B	LAND USE C	TOTAL	
Enter	190	77	171	438	
Exit	194	244	132	570	INTERNAL CAPTURE
Total	384	321	303	1008	
Single-Use Trip Gen. Est.	441	339	356	1136	11%

Internal Capture 13% 5% 15%

Input data

Source: ITE Trip Generation Handbook, Chapter 7 - Multi-Use Development

J:\2012\JB23054 HI_Kaloko TIS\Analysis\Trip Generation\Internal Capture\[JB23054 Internalcapture_Phase_1_TAZ3.xls]T 1-3-PM

KOA CORPORATION
PLANNING & ENGINEERING

TABLE C - 32

MULTI-USE DEVELOPMENT

TRIP GENERATION
AND INTERNAL CAPTURE SUMMARY (DAILY)

Project Name: Kaloko Makai Village Project

Analyst JX
Date 5/24/2012

PN: JB23054
Time Period: Daily

Zone: Phase 2, TAZ 6

LAND USE A **Retail**

ITE LU Code		820	
Size (TSF)		10	
	Total	Internal	External
Enter	698	91	607
Exit	698	98	600
Total	1,395	189	1,206
%		14%	86%

599.5 / 606.5

3% 21 Demand; 21 Balanced; 15% 27 Demand

4% 28 Demand; 28 Balanced; 22% 39 Demand

11% 77 Demand; 77 Balanced; 33% 1085 Demand

9% 63 Demand; 63 Balanced; 38% 1249 Demand

LAND USE B **Office**

ITE LU Code		--	
Size (TSF)		35.0	
	Total	Internal	External
Enter	179	26	153
Exit	179	32	147
Total	358	58	300
%		16%	84%

147 / 153

Demand 3% 5; Balanced 5; Demand 3% 99

Demand 2% 4; Balanced 4; Demand 3% 99

LAND USE C **Residential**

ITE LU Code		--	
Size		257	
	Total	Internal	External
Enter	3,287	81	3,206
Exit	3,287	68	3,219
Total	6,574	149	6,425
%		2%	98%

3206 / 3219

Net External Trips fro Multi-Use Development					
	LAND USE A	LAND USE B	LAND USE C	TOTAL	
Enter	607	153	3,206	3,966	
Exit	600	147	3,219	3,966	INTERNAL CAPTURE
Total	1,206	300	6,425	7,931	
Single-Use Trip Gen. Est.	1,395	358	6,574	8,327	5%

Internal Capture 14% 16% 2%

Input data

Source: ITE Trip Generation Handbook, Chapter 7 - Multi-Use Development

J:\2012\JB23054 HI_Kaloko TIS\Analysis\Trip Generation\Internal Capture\[JB23054 Internalcapture_Phase_2_TAZ6.xls]T -1-6 Daily

KOA CORPORATION
PLANNING & ENGINEERING

TABLE C - 33

MULTI-USE DEVELOPMENT

TRIP GENERATION
AND INTERNAL CAPTURE SUMMARY (AM)

Project Name: Kaloko Makai Village Project

Analyst JX
Date 5/24/2012

PN: JB23054
Time Period: AM Peak Hour

Zone: Phase 2, TAZ 6

LAND USE A **Retail**

ITE LU Code		820	
Size (TSF)		10	
	Total	Internal	External
Enter	20	2	18
Exit	13	1	12
Total	33	3	30
%		9%	91%

12 / 18

3% 0 Demand; 0 Balanced; 38% 17 Demand

4% 1 Demand; 1 Balanced; 20% 1 Demand

7% 1 Demand; 1 Balanced; 37% 44 Demand

5% 1 Demand; 1 Balanced; 34% 133 Demand

LAND USE B **Office**

ITE LU Code		--	
Size (TSF)		35.0	
	Total	Internal	External
Enter	44	1	43
Exit	6	1	5
Total	50	2	48
%		4%	96%

5 / 43

Demand 3% 1; Balanced 1; Demand 3% 12

Demand 0% 0; Balanced 0; Demand 0% 0

LAND USE C **Residential**

ITE LU Code		--	
Size		257	
	Total	Internal	External
Enter	120	1	119
Exit	391	2	389
Total	511	3	508
%		1%	99%

119 / 389

Net External Trips fro Multi-Use Development					
	LAND USE A	LAND USE B	LAND USE C	TOTAL	
Enter	18	43	119	180	
Exit	12	5	389	406	INTERNAL CAPTURE
Total	30	48	508	586	
Single-Use Trip Gen. Est.	33	50	511	594	1%

Internal Capture 9% 4% 1%

Input data

Source: ITE Trip Generation Handbook, Chapter 7 - Multi-Use Development

J:\2012\JB23054 HI_Kaloko TIS\Analysis\Trip Generation\Internal Capture\[JB23054 Internalcapture_Phase_2_TAZ6.xls]T 1-6-AM

KOA CORPORATION
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TABLE C - 34

MULTI-USE DEVELOPMENT

TRIP GENERATION
AND INTERNAL CAPTURE SUMMARY (PM)

Project Name: Kaloko Makai Village Project

Analyst JX
Date 5/24/2012

PN: JB23054
Time Period: PM Peak Hour

Zone: Phase 2, TAZ 6

LAND USE A **Retail**

ITE LU Code		820	
Size (TSF)		10	
	Total	Internal	External
Enter	59	6	53
Exit	62	9	53
Total	121	15	106
%		12%	88%

53 → 53

3% 2 Demand; 2 Balanced; 31% 2 Demand

2% 1 Demand; 1 Balanced; 23% 9 Demand

12% 7 Demand; 7 Balanced; 31% 133 Demand

9% 5 Demand; 5 Balanced; 53% 128 Demand

LAND USE B **Office**

ITE LU Code		--	
Size (TSF)		35.0	
	Total	Internal	External
Enter	8	2	6
Exit	40	2	38
Total	48	4	44
%		8%	92%

38 → 6

3% 0 | 0 | 3% 7

2% 1 | 1 | 2% 9

LAND USE C **Residential**

ITE LU Code		--	
Size		257	
	Total	Internal	External
Enter	428	8	420
Exit	242	5	237
Total	670	13	657
%		2%	98%

420 → 237

Net External Trips fro Multi-Use Development					
	LAND USE A	LAND USE B	LAND USE C	TOTAL	
Enter	53	6	420	479	
Exit	53	38	237	328	INTERNAL CAPTURE
Total	106	44	657	807	
Single-Use Trip Gen. Est.	121	48	670	839	4%

Internal Capture 12% 8% 2%

Input data

Source: ITE Trip Generation Handbook, Chapter 7 - Multi-Use Development

J:\2012\JB23054 HI_Kaloko TIS\Analysis\Trip Generation\Internal Capture\[JB23054 Internalcapture_Phase_2_TAZ6.xls]T 1-6-PM

KOA CORPORATION
PLANNING & ENGINEERING

TABLE C - 32

MULTI-USE DEVELOPMENT

TRIP GENERATION
AND INTERNAL CAPTURE SUMMARY (DAILY)

Project Name: Kaloko Makai Village Project

Analyst JX
Date 5/24/2012

PN: JB023054
Time Period: Daily

Zone: Phase 2, TAZ 7

LAND USE A **Retail**

ITE LU Code		820	
Size (TSF)		10	
	Total	Internal	External
Enter	1,181	118	1,063
Exit	1,181	138	1,043
Total	2,362	256	2,106
%		11%	89%

1043 → 1063

3% 35 Demand; 8 Balanced; 15% 8 Demand

4% 47 Demand; 12 Balanced; 22% 12 Demand

11% 130 Demand; 130 Balanced; 3.3% 1364 Demand

9% 106 Demand; 106 Balanced; 38% 1570 Demand

LAND USE B **Office**

ITE LU Code		--	
Size (TSF)		35.0	
	Total	Internal	External
Enter	55	10	45
Exit	55	13	42
Total	110	23	87
%		21%	79%

42 → 45

Demand 3% 2 | Balanced 2 | Demand 3% 124

2% 1 Demand; 1 Balanced; 3% 124 Demand

LAND USE C **Residential**

ITE LU Code		--	
Size		257	
	Total	Internal	External
Enter	4,133	131	4,002
Exit	4,133	108	4,025
Total	8,265	239	8,026
%		3%	97%

4001.5 → 4024.5

Net External Trips fro Multi-Use Development					
	LAND USE A	LAND USE B	LAND USE C	TOTAL	
Enter	1,063	45	4,002	5,110	
Exit	1,043	42	4,025	5,110	INTERNAL CAPTURE
Total	2,106	87	8,026	10,219	
Single-Use Trip Gen. Est.	2,362	110	8,265	10,737	5%

Internal Capture 11% 21% 3%

Input data

Source: ITE Trip Generation Handbook, Chapter 7 - Multi-Use Development

J:\2012\JB23054 HI_Kaloko TIS\Analysis\Trip Generation\Internal Capture\[JB23054 Internalcapture_Phase_2_TAZ7.xls]T -1-7 Daily

KOA CORPORATION
PLANNING & ENGINEERING

TABLE C - 33

MULTI-USE DEVELOPMENT

Project Name: Kaloko Makai Village Project

TRIP GENERATION
AND INTERNAL CAPTURE SUMMARY (AM)

Analyst JX
Date 5/24/2012

PN: JB023054
Time Period: AM Peak Hour

Zone: Phase 2, TAZ 7

LAND USE A **Retail**

ITE LU Code		820	
Size (TSF)		10	
	Total	Internal	External
Enter	34	2	32
Exit	21	2	19
Total	55	4	51
%		7%	93%

19 ⇄ 32

3% 1 Demand; 1 Balanced; 38% 5 Demand

4% 1 Demand; 0 Balanced; 20% 0 Demand

7% 1 Demand; 1 Balanced; 37% 51 Demand

5% 2 Demand; 2 Balanced; 34% 165 Demand

LAND USE B **Office**

ITE LU Code		--	
Size (TSF)		35.0	
	Total	Internal	External
Enter	14	1	13
Exit	2	0	2
Total	16	1	15
%		6%	94%

2 ⇄ 13

Demand 3% 0; Balanced 0; Demand 3% 15

Demand 0% 0; Balanced 0; Demand 0% 0

LAND USE C **Residential**

ITE LU Code		--	
Size		257	
	Total	Internal	External
Enter	137	1	136
Exit	485	2	483
Total	622	3	619
%		0%	100%

136 ⇄ 483

Net External Trips fro Multi-Use Development					
	LAND USE A	LAND USE B	LAND USE C	TOTAL	
Enter	32	13	136	181	
Exit	19	2	483	504	INTERNAL CAPTURE
Total	51	15	619	685	
Single-Use Trip Gen. Est.	55	16	622	693	1%

Internal Capture 7% 6% 0%

Input data

Source: ITE Trip Generation Handbook, Chapter 7 - Multi-Use Development

J:\2012\JB23054 HI_Kaloko TIS\Analysis\Trip Generation\Internal Capture\[JB23054 Internalcapture_Phase_2_TAZ7.xls]T 1-7-AM

KOA CORPORATION
PLANNING & ENGINEERING

TABLE C - 34

MULTI-USE DEVELOPMENT

Project Name: Kaloko Makai Village Project

TRIP GENERATION
AND INTERNAL CAPTURE SUMMARY (PM)

Analyst JX
Date 5/24/2012

PN: JB023054
Time Period: PM Peak Hour

Zone: Phase 2, TAZ 7

LAND USE A **Retail**

ITE LU Code		820	
Size (TSF)		10	
	Total	Internal	External
Enter	101	11	90
Exit	105	14	91
Total	206	25	181
%		12%	88%

91 ⇄ 90

3% 3 Demand; 1 Balanced; 31% 1 Demand

2% 2 Demand; 2 Balanced; 23% 3 Demand

12% 13 Demand; 13 Balanced; 31% 157 Demand

9% 9 Demand; 9 Balanced; 53% 149 Demand

LAND USE B **Office**

ITE LU Code		--	
Size (TSF)		35.0	
	Total	Internal	External
Enter	3	1	2
Exit	12	2	10
Total	15	3	12
%		20%	80%

10 ⇄ 2

3% 0; 0; 3% 8

2% 0; 0; 2% 10

LAND USE C **Residential**

ITE LU Code		--	
Size		257	
	Total	Internal	External
Enter	505	13	492
Exit	282	9	273
Total	787	22	765
%		3%	97%

492 ⇄ 273

Net External Trips fro Multi-Use Development					
	LAND USE A	LAND USE B	LAND USE C	TOTAL	
Enter	90	2	492	584	
Exit	91	10	273	374	INTERNAL CAPTURE
Total	181	12	765	958	
Single-Use Trip Gen. Est.	206	15	787	1008	5%

Internal Capture 12% 20% 3%

Input data

Source: ITE Trip Generation Handbook, Chapter 7 - Multi-Use Development

J:\2012\JB23054 HI_Kaloko TIS\Analysis\Trip Generation\Internal Capture\[JB23054 Internalcapture_Phase_2_TAZ7.xls]T 1-7-PM

KOA CORPORATION
PLANNING & ENGINEERING

TABLE C - 32

MULTI-USE DEVELOPMENT

TRIP GENERATION
AND INTERNAL CAPTURE SUMMARY (DAILY)

Project Name: Kaloko Makai Village Project

Analyst JX
Date 5/24/2012

PN: JB23054
Time Period: Daily

Zone: Phase 3, TAZ 9

LAND USE A **Retail**

ITE LU Code		820	
Size (TSF)		10	
	Total	Internal	External
Enter	322	42	280
Exit	322	45	277
Total	644	87	557
%		14%	86%

277 ⇄ 280

3% 10 Demand → 10 Balanced → 15% 12 Demand

4% 13 Demand → 13 Balanced → 22% 18 Demand

11% 35 Demand → 35 Balanced → 33% 594 Demand

9% 29 Demand → 29 Balanced → 38% 685 Demand

LAND USE B **Office**

ITE LU Code		--	
Size (TSF)		35.0	
	Total	Internal	External
Enter	83	12	71
Exit	83	15	68
Total	165	27	138
%		16%	84%

67.5 ⇄ 70.5

Demand 3% 2 → 2 Balanced → Demand 3% 54

2% 2 Demand → 2 Balanced → 3% 54 Demand

LAND USE C **Residential**

ITE LU Code		--	
Size		257	
	Total	Internal	External
Enter	1,802	37	1,765
Exit	1,802	31	1,771
Total	3,603	68	3,535
%		2%	98%

1764.5 ⇄ 1770.5

Net External Trips fro Multi-Use Development					
	LAND USE A	LAND USE B	LAND USE C	TOTAL	
Enter	280	71	1,765	2,115	
Exit	277	68	1,771	2,115	INTERNAL CAPTURE
Total	557	138	3,535	4,230	
Single-Use Trip Gen. Est.	644	165	3,603	4,412	4%

Internal Capture 14% 16% 2%

Input data

Source: ITE Trip Generation Handbook, Chapter 7 - Multi-Use Development

J:\2012\JB23054 HI_Kaloko TIS\Analysis\Trip Generation\Internal Capture\[JB23054 Internalcapture_Phase_3_TAZ9.xls]T -1-9 Daily

KOA CORPORATION
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TABLE C - 33

MULTI-USE DEVELOPMENT

TRIP GENERATION
AND INTERNAL CAPTURE SUMMARY (AM)

Project Name: Kaloko Makai Village Project

Analyst JX
Date 5/24/2012

PN: JB23054
Time Period: AM Peak Hour

Zone: Phase 3, TAZ 9

LAND USE A **Retail**

ITE LU Code		820	
Size (TSF)		10	
	Total	Internal	External
Enter	9	0	9
Exit	6	0	6
Total	15	0	15
%		0%	100%

6 ⇄ 9

3% 0 Demand → 0 Balanced → 38% 8 Demand

4% 0 Demand → 0 Balanced → 20% 1 Demand

7% 0 Demand → 0 Balanced → 37% 24 Demand

5% 0 Demand → 0 Balanced → 34% 73 Demand

LAND USE B **Office**

ITE LU Code		--	
Size (TSF)		35.0	
	Total	Internal	External
Enter	20	1	19
Exit	3	0	3
Total	23	1	22
%		4%	96%

3 ⇄ 19

Demand 3% 1 → 1 Balanced → Demand 3% 6

0% 0 Demand → 0 Balanced → 0% 0 Demand

LAND USE C **Residential**

ITE LU Code		--	
Size		257	
	Total	Internal	External
Enter	66	0	66
Exit	214	1	213
Total	280	1	279
%		0%	100%

66 ⇄ 213

Net External Trips fro Multi-Use Development					
	LAND USE A	LAND USE B	LAND USE C	TOTAL	
Enter	9	19	66	94	
Exit	6	3	213	222	INTERNAL CAPTURE
Total	15	22	279	316	
Single-Use Trip Gen. Est.	15	23	280	318	1%

Internal Capture 0% 4% 0%

Input data

Source: ITE Trip Generation Handbook, Chapter 7 - Multi-Use Development

J:\2012\JB23054 HI_Kaloko TIS\Analysis\Trip Generation\Internal Capture\[JB23054 Internalcapture_Phase_3_TAZ9.xls]T 1-9-AM

KOA CORPORATION
PLANNING & ENGINEERING

TABLE C - 34

MULTI-USE DEVELOPMENT

TRIP GENERATION
AND INTERNAL CAPTURE SUMMARY (PM)

Project Name: Kaloko Makai Village Project

Analyst JX
Date 5/24/2012

PN: JB23054
Time Period: PM Peak Hour

Zone: Phase 3, TAZ 9

LAND USE A **Retail**

ITE LU Code		820	
Size (TSF)		10	
	Total	Internal	External
Enter	27	3	24
Exit	29	4	25
Total	56	7	49
%		13%	88%

25 ⇄ 24

3% 1 Demand
1 Balanced
31% 1 Demand

2% 1 Demand
1 Balanced
23% 4 Demand

12% 3 Demand
3 Balanced
31% 72 Demand

9% 2 Demand
2 Balanced
53% 70 Demand

LAND USE B **Office**

ITE LU Code		--	
Size (TSF)		35.0	
	Total	Internal	External
Enter	4	1	3
Exit	19	1	18
Total	23	2	21
%		9%	91%

18 ⇄ 3

3% 0 | 0 | 3% 4

2% 0 | 0 | 2% 5

LAND USE C **Residential**

ITE LU Code		--	
Size		257	
	Total	Internal	External
Enter	233	3	230
Exit	133	2	131
Total	366	5	361
%		1%	99%

230 ⇄ 131

Net External Trips fro Multi-Use Development					
	LAND USE A	LAND USE B	LAND USE C	TOTAL	
Enter	24	3	230	257	
Exit	25	18	131	174	INTERNAL
Total	49	21	361	431	CAPTURE
Single-Use Trip Gen. Est.	56	23	366	445	3%
Internal Capture	13%	9%	1%		

Input data

Source: ITE Trip Generation Handbook, Chapter 7 - Multi-Use Development

J:\2012\JB23054 HI_Kaloko TIS\Analysis\Trip Generation\Internal Capture\[JB23054 Internalcapture_Phase_3_TAZ9.xls]T 1-9-PM

Appendix G – Detailed Project Traffic Generation Calculations

Appendix G (1 of 8) - Detailed Project Traffic Generation Calculations

TRIP GENERATION RATES

ITE Code	ITE Decription	Unit	Daily	AM Peak Hour Total	AM Peak Hour In	AM Peak Hour Out	PM Peak Hour Total	PM Peak Hour In	PM Peak Hour Out
90	Park-and-Ride Lot with Bus Service	AC	372.32	48.81	39.54	9.27	43.75	10.06	33.69
110	General Light Industrial	AC	51.80	7.51	6.23	1.28	7.26	1.60	5.66
170	Utilities [1]	AC	13.36	2.49	1.57	0.92	1.32	0.59	0.73
210	Single-Family Detached Housing	DU	9.57	0.75	0.19	0.56	1.01	0.64	0.37
220	Apartment	DU	6.65	0.51	0.10	0.41	0.62	0.40	0.22
230	Residential Condo/Townhouse	DU	5.81	0.44	0.07	0.37	0.52	0.35	0.17
252	Senior Adult Housing-Attached	DU	3.48	0.13	0.05	0.08	0.16	0.10	0.06
310	Hotel	RM	8.17	0.56	0.34	0.22	0.59	0.31	0.28
412	County Park	AC	2.28	0.01	0.01	0.00	0.06	0.02	0.04
520	Elementary School	STU	1.29	0.45	0.25	0.20	0.15	0.07	0.08
522	Middle School/Junior High School	STU	1.62	0.54	0.30	0.24	0.16	0.08	0.08
610	Hospital	BEDS	11.81	1.14	0.81	0.33	1.31	0.47	0.84
620	Nursing Home	BEDS	2.37	0.17	0.12	0.05	0.22	0.07	0.15
710	General Office Building	TSF	11.01	1.55	1.36	0.19	1.49	0.25	1.24
720	Medical-Dental Office Building	TSF	36.13	2.30	1.82	0.48	3.46	0.93	2.53
730	Government Office Building	TSF	68.93	5.88	4.94	0.94	1.21	0.38	0.83
770	Business Park	TSF	12.76	1.43	1.20	0.23	1.29	0.30	0.99
820	Shopping Center	TSF	42.94	1.00	0.61	0.39	3.73	1.83	1.90

Source: ITE (Institute of Transportation Engineers) Trip Generation Manual, 8th Edition, 2008.

[1] Trip rate for daily is not available in ITE Trip Generation. The daily to AM/PM peak hours ratio for general light industrial use was applied to the AM plus PM peak hour rates to estimate the daily trip rate for utilities use.

PROJECT TRAFFIC GENERATION

Project Decription	Parcel I.D.	TAZ	ITE Code	ITE Decription	Quantity	Daily	AM Peak Hour Total	AM Peak Hour In	AM Peak Hour Out	PM Peak Hour Total	PM Peak Hour In	PM Peak Hour Out
Project Phase I												
Phase I, TAZ I												
District Sized Park &Drainage Retention	P-4	I	412	County Park	25 AC	57	0	0	-	2	1	1
Waste Water Treatment Plant	WWTP	I	170	Utilities [1]	20 AC	267	50	31	18	26	12	15
Electrical Substation	ELEC. SUB	I	170	Utilities [1]	1 AC	13	2	2	1	1	1	1
				Subtotal	**46**	**338**	**53**	**33**	**19**	**29**	**13**	**16**
				Transit Trip Discount	5%	-17	-3	-2	-1	-1	-1	-
				Total (less Internal/Transit Trips)		321	50	31	18	28	12	16
Affortible Single Family	T4-15	I	210	Single-Family Detached Housing	104 DU	995	78	20	58	105	67	38
Affortible Multi Family	T4-15	I	230	Residential Condo/Townhouse	35 DU	203	15	2	13	18	12	6
Affortible Single Family	T4-16	I	210	Single-Family Detached Housing	88 DU	842	66	17	49	89	56	33
Affortible Multi Family	T4-16	I	220	Apartment	30 DU	200	15	3	12	19	12	7
				Subtotal	**257**	**2,240**	**175**	**42**	**133**	**231**	**147**	**84**
				Internal Capture (5% Daily, 2% AM, 4% PM)		-112	-3	-1	-2	-9	-6	-3
				Transit Trip Discount	5%	-112	-9	-2	-7	-12	-7	-5
				Total (less Internal/Transit Trips)		2,016	163	39	124	210	134	76
Retail	T4-15	I	820	Shopping Center	10 TSF	429	10	6	4	37	18	19
				Subtotal	**10 TSF**	**429**	**10**	**6**	**4**	**37**	**18**	**19**
				Internal Capture (5% Daily, 2% AM, 4% PM)		-21	-	-	-	-1	-1	-
				Transit Trip Discount	5%	-21	-1	-	-1	-2	-1	-1
				Total (less Internal/Transit Trips)		387	9	6	3	34	16	18
				Pass-by Trip Discount	15%	-58	-	-	-	-5	-2	-3
				Total (less Internal/Transit/Pass-by Trips)		329	9	6	3	29	14	15
Light Industrial	INDUSTRIAL	I	110	General Light Industrial	25 AC	1,295	188	156	32	182	40	142
Office	T4-15	I	710	General Office Building	10 TSF	110	16	14	2	15	3	12
				Subtotal	**35**	**1,405**	**203**	**169**	**34**	**196**	**43**	**154**
				Internal Capture (5% Daily, 2% AM, 4% PM)		-70	-4	-3	-1	-8	-2	-6
				Transit Trip Discount	5%	-70	-10	-8	-2	-10	-2	-8
				Total (less Internal/Transit Trips)		1,265	189	158	31	178	39	140
		I		**Total without Trip Discount**		**4,412**	**440**	**251**	**190**	**494**	**221**	**273**
		I		**Total with Trip Discount**		**3,931**	**410**	**235**	**176**	**446**	**199**	**247**

Appendix G (2 of 8) - Detailed Project Traffic Generation Calculations

PROJECT TRAFFIC GENERATION

Project Decription	Parcel I.D.	TAZ	ITE Code	ITE Decription	Quantity	Daily	AM Peak Hour Total	AM Peak Hour In	AM Peak Hour Out	PM Peak Hour Total	PM Peak Hour In	PM Peak Hour Out
Phase I, TAZ 2												
Single Family	T3-10	2	210	Single-Family Detached Housing	37 DU	354	28	7	21	37	24	14
Single Family	T3-11	2	210	Single-Family Detached Housing	58 DU	555	44	11	32	59	37	21
Live-Work, SF	T4-10	2	210	Single-Family Detached Housing	121 DU	1,158	91	23	68	122	77	45
Multi Family	T4-10	2	230	Residential Condo/Townhouse	41 DU	238	18	3	15	21	14	7
Single Family	T4-11	2	210	Single-Family Detached Housing	63 DU	603	47	12	35	64	40	23
Multi Family	T4-11	2	230	Residential Condo/Townhouse	22 DU	128	10	2	8	11	8	4
Multi Family	T5-10	2	220	Apartment	423 DU	2,813	216	42	173	262	169	93
				Subtotal	**765**	**5,849**	**453**	**100**	**353**	**577**	**370**	**207**
				Internal Capture (10% Daily, 4% AM, 9% PM)		-585	-18	-4	-14	-52	-33	-19
				Transit Trip Discount	5%	-292	-23	-5	-18	-29	-18	-11
				Total (less Internal/Transit Trips)		4,972	412	91	321	496	319	177
Retail	T4-10	2	820	Shopping Center	7.5 TSF	322	8	5	3	28	14	14
Retail	T5-10	2	820	Shopping Center	75 TSF	3,221	75	46	29	280	137	143
				Subtotal	**83**	**3,543**	**83**	**50**	**32**	**308**	**151**	**157**
				Internal Capture (10% Daily, 4% AM, 9% PM)		-354	-3	-2	-1	-28	-14	-14
				Transit Trip Discount	5%	-177	-4	-3	-1	-15	-8	-7
				Total (less Internal/Transit Trips)		3,012	76	45	30	265	129	136
				Pass-by Trip Discount	15%	-452	-	-	-	-40	-19	-21
				Total (less Internal/Transit/Pass-by Trips)		2,560	76	45	30	225	110	115
Office	T4-10	2	710	General Office Building	7.5 TSF	83	12	10	1	11	2	9
Office	T5-10	2	710	General Office Building	80 TSF	881	124	109	15	119	20	99
				Subtotal	**88**	**963**	**136**	**119**	**17**	**130**	**22**	**109**
				Internal Capture (10% Daily, 4% AM, 9% PM)		-96	-5	-5	-	-12	-2	-10
				Transit Trip Discount	5%	-48	-7	-6	-1	-7	-1	-6
				Total (less Internal/Transit Trips)		819	124	108	16	111	19	93
		2		**Total without Trip Discount**		**10,355**	**671**	**269**	**402**	**1,015**	**543**	**472**
		2		**Total with Trip Discount**		**8,351**	**611**	**244**	**367**	**832**	**448**	**384**

Appendix G (3 of 8) - Detailed Project Traffic Generation Calculations

PROJECT TRAFFIC GENERATION

Project Decription	Parcel I.D.	TAZ	ITE Code	ITE Decription	Quantity	Daily	AM Peak Hour Total	AM Peak Hour In	AM Peak Hour Out	PM Peak Hour Total	PM Peak Hour In	PM Peak Hour Out
Phase 1, TAZ 3												
Park	P-2	3	412	County Park	10 AC	23	0	0	-	1	0	0
School	SCHOOL	3	522	Middle School/Junior High School	600 STU	972	324	180	144	96	48	48
Hospital	HOSPITAL	3	610	Hospital	150 BEDS	1,772	171	122	50	197	71	126
				Subtotal	**760**	**2,766**	**495**	**302**	**194**	**293**	**119**	**174**
				Transit Trip Discount	5%	-138	-25	-15	-10	-15	-6	-9
				Total (less Internal/Transit Trips)		2,628	470	287	184	278	113	165
Long Term Care	T5-5	3	620	Nursing Home	179 BEDS	424	30	21	9	39	13	27
Long Term Care	T5-6	3	620	Nursing Home	83 BEDS	197	14	10	4	18	6	12
Lodge	T5-7	3	310	Hotel	120 RM	980	67	41	26	71	37	34
Senior Adult Housing	T5-8	3	252	Senior Adult Housing-Attached	137 DU	477	18	7	11	22	14	8
Multi Family	T5-9	3	220	Apartment	116 DU	771	59	12	48	72	46	26
Affordable Multi Family	T5-13	3	220	Apartment	100 DU	665	51	10	41	62	40	22
Multi Family	T5-13	3	220	Apartment	115 DU	765	59	12	47	71	46	25
				Subtotal	**850**	**4,279**	**298**	**112**	**186**	**356**	**202**	**154**
				Internal Capture (12% Daily, 5% AM, 11% PM)		-514	-15	-6	-9	-39	-22	-17
				Transit Trip Discount	5%	-214	-15	-6	-9	-18	-10	-8
				Total (less Internal/Transit Trips)		3,551	268	100	168	299	170	129
Retail	T5-5	3	820	Shopping Center	15 TSF	644	15	9	6	56	27	29
Retail	T5-6	3	820	Shopping Center	15 TSF	644	15	9	6	56	27	29
Business Center	T5-7	3	770	Business Park	10 TSF	128	14	12	2	13	3	10
Transit Station, TOD Square	T5-8	3	820	Shopping Center	20 TSF	859	20	12	8	75	37	38
Retail	T5-9	3	820	Shopping Center	20 TSF	859	20	12	8	75	37	38
Retail	T5-13	3	820	Shopping Center	45 TSF	1,932	45	27	18	168	82	86
				Subtotal	**125**	**5,066**	**129**	**82**	**47**	**442**	**213**	**228**
				Internal Capture (13% Daily, 5% AM, 12% PM)		-608	-6	-4	-2	-49	-23	-26
				Transit Trip Discount	5%	-253	-6	-4	-2	-22	-11	-11
				Total (less Internal/Transit Trips)		4,205	117	74	43	371	179	191
				Pass-by Trip Discount	15%	-631	-	-	-	-56	-27	-29
				Total (less Internal/Transit/Pass-by Trips)		3,574	117	74	43	315	152	162
Medical Offices	T5-5	3	720	Medical-Dental Office Building	15 TSF	542	35	27	7	52	14	38
Office	T5-6	3	710	General Office Building	15 TSF	165	23	20	3	22	4	19
Medical Offices	T5-7	3	720	Medical-Dental Office Building	30 TSF	1,084	69	55	14	104	28	76
Medical Offices	T5-8	3	720	Medical-Dental Office Building	40 TSF	1,445	92	73	19	138	37	101
Office	T5-13	3	710	General Office Building	15 TSF	165	23	20	3	22	4	19
				Subtotal	**115**	**3,401**	**242**	**196**	**47**	**339**	**87**	**252**
				Internal Capture (13% Daily, 5% AM, 12% PM)		-408	-12	-10	-2	-37	-10	-27
				Transit Trip Discount	5%	-170	-12	-10	-2	-17	-4	-13
				Total (less Internal/Transit Trips)		2,823	218	176	43	285	73	212
		3		**Total without Trip Discount**		**15,513**	**1,165**	**691**	**473**	**1,429**	**620**	**809**
		3		Total with Trip Discount		12,577	1,074	636	437	1,176	507	669

Project Phase 2

Project Decription	Parcel I.D.	TAZ	ITE Code	ITE Decription	Quantity	Daily	AM Peak Hour Total	AM Peak Hour In	AM Peak Hour Out	PM Peak Hour Total	PM Peak Hour In	PM Peak Hour Out
Phase 2, TAZ 4												
Light Industrial	INDUSTRIAL	4	110	General Light Industrial	10 AC	518	75	62	13	73	16	57
				Subtotal	**10**	**518**	**75**	**62**	**13**	**73**	**16**	**57**
				Transit Trip Discount	5%	-26	-4	-3	-1	-4	-1	-3
				Total (less Internal/Transit Trips)		492	71	59	12	69	15	54
		4		**Total without Trip Discount**		**518**	**75**	**62**	**13**	**73**	**16**	**57**
		4		Total with Trip Discount		492	71	59	12	69	15	54

Appendix G (4 of 8) - Detailed Project Traffic Generation Calculations

PROJECT TRAFFIC GENERATION

Project Decription	Parcel I.D.	TAZ	ITE Code	ITE Decription	Quantity	Daily	AM Peak Hour Total	AM Peak Hour In	AM Peak Hour Out	PM Peak Hour Total	PM Peak Hour In	PM Peak Hour Out
Phase 2, TAZ 5												
Light Industrial	INDUSTRIAL	5	110	General Light Industrial	15 AC	777	113	93	19	109	24	85
				Subtotal	**15**	**777**	**113**	**93**	**19**	**109**	**24**	**85**
				Transit Trip Discount	5%	-39	-6	-5	-1	-5	-1	-4
				Total (less Internal/Transit Trips)		738	107	88	18	104	23	81
		5		**Total without Trip Discount**		**777**	**113**	**93**	**19**	**109**	**24**	**85**
		5		Total with Trip Discount		738	107	88	18	104	23	81
Phase 2, TAZ 6												
Park	P-3	6	412	County Park	10 AC	23	0	0	-	1	0	0
School	SCHOOL	6	520	Elementary School	450 STU	581	203	113	90	68	32	36
				Subtotal	**460**	**603**	**203**	**113**	**90**	**68**	**32**	**36**
				Transit Trip Discount	5%	-30	-10	-6	-4	-3	-2	-1
				Total (less Internal/Transit Trips)		573	193	107	86	65	30	35
Single Family	T3-12	6	210	Single-Family Detached Housing	171 DU	1,636	128	32	96	173	109	63
Single Family	T3-13	6	210	Single-Family Detached Housing	60 DU	574	45	11	34	61	38	22
Single Family	T4-12	6	210	Single-Family Detached Housing	39 DU	373	29	7	22	39	25	14
Multi Family	T4-12	6	230	Residential Condo/Townhouse	13 DU	76	6	1	5	7	5	2
Single Family	T4-13	6	210	Single-Family Detached Housing	102 DU	976	77	19	57	103	65	38
Multi Family	T4-13	6	230	Residential Condo/Townhouse	35 DU	203	15	2	13	18	12	6
Affordable Single Family	T4-14	6	210	Single-Family Detached Housing	37 DU	354	28	7	21	37	24	14
Single Family	T4-14	6	210	Single-Family Detached Housing	90 DU	861	68	17	50	91	58	33
Affordable Multi Family	T4-14	6	230	Residential Condo/Townhouse	13 DU	76	6	1	5	7	5	2
Multi Family	T4-14	6	230	Residential Condo/Townhouse	30 DU	174	13	2	11	16	11	5
Affordable Multi Family	T5-11	6	220	Apartment	90 DU	599	46	9	37	56	36	20
Multi Family	T5-12	6	220	Apartment	1 DU	7	1	0	0	1	0	0
Affordable Multi Family	T5-12	6	220	Apartment	100 DU	665	51	10	41	62	40	22
				Subtotal	**781**	**6,574**	**512**	**120**	**391**	**670**	**428**	**242**
				Internal Capture (5% Daily, 1% AM, 4% PM)		-329	-5	-1	-4	-27	-17	-10
				Transit Trip Discount	5%	-329	-26	-6	-20	-33	-21	-12
				Total (less Internal/Transit Trips)		5,916	481	113	367	610	390	220
Retail	T4-13	6	820	Shopping Center	7.5 TSF	322	8	5	3	28	14	14
Retail	T4-14	6	820	Shopping Center	7.5 TSF	322	8	5	3	28	14	14
Retail	T5-11	6	820	Shopping Center	7.5 TSF	322	8	5	3	28	14	14
Retail	T5-12	6	820	Shopping Center	10 TSF	429	10	6	4	37	18	19
				Subtotal	**32.5**	**1,396**	**33**	**20**	**13**	**121**	**59**	**62**
				Internal Capture (5% Daily, 1% AM, 4% PM)		-70	-	-	-	-5	-2	-3
				Transit Trip Discount	5%	-70	-2	-1	-1	-6	-3	-3
				Total (less Internal/Transit Trips)		1,256	31	19	12	110	54	56
				Pass-by Trip Discount	15%	-188	-	-	-	-17	-8	-9
				Total (less Internal/Transit/Pass-by Trips)		1,068	31	19	12	93	46	47
Office	T4-13	6	710	General Office Building	7.5 TSF	83	12	10	1	11	2	9
Office	T4-14	6	710	General Office Building	7.5 TSF	83	12	10	1	11	2	9
Office	T5-11	6	710	General Office Building	7.5 TSF	83	12	10	1	11	2	9
Office	T5-12	6	710	General Office Building	10 TSF	110	16	14	2	15	3	12
				Subtotal	**32.5**	**358**	**50**	**44**	**6**	**48**	**8**	**40**
				Internal Capture (5% Daily, 1% AM, 4% PM)		-18	-1	-	-1	-2	-	-2
				Transit Trip Discount	5%	-18	-3	-2	-1	-2	-	-2
				Total (less Internal/Transit Trips)		322	46	42	4	44	8	36
		6		**Total without Trip Discount**		**8,931**	**797**	**297**	**500**	**907**	**527**	**381**
		6		Total with Trip Discount		8,644	809	292	516	884	520	364

Appendix G (5 of 8) - Detailed Project Traffic Generation Calculations

PROJECT TRAFFIC GENERATION

Project Decription	Parcel I.D.	TAZ	ITE Code	ITE Decription	Quantity	Daily	AM Peak Hour Total	AM Peak Hour In	AM Peak Hour Out	PM Peak Hour Total	PM Peak Hour In	PM Peak Hour Out
Phase 2, TAZ 7												
Affordable Single Family	T4-1	7	210	Single-Family Detached Housing	52 DU	498	39	10	29	53	33	19
Single Family	T4-1	7	210	Single-Family Detached Housing	24 DU	230	18	5	13	24	15	9
Affordable Multi Family	T4-1	7	230	Residential Condo/Townhouse	18 DU	105	8	1	7	9	6	3
Multi Family	T4-1	7	230	Residential Condo/Townhouse	8 DU	46	4	1	3	4	3	1
Single Family	T4-2	7	210	Single-Family Detached Housing	64 DU	612	48	12	36	65	41	24
Multi Family	T4-2	7	230	Residential Condo/Townhouse	22 DU	128	10	2	8	11	8	4
Single Family	T4-3	7	210	Single-Family Detached Housing	93 DU	890	70	18	52	94	60	34
Multi Family	T4-3	7	230	Residential Condo/Townhouse	31 DU	180	14	2	11	16	11	5
Single Family	T4-4	7	210	Single-Family Detached Housing	33 DU	316	25	6	18	33	21	12
Multi Family	T4-4	7	230	Residential Condo/Townhouse	12 DU	70	5	1	4	6	4	2
Single Family	T4-5	7	210	Single-Family Detached Housing	64 DU	612	48	12	36	65	41	24
Multi Family	T4-5	7	230	Residential Condo/Townhouse	22 DU	128	10	2	8	11	8	4
Multi Family	T5-1	7	220	Apartment	161 DU	1,071	82	16	66	100	64	35
Multi Family	T5-2	7	220	Apartment	116 DU	771	59	12	48	72	46	26
Senior Adult Housing	T5-3	7	252	Senior Adult Housing-Attached	119 DU	414	15	6	10	19	12	7
Multi Family	T5-4	7	220	Apartment	175 DU	1,164	89	18	72	109	70	39
Multi Family	T5-14	7	220	Apartment	82 DU	545	42	8	34	51	33	18
Affordable Multi Family	T5-14	7	220	Apartment	73 DU	485	37	7	30	45	29	16
				Subtotal	**1169**	**8,265**	**622**	**137**	**485**	**787**	**505**	**282**
				Internal Capture (5% Daily, 1% AM, 5% PM)		-413	-6	-1	-5	-39	-25	-14
				Transit Trip Discount	5%	-413	-31	-7	-24	-39	-25	-14
				Total (less Internal/Transit Trips)		7,439	585	129	456	709	455	254
Retail	T4-5	7	820	Shopping Center	20 TSF	859	20	12	8	75	37	38
Retail	T5-4	7	820	Shopping Center	25 TSF	1,074	25	15	10	93	46	48
Mixed Use, Retail	T5-14	7	820	Shopping Center	10 TSF	429	10	6	4	37	18	19
				Subtotal	**55**	**2,362**	**55**	**34**	**21**	**205**	**101**	**105**
				Internal Capture (5% Daily, 1% AM, 5% PM)		-118	-1	-	-1	-10	-5	-5
				Transit Trip Discount	5%	-118	-3	-2	-1	-10	-5	-5
				Total (less Internal/Transit Trips)		2,126	51	32	19	185	91	95
				Pass-by Trip Discount	15%	-319	-	-	-	-28	-14	-14
				Total (less Internal/Transit/Pass-by Trips)		1,807	51	32	19	157	77	81
Mixed Use, Office	T5-14	7	710	General Office Building	10 TSF	110	16	14	2	15	3	12
				Subtotal	**10**	**110**	**16**	**14**	**2**	**15**	**3**	**12**
				Internal Capture (5% Daily, 1% AM, 5% PM)		-6	-	-	-	-1	-	-1
				Transit Trip Discount	5%	-6	-1	-1	-	-1	-	-1
				Total (less Internal/Transit Trips)		98	15	13	2	13	3	10
		7		**Total without Trip Discount**		**10,737**	**693**	**184**	**508**	**1,007**	**609**	**399**
		7		**Total with Trip Discount**		**9,344**	**651**	**173**	**477**	**879**	**535**	**345**

Project Phase 3

Project Decription	Parcel I.D.	TAZ	ITE Code	ITE Decription	Quantity	Daily	AM Peak Hour Total	AM Peak Hour In	AM Peak Hour Out	PM Peak Hour Total	PM Peak Hour In	PM Peak Hour Out
Phase 3, TAZ 8												
Light Industrial	INDUSTRIAL	8	110	General Light Industrial	25 AC	1,295	188	156	32	182	40	142
				Subtotal	**25**	**1,295**	**188**	**156**	**32**	**182**	**40**	**142**
				Transit Trip Discount	5%	-65	-9	-8	-1	-9	-2	-7
				Total (less Internal/Transit Trips)		1,230	179	148	31	173	38	135
		8		**Total without Trip Discount**		**1,295**	**188**	**156**	**32**	**182**	**40**	**142**
		8		**Total with Trip Discount**		**1,230**	**179**	**148**	**31**	**173**	**38**	**135**

Appendix G (6 of 8) - Detailed Project Traffic Generation Calculations

PROJECT TRAFFIC GENERATION

Project Decription	Parcel I.D.	TAZ	ITE Code	ITE Decription	Quantity	Daily	AM Peak Hour Total	AM Peak Hour In	AM Peak Hour Out	PM Peak Hour Total	PM Peak Hour In	PM Peak Hour Out
Phase 3, TAZ 9												
Fire Station	FIRE STATION	9	730	Government Office Building	3 TSF	207	18	15	3	4	1	2
Desalinization Plant	DESAL. PLANT	9	170	Utilities [1]	1.7 AC	23	4	3	2	2	1	1
				Subtotal	**5**	**230**	**22**	**17**	**4**	**6**	**2**	**4**
				Transit Trip Discount	5%	-11	-1	-1	-	-	-	-
				Total (less Internal/Transit Trips)		219	21	16	4	6	2	4
Affordable Single Family	T4-8	9	210	Single-Family Detached Housing	60 DU	574	45	11	34	61	38	22
Single Family	T4-8	9	210	Single-Family Detached Housing	74 DU	708	56	14	41	75	47	27
Affordable Multi Family	T4-8	9	220	Apartment	40 DU	266	20	4	16	25	16	9
Multi Family	T4-8	9	220	Apartment	50 DU	333	26	5	21	31	20	11
Affordable Single Family	T4-9	9	210	Single-Family Detached Housing	96 DU	919	72	18	54	97	61	36
Single Family	T4-9	9	210	Single-Family Detached Housing	27 DU	258	20	5	15	27	17	10
Affordable Multi Family	T4-9	9	220	Apartment	64 DU	426	33	6	26	40	26	14
Multi Family	T4-9	9	220	Apartment	18 DU	120	9	2	7	11	7	4
				Subtotal	**429**	**3,603**	**280**	**66**	**214**	**366**	**233**	**133**
				Internal Capture (4% Daily, 1% AM, 3% PM)		-144	-3	-1	-2	-11	-7	-4
				Transit Trip Discount	5%	-180	-14	-3	-11	-18	-12	-6
				Total (less Internal/Transit Trips)		3,279	263	62	201	337	214	123
Retail	T4-9	9	820	Shopping Center	15 TSF	644	15	9	6	56	27	29
				Subtotal	**15**	**644**	**15**	**9**	**6**	**56**	**27**	**29**
				Internal Capture (4% Daily, 1% AM, 3% PM)		-26	-	-	-	-2	-1	-1
				Transit Trip Discount	5%	-32	-1	-	-1	-3	-1	-2
				Total (less Internal/Transit Trips)		586	14	9	5	51	25	26
				Pass-by Trip Discount	15%	-88	-	-	-	-8	-4	-4
				Total (less Internal/Transit/Pass-by Trips)		498	14	9	5	43	21	22
Office	T4-9	9	710	General Office Building	15 TSF	165	23	20	3	22	4	19
				Subtotal	**15 TSF**	**165**	**23**	**20**	**3**	**22**	**4**	**19**
				Internal Capture (4% Daily, 1% AM, 3% PM)		-7	-	-	-	-1	-	-1
				Transit Trip Discount	5%	-8	-1	-1	-	-1	-	-1
				Total (less Internal/Transit Trips)		150	22	19	3	20	4	17
		9		**Total without Trip Discount**		**4,642**	**341**	**113**	**228**	**450**	**267**	**184**
		9		**Total with Trip Discount**		**4,146**	**321**	**107**	**214**	**406**	**242**	**165**
Phase 3, TAZ 10												
Large Lot Single Family	T3-1	10	210	Single-Family Detached Housing	17 DU	163	13	3	10	17	11	6
Large Lot Single Family	T3-2	10	210	Single-Family Detached Housing	6 DU	57	5	1	3	6	4	2
Large Lot Single Family	T3-3	10	210	Single-Family Detached Housing	5 DU	48	4	1	3	5	3	2
Large Lot Single Family	T3-4	10	210	Single-Family Detached Housing	76 DU	727	57	14	43	77	49	28
Single Family	T3-5	10	210	Single-Family Detached Housing	112 DU	1,072	84	21	63	113	72	41
				Subtotal	**216**	**2,067**	**162**	**41**	**121**	**218**	**138**	**80**
				Transit Trip Discount	5%	-103	-8	-2	-6	-11	-7	-4
				Total (less Internal/Transit Trips)		1,964	154	39	115	207	131	76
		10		**Total without Trip Discount**		**2,067**	**162**	**41**	**121**	**218**	**138**	**80**
		10		**Total with Trip Discount**		**1,964**	**154**	**39**	**115**	**207**	**131**	**76**

Appendix G (7 of 8) - Detailed Project Traffic Generation Calculations

PROJECT TRAFFIC GENERATION

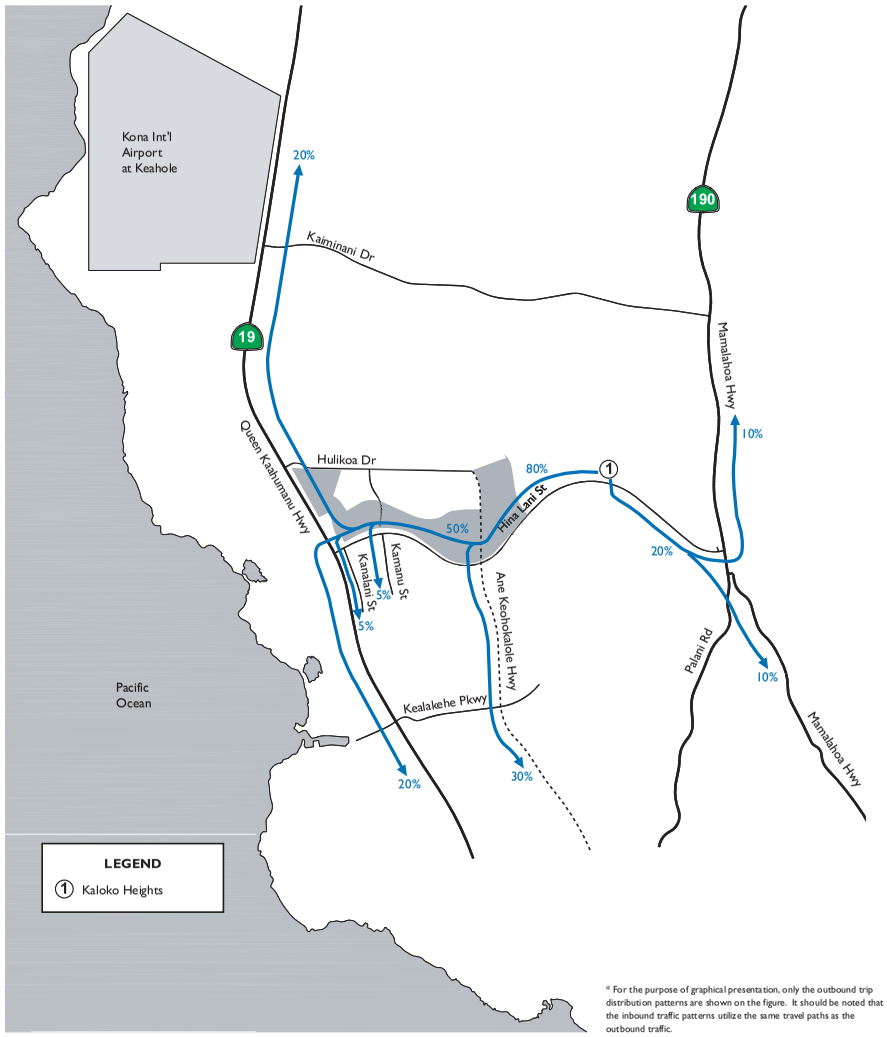
Project Decription	Parcel I.D.	TAZ	ITE Code	ITE Decription	Quantity	Daily	AM Peak Hour Total	AM Peak Hour In	AM Peak Hour Out	PM Peak Hour Total	PM Peak Hour In	PM Peak Hour Out
Phase 3, TAZ 11												
Park	P-1	11	412	County Park	11.2 AC	26	0	0	-	1	0	0
School	SCHOOL	11	520	Elementary School	450 STU	581	203	113	90	68	32	36
				Subtotal	**461**	**606**	**203**	**113**	**90**	**68**	**32**	**36**
				Transit Trip Discount	5%	-30	-10	-6	-4	-3	-2	-1
				Total (less Internal/Transit Trips)		576	193	107	86	65	30	35
Single Family	T3-6	11	210	Single-Family Detached Housing	71 DU	679	53	13	40	72	45	26
Single Family	T3-7	11	210	Single-Family Detached Housing	117 DU	1,120	88	22	66	118	75	43
Single Family	T3-8	11	210	Single-Family Detached Housing	63 DU	603	47	12	35	64	40	23
Single Family	T3-9	11	210	Single-Family Detached Housing	193 DU	1,847	145	37	108	195	124	71
Single Family	T4-6	11	210	Single-Family Detached Housing	83 DU	794	62	16	46	84	53	31
Multi Family	T4-6	11	230	Residential Condo/Townhouse	35 DU	203	15	2	13	18	12	6
Single Family	T4-7	11	210	Single-Family Detached Housing	54 DU	517	41	10	30	55	35	20
Multi Family	T4-7	11	230	Residential Condo/Townhouse	37 DU	215	16	3	14	19	13	6
				Subtotal	**653**	**5,978**	**467**	**115**	**352**	**624**	**397**	**227**
				Transit Trip Discount	5%	-299	-23	-6	-17	-31	-20	-11
				Total (less Internal/Transit Trips)		5,679	444	109	335	593	377	216
		11		**Total without Trip Discount**		**6,585**	**670**	**228**	**442**	**692**	**429**	**264**
		11		**Total with Trip Discount**		**6,256**	**637**	**216**	**421**	**658**	**407**	**252**

Appendix G (8 of 8) - Detailed Project Traffic Generation Calculations

PROJECT TRAFFIC GENERATION

Project Decription	Parcel I.D.	TAZ	ITE Code	ITE Decription	Quantity	Daily	AM Peak Hour Total	AM Peak Hour In	AM Peak Hour Out	PM Peak Hour Total	PM Peak Hour In	PM Peak Hour Out
SUMMARY												
Phase 1		TAZ 1		Total without Trip Discount		4,412	440	251	190	494	221	273
		TAZ 1		Total with Trip Discount		3,931	410	235	176	446	199	247
		TAZ 2		Total without Trip Discount		10,355	671	269	402	1,015	543	472
		TAZ 2		Total with Trip Discount		8,351	611	244	367	832	448	384
		TAZ 3		Total without Trip Discount		15,513	1,165	691	473	1,429	620	809
		TAZ 3		Total with Trip Discount		12,577	1,074	636	437	1,176	507	669
			Phase 1	Total without Trip Discount		30,280	2,276	1,211	1,065	2,938	1,384	1,554
			Phase 1	Trip Discount		-5,421	-181	-96	-85	-484	-230	-254
			Phase 1	**Total with Trip Discount**		**24,859**	**2,095**	**1,115**	**980**	**2,454**	**1,154**	**1,300**
Phase 2		TAZ 4		Total without Trip Discount		518	75	62	13	73	16	57
		TAZ 4		Total with Trip Discount		492	71	59	12	69	15	54
		TAZ 5		Total without Trip Discount		777	113	93	19	109	24	85
		TAZ 5		Total with Trip Discount		738	107	88	18	104	23	81
		TAZ 6		Total without Trip Discount		8,931	797	297	500	907	527	381
		TAZ 6		Total with Trip Discount		8,644	809	292	516	884	520	364
		TAZ 7		Total without Trip Discount		10,737	693	184	508	1,007	609	399
		TAZ 7		Total with Trip Discount		9,344	651	173	477	879	535	345
			Phase 2	Total without Trip Discount		20,963	1,678	637	1,041	2,096	1,176	921
			Phase 2	Trip Discount		-1,745	-40	-24	-17	-161	-83	-78
			Phase 2	**Total with Trip Discount**		**19,218**	**1,637**	**614**	**1,024**	**1,936**	**1,093**	**843**
Phase 3		TAZ 8		Total without Trip Discount		1,295	188	156	32	182	40	142
		TAZ 8		Total with Trip Discount		1,230	179	148	31	173	38	135
		TAZ 9		Total without Trip Discount		4,642	341	113	228	450	267	184
		TAZ 9		Total with Trip Discount		4,146	321	107	214	406	242	165
		TAZ 10		Total without Trip Discount		2,067	162	41	121	218	138	80
		TAZ 10		Total with Trip Discount		1,964	154	39	115	207	131	76
		TAZ 11		Total without Trip Discount		6,585	670	228	442	692	429	264
		TAZ 11		Total with Trip Discount		6,256	637	216	421	658	407	252
			Phase 3	Total without Trip Discount		14,589	1,360	538	822	1,542	874	669
			Phase 3	Trip Discount		-993	-70	-28	-42	-98	-56	-42
			Phase 3	**Total with Trip Discount**		**13,596**	**1,290**	**510**	**780**	**1,444**	**818**	**627**
Kaloko Makai Project				Total without Trip Discount		65,832	5,314	2,386	2,928	6,577	3,433	3,144
				Trip Discount		-8,159	-291	-148	-144	-743	-369	-374
				Total with Trip Discount		**57,672**	**5,023**	**2,239**	**2,784**	**5,834**	**3,064**	**2,770**

Appendix H – Cumulative Development Trip Distribution



* For the purpose of graphical presentation, only the outbound trip distribution patterns are shown on the figure. It should be noted that the inbound traffic patterns utilize the same travel paths as the outbound traffic.

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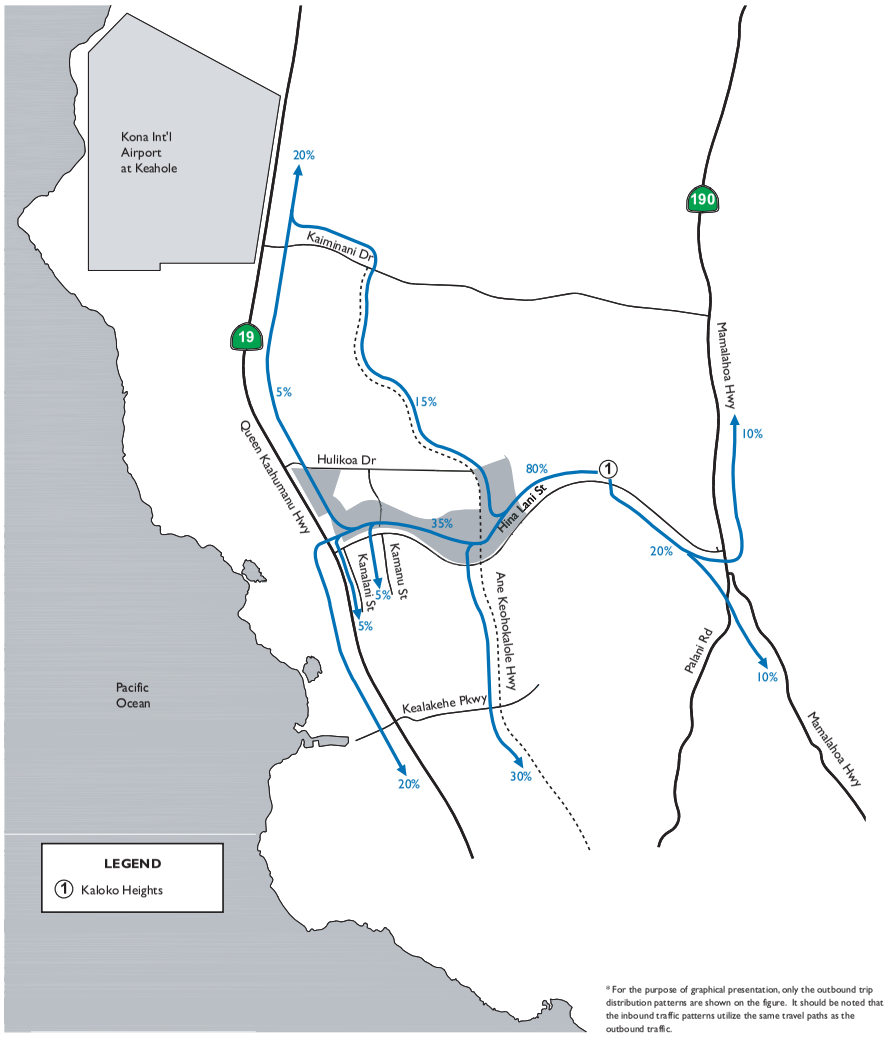

* For the purpose of graphical presentation, only the outbound trip distribution patterns are shown on the figure. It should be noted that the inbound traffic patterns utilize the same travel paths as the outbound traffic.

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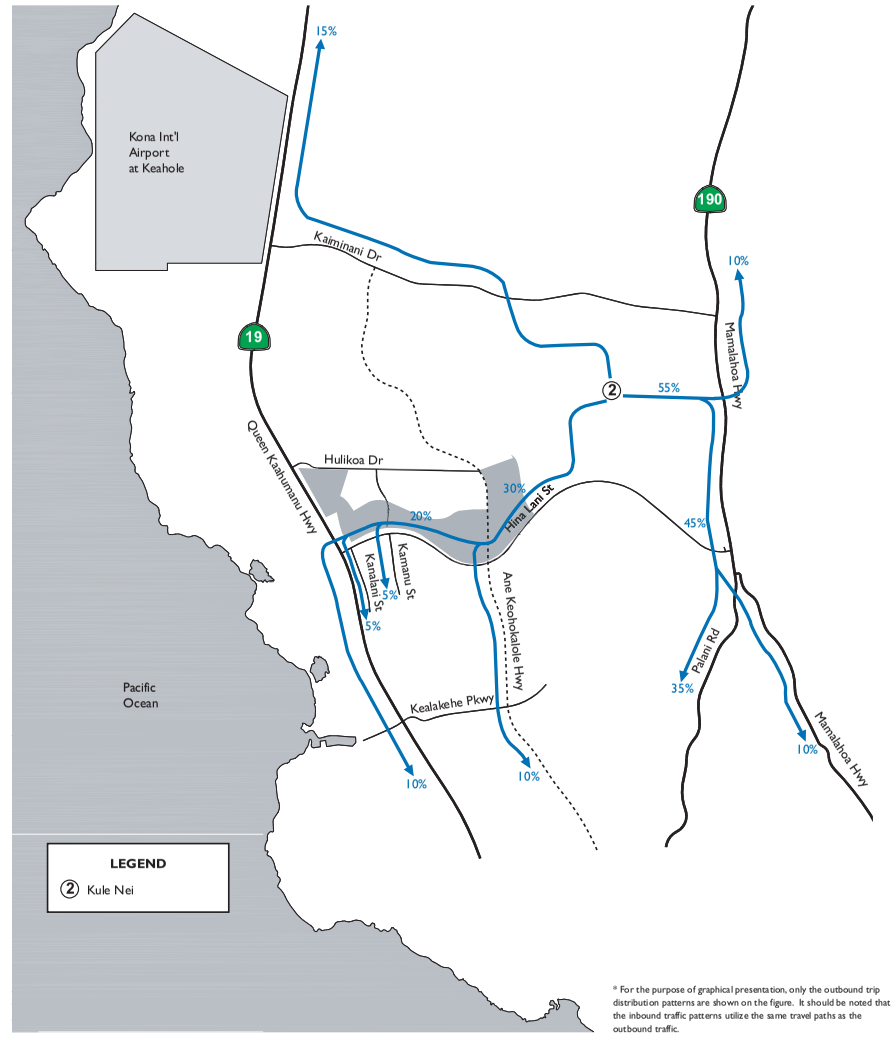
Kaloko Makai Project — Figure C-2

Kona, Hawaii — Other Cumulative Development Phases 2 and 3 Trip Distribution-Kaloko Heights



* For the purpose of graphical presentation, only the outbound trip distribution patterns are shown on the figure. It should be noted that the inbound traffic patterns utilize the same travel paths as the outbound traffic.

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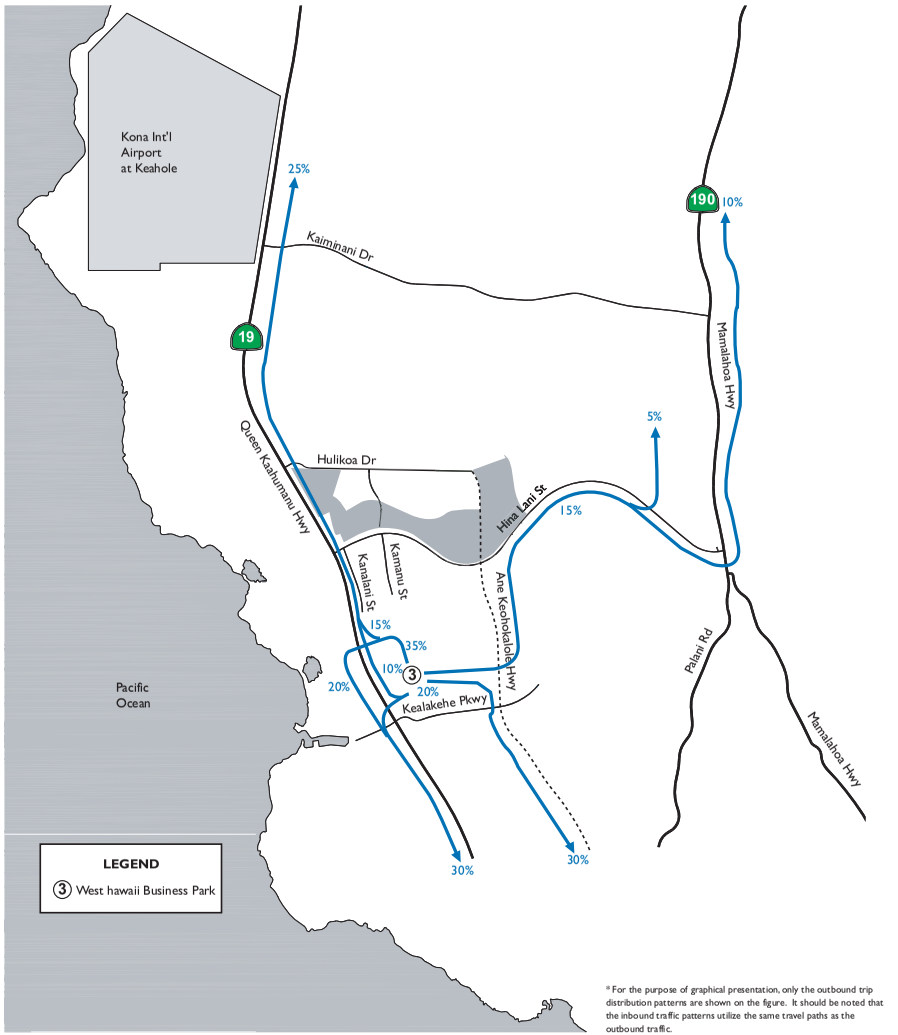
KOA CORPORATION
PLANNING & ENGINEERING

Kaloko Makai Project — Figure C-3

Kona, Hawaii — Other Cumulative Development Phases 1, 2 and 3 Trip Distribution-Kule Nei



* For the purpose of graphical presentation, only the outbound trip distribution patterns are shown on the figure. It should be noted that the inbound traffic patterns utilize the same travel paths as the outbound traffic.

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KOA CORPORATION
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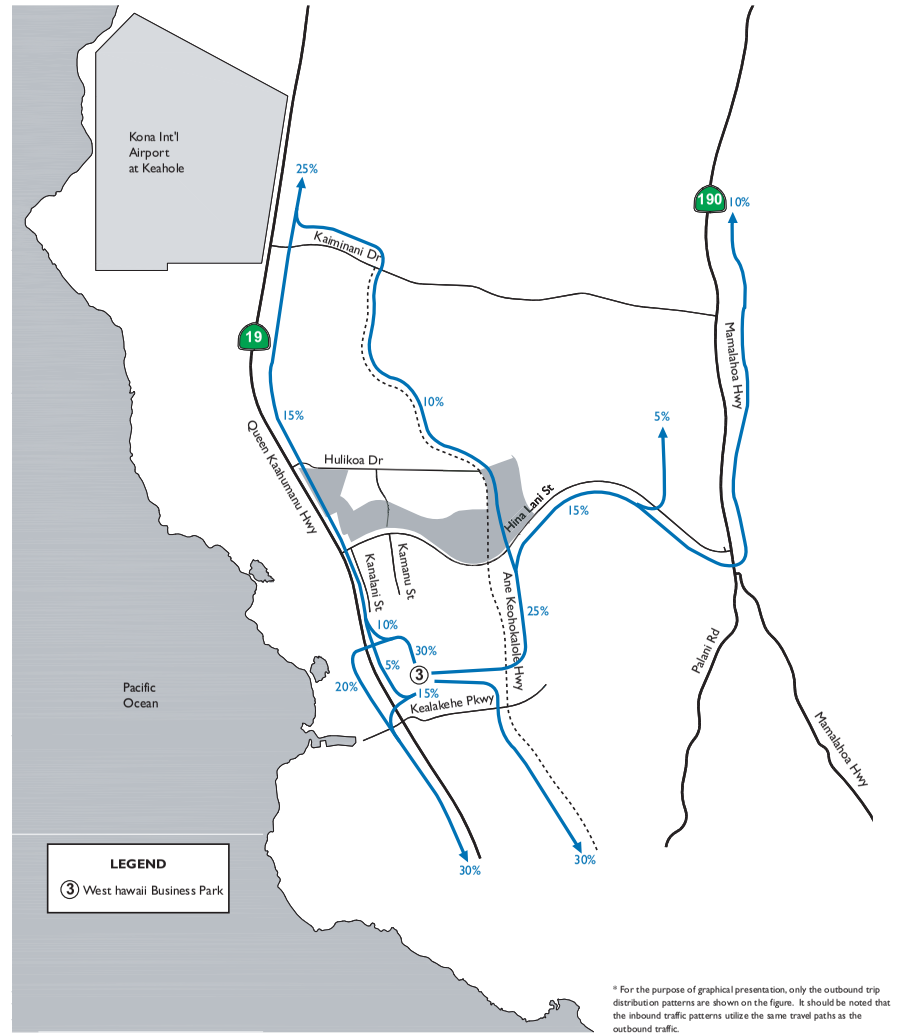
Kaloko Makai Project — Figure C-4

Kona, Hawaii — Other Cumulative Development Phase 1 Trip Distribution-West Hawaii Business Park



* For the purpose of graphical presentation, only the outbound trip distribution patterns are shown on the figure. It should be noted that the inbound traffic patterns utilize the same travel paths as the outbound traffic.

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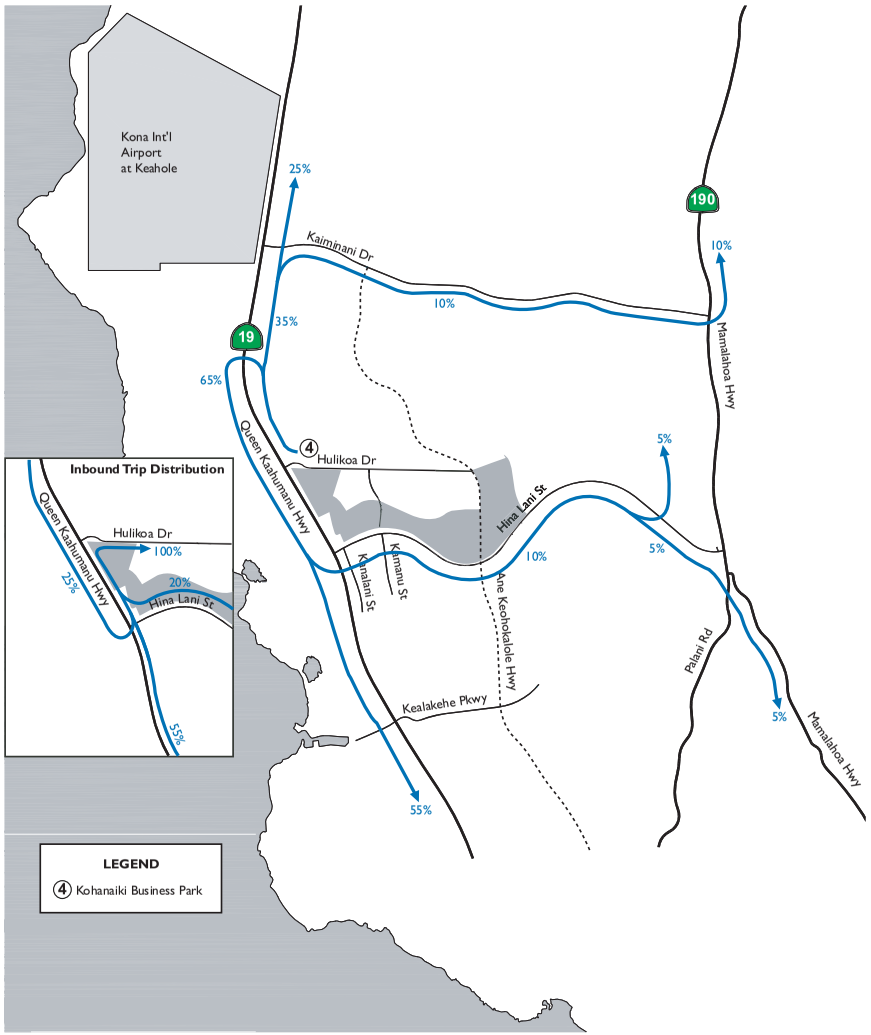
Kaloko Makai Project — Figure C-5

Kona, Hawaii — Other Cumulative Development Phases 2 and 3 Trip Distribution-West Hawaii Business Park



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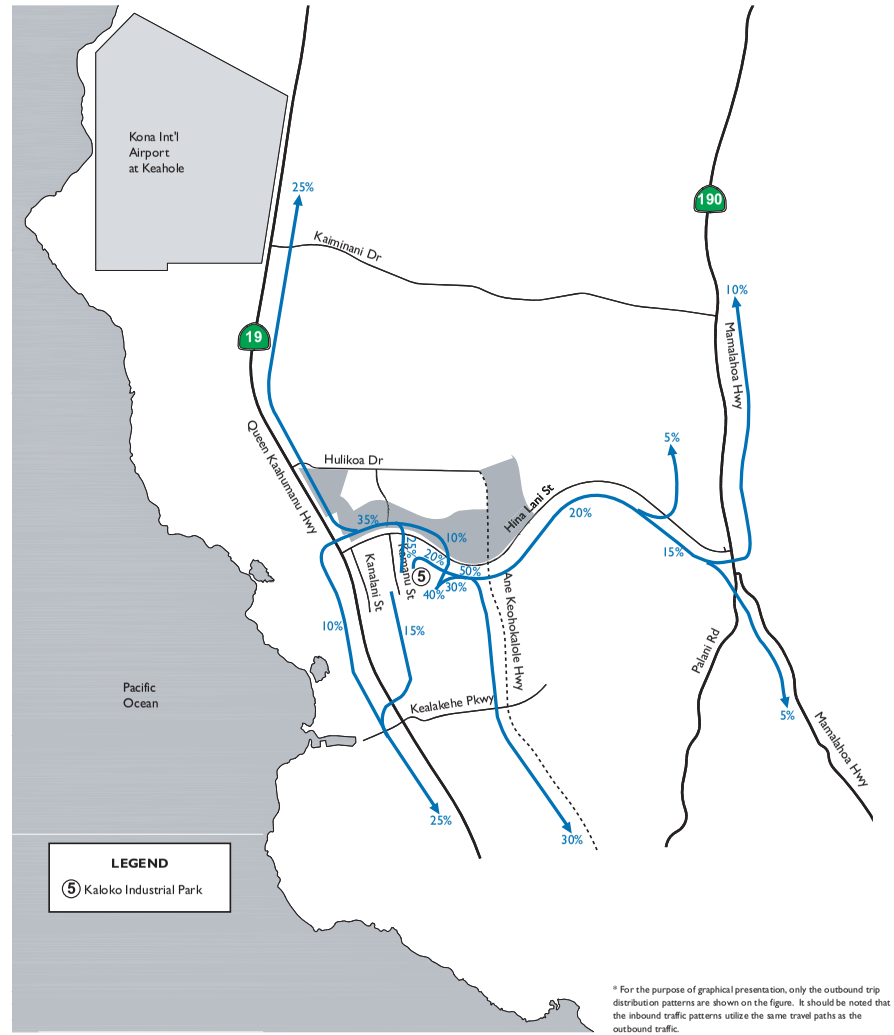
Kaloko Makai Project — Figure C-6

Kona, Hawaii — Other Cumulative Development Phases 1, 2 and 3 Trip Distribution-Kohanaiki Business Park



* For the purpose of graphical presentation, only the outbound trip distribution patterns are shown on the figure. It should be noted that the inbound traffic patterns utilize the same travel paths as the outbound traffic.

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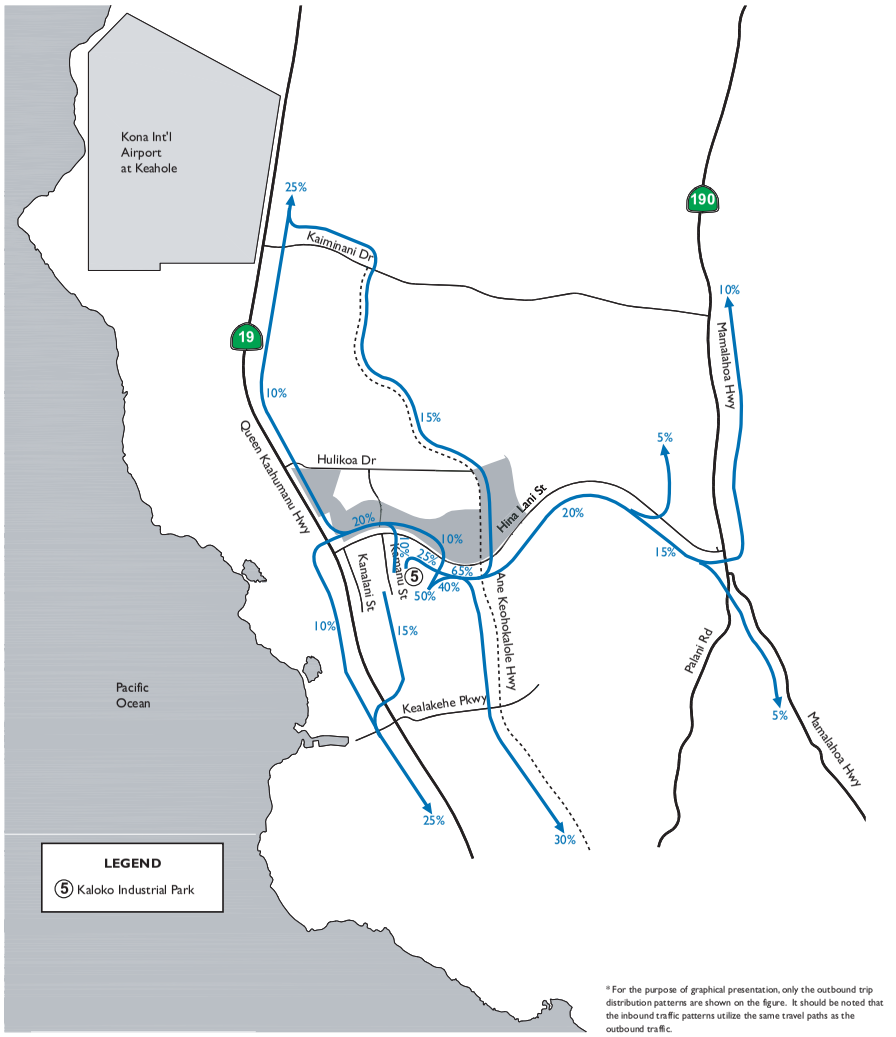
Kaloko Makai Project — Figure C-7

Kona, Hawaii — Other Cumulative Development Phase 1 Trip Distribution-Kaloko Industrial Park



* For the purpose of graphical presentation, only the outbound trip distribution patterns are shown on the figure. It should be noted that the inbound traffic patterns utilize the same travel paths as the outbound traffic.

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Kaloko Makai Project — Figure C-8

Kona, Hawaii — Other Cumulative Development Phases 2 and 3 Trip Distribution-Kaloko Industrial Park

Appendix I – Ambient Background Growth Calculation Worksheets

Appendix I-1

Historic Average Daily Traffic (ADT) Volume Comparisons on Queen Kaahumanu Highway, North of OTEC Access Road (Station T8M)

DOT[1] Data		Year-to-Year Growth		
Count Year	ADT Volume	Duration (Years)	Volume Change	One Year Growth
1996	15,709	2	1,805	5.6%
1998	17,514	2	1,528	4.3%
2000	19,042	2	636	1.7%
2002	19,678	2	3,119	7.6%
2004	22,797	2	-37	-0.1%
2006	22,760	1	548	2.4%
2007	23,308	1	-1,330	-5.7%
2008	21,978	1	-1,140	-5.2%
2009	20,838	1	1,063	5.1%
2010	21,901	0	0	0.0%
Average				**1.74%**

Footnote:

[1] Hawaii State Department of Transportation, 24-Hour Traffic Count, Queen Kaahumanu Highway North of OTEC Road (Palani Road / Kuhio Wharf / Nelha), Station Number T8M.

Growth Rate Calculations

Phase	Analysis Year	Years of Growth	Total Growth
Existing	**2010**	n/a	n/a
1	2015 - **2025**	15	29.6%
2	2025 - **2035**	25	54.0%
3	2035 - **2045**	35	83.1%

Appendix I-2

Regional Ambient Growth Traffic on Highways

Highway	Year	Ambient	AM Peak Hour		PM Peak Hour	
			Northbound (In)	Southbound (Out)	Northbound (In)	Southbound (Out)
SR-19 Queen Kaahumanu Hwy.	2010	Existing	562	374	497	623
	2025	29.6%	**166**	**111**	**147**	**184**
	2035	54.0%	**304**	**202**	**268**	**337**
	2045	83.1%	**467**	**311**	**413**	**518**
SR-190 Mamalahoa Hwy. NBT/SBT	2010	Existing	274	956	511	391
	2025	29.6%	**81**	**283**	**151**	**116**
	Post 2035	*Diverted*	*174*	*656*	*361*	*291*
	2035	54.0%	**94**	**354**	**195**	**157**
	2045	83.1%	**145**	**545**	**300**	**242**
Ane Keohokalole Hwy. NBT/SBT	2010	Existing	29	38	23	29
	2025	29.6%	**9**	**11**	**7**	**9**
	Post 2035	*Diverted*	*79*	*188*	*98*	*79*
	2035	54.0%	**43**	**102**	**53**	**43**
	2045	83.1%	**66**	**156**	**81**	**66**
Hina Lani 6NR -> 7EL 7SR -> 6WL	Post 2035	Diverted	50	150	75	50
	2035	54.0%	**27**	**81**	**41**	**27**
	2045	83.1%	**42**	**125**	**62**	**42**
Total Volume	2010		865	1368	1031	1043
	2025		256	405	305	309
	2035		468	739	557	564
	2045		720	1137	856	868

Appendix J – Intersection Operations Analysis Worksheets for 2025 Without Project Conditions, with Existing Geometry and Planned Improvements

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	3539	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.19	1.00
Satd. Flow (perm)	1770	1583	3539	1583	351	3539
Volume (vph)	480	244	869	109	33	830
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	522	265	945	118	36	902
RTOR Reduction (vph)	0	125	0	76	0	0
Lane Group Flow (vph)	522	140	945	42	36	902
Turn Type		Perm		Perm	pm+pt	
Protected Phases	8		2		1	6
Permitted Phases		8		2	6	
Actuated Green, G (s)	17.7	17.7	17.2	17.2	22.4	22.4
Effective Green, g (s)	17.7	17.7	17.2	17.2	22.4	22.4
Actuated g/C Ratio	0.37	0.37	0.36	0.36	0.47	0.47
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	651	583	1266	566	199	1648
v/s Ratio Prot	c0.29		c0.27		0.00	c0.25
v/s Ratio Perm		0.17		0.07	0.08	
v/c Ratio	0.80	0.24	0.75	0.07	0.18	0.55
Uniform Delay, d1	13.6	10.5	13.5	10.2	8.5	9.2
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	7.1	0.2	2.4	0.1	0.4	0.4
Delay (s)	20.7	10.8	16.0	10.3	9.0	9.6
Level of Service	C	B	B	B	A	A
Approach Delay (s)	17.3		15.3			9.6
Approach LOS	B		B			A

Intersection Summary			
HCM Average Control Delay	14.0	HCM Level of Service	B
HCM Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	48.1	Sum of lost time (s)	12.0
Intersection Capacity Utilization	60.7%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

HCM Unsignalized Intersection Capacity Analysis
2: Hulikoa Drive & Queen Kaahumanu Highway

2025 AM Without Project
7/25/2012

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Yield		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	0	247	881	299	0	1333
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	268	958	325	0	1449
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	TWLTL					
Median storage veh)	5					
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1682	479			958	
vC1, stage 1 conf vol	958					
vC2, stage 2 conf vol	724					
vCu, unblocked vol	1682	479			958	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)	5.8					
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	50			100	
cM capacity (veh/h)	319	533			714	

Direction, Lane #	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	268	479	479	325	724	724
Volume Left	0	0	0	0	0	0
Volume Right	268	0	0	325	0	0
cSH	533	1700	1700	1700	1700	1700
Volume to Capacity	0.50	0.28	0.28	0.19	0.43	0.43
Queue Length (ft)	70	0	0	0	0	0
Control Delay (s)	18.4	0.0	0.0	0.0	0.0	0.0
Lane LOS	C					
Approach Delay (s)	18.4	0.0			0.0	
Approach LOS	C					

Intersection Summary			
Average Delay	1.6		
Intersection Capacity Utilization	46.3%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Signalized Intersection Capacity Analysis
3: Hina Lani Street & Queen Kaahumanu Highway

2025 AM Without Project
7/25/2012

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	1.00	0.95	1.00	0.97	0.95
Frpb, ped/bikes	1.00	0.98	1.00	0.98	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1558	3539	1553	3433	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1558	3539	1553	3433	3539
Volume (vph)	275	270	752	433	382	1032
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	299	293	817	471	415	1122
RTOR Reduction (vph)	0	0	0	309	0	0
Lane Group Flow (vph)	299	293	817	162	415	1122
Confl. Peds. (#/hr)		14		8	8	
Turn Type		Free		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		Free		2		
Actuated Green, G (s)	9.9	46.8	16.1	16.1	8.8	28.9
Effective Green, g (s)	9.9	46.8	16.1	16.1	8.8	28.9
Actuated g/C Ratio	0.21	1.00	0.34	0.34	0.19	0.62
Clearance Time (s)	4.0		4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0		3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	726	1558	1217	534	646	2185
v/s Ratio Prot	c0.09		0.23		c0.12	0.32
v/s Ratio Perm		0.19		0.30		
v/c Ratio	0.41	0.19	0.67	0.30	0.64	0.51
Uniform Delay, d1	15.9	0.0	13.1	11.2	17.5	5.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.4	0.3	1.5	0.3	2.2	0.2
Delay (s)	16.3	0.3	14.6	11.6	19.7	5.2
Level of Service	B	A	B	B	B	A
Approach Delay (s)	8.4		13.5			9.1
Approach LOS	A		B			A

Intersection Summary			
HCM Average Control Delay	10.6	HCM Level of Service	B
HCM Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	46.8	Sum of lost time (s)	12.0
Intersection Capacity Utilization	51.6%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	322	363	29	339	225	18
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	350	395	32	368	245	20
Pedestrians					2	
Lane Width (ft)					12.0	
Walking Speed (ft/s)					4.0	
Percent Blockage					0	
Right turn flare (veh)						6
Median type					None	
Median storage veh)						
Upstream signal (ft)	475					
pX, platoon unblocked						
vC, conflicting volume			747		599	352
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			747		599	352
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			96		41	97
cM capacity (veh/h)			856		416	643

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	350	395	154	246	264
Volume Left	0	0	32	0	245
Volume Right	0	395	0	0	20
cSH	1700	1700	856	1700	449
Volume to Capacity	0.21	0.23	0.04	0.14	0.59
Queue Length (ft)	0	0	3	0	92
Control Delay (s)	0.0	0.0	2.2	0.0	24.2
Lane LOS			A		C
Approach Delay (s)	0.0		0.9		24.2
Approach LOS					C

Intersection Summary			
Average Delay	4.8		
Intersection Capacity Utilization	49.6%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	0.97	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (prot)	1863	1583	1770	1863	3433	1583
Flt Permitted	1.00	1.00	0.67	1.00	0.95	1.00
Satd. Flow (perm)	1863	1583	1243	1863	3433	1583
Volume (vph)	130	198	202	243	134	77
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	141	215	220	264	146	84
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	141	215	220	264	146	84
Turn Type		Free	Perm			Free
Protected Phases	4			8	2	
Permitted Phases		Free	8			Free
Actuated Green, G (s)	6.2	18.9	6.2	6.2	4.7	18.9
Effective Green, g (s)	6.2	18.9	6.2	6.2	4.7	18.9
Actuated g/C Ratio	0.33	1.00	0.33	0.33	0.25	1.00
Clearance Time (s)	4.0		4.0	4.0	4.0	
Vehicle Extension (s)	3.0		3.0	3.0	3.0	
Lane Grp Cap (vph)	611	1583	408	611	854	1583
v/s Ratio Prot	0.08			0.14	0.04	
v/s Ratio Perm		0.14	c0.18			0.05
v/c Ratio	0.23	0.14	0.54	0.43	0.17	0.05
Uniform Delay, d1	4.6	0.0	5.2	5.0	5.6	0.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.2	0.2	1.4	0.5	0.1	0.1
Delay (s)	4.8	0.2	6.6	5.5	5.7	0.1
Level of Service	A	A	A	A	A	A
Approach Delay (s)	2.0			6.0	3.6	
Approach LOS	A			A	A	

Intersection Summary			
HCM Average Control Delay	4.1	HCM Level of Service	A
HCM Volume to Capacity ratio	0.30		
Actuated Cycle Length (s)	18.9	Sum of lost time (s)	4.0
Intersection Capacity Utilization	31.9%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0	4.0	4.0		4.0	4.0	4.0		4.0	
Lane Util. Factor		1.00	1.00	1.00	1.00		1.00	1.00	1.00		1.00	
Frt		1.00	0.85	1.00	1.00		1.00	1.00	0.85		1.00	
Flt Protected		1.00	1.00	0.95	1.00		0.95	1.00	1.00		1.00	
Satd. Flow (prot)		1863	1583	1770	1863		1770	1863	1583		1863	
Flt Permitted		1.00	1.00	0.95	1.00		0.75	1.00	1.00		1.00	
Satd. Flow (perm)		1863	1583	1770	1863		1397	1863	1583		1863	
Volume (vph)	0	164	26	189	437	0	129	9	64	0	11	0
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	178	28	205	475	0	140	10	70	0	12	0
RTOR Reduction (vph)	0	0	22	0	0	0	0	0	55	0	0	0
Lane Group Flow (vph)	0	178	6	205	475	0	140	10	15	0	12	0
Turn Type	Prot		Perm	Prot		Perm	Perm		Perm	Perm		Perm
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4			8	2		2	6		6
Actuated Green, G (s)		7.3	7.3	6.8	18.1		7.3	7.3	7.3		7.3	
Effective Green, g (s)		7.3	7.3	6.8	18.1		7.3	7.3	7.3		7.3	
Actuated g/C Ratio		0.22	0.22	0.20	0.54		0.22	0.22	0.22		0.22	
Clearance Time (s)		4.0	4.0	4.0	4.0		4.0	4.0	4.0		4.0	
Vehicle Extension (s)		3.0	3.0	3.0	3.0		3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)		407	346	360	1010		305	407	346		407	
v/s Ratio Prot		0.10		0.12	c0.26			0.01			0.01	
v/s Ratio Perm			0.02				c0.10		0.04			
v/c Ratio		0.44	0.02	0.57	0.47		0.46	0.02	0.04		0.03	
Uniform Delay, d1		11.3	10.2	12.0	4.7		11.3	10.3	10.3		10.3	
Progression Factor		1.00	1.00	1.00	1.00		1.00	1.00	1.00		1.00	
Incremental Delay, d2		0.8	0.0	2.1	0.3		1.1	0.0	0.1		0.0	
Delay (s)		12.0	10.3	14.0	5.1		12.4	10.3	10.4		10.3	
Level of Service		B	B	B	A		B	B	B		B	
Approach Delay (s)		11.8			7.8			11.7			10.3	
Approach LOS		B			A			B			B	

Intersection Summary			
HCM Average Control Delay	9.3	HCM Level of Service	A
HCM Volume to Capacity ratio	0.47		
Actuated Cycle Length (s)	33.4	Sum of lost time (s)	8.0
Intersection Capacity Utilization	50.1%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1770	1583	1770	1863	1863	1583
Flt Permitted	0.95	1.00	0.04	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	70	1863	1863	1583
Volume (vph)	110	103	150	378	1307	270
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	120	112	163	411	1421	293
RTOR Reduction (vph)	0	101	0	0	0	25
Lane Group Flow (vph)	120	11	163	411	1421	268
Turn Type		Perm	pm+pt			Perm
Protected Phases	4		5	2	6	
Permitted Phases		4	2			6
Actuated Green, G (s)	13.5	13.5	116.0	116.0	103.0	103.0
Effective Green, g (s)	13.5	13.5	116.0	116.0	103.0	103.0
Actuated g/C Ratio	0.10	0.10	0.84	0.84	0.75	0.75
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	174	155	170	1572	1396	1186
v/s Ratio Prot	0.07		c0.06	0.22	c0.76	
v/s Ratio Perm		0.07	0.75			0.19
v/c Ratio	0.69	0.07	0.96	0.26	1.02	0.23
Uniform Delay, d1	60.0	56.3	66.1	2.2	17.2	5.2
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	10.8	0.2	56.2	0.1	28.7	0.1
Delay (s)	70.8	56.5	122.4	2.2	45.9	5.3
Level of Service	E	E	F	A	D	A
Approach Delay (s)	63.9			36.4	39.0	
Approach LOS	E			D	D	

Intersection Summary			
HCM Average Control Delay	40.7	HCM Level of Service	D
HCM Volume to Capacity ratio	0.98		
Actuated Cycle Length (s)	137.5	Sum of lost time (s)	12.0
Intersection Capacity Utilization	93.2%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
8: Kealakehe Parkway & Queen Kaahumanu Highway

2025 AM Without Project
7/25/2012

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor		1.00	1.00		1.00	1.00	1.00	0.95	1.00	1.00	0.95	
Frpb, ped/bikes		1.00	1.00		1.00	1.00	1.00	1.00	0.98	1.00	1.00	
Flpb, ped/bikes		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt		1.00	0.85		1.00	0.85	1.00	1.00	0.85	1.00	0.99	
Flt Protected		0.97	1.00		0.96	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1800	1583		1779	1583	1769	3539	1548	1770	3508	
Flt Permitted		0.77	1.00		0.72	1.00	0.23	1.00	1.00	0.14	1.00	
Satd. Flow (perm)		1443	1583		1342	1583	432	3539	1548	261	3508	
Volume (vph)	17	7	24	270	18	166	68	1063	441	240	878	48
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	18	8	26	293	20	180	74	1155	479	261	954	52
RTOR Reduction (vph)	0	0	19	0	0	132	0	0	281	0	6	0
Lane Group Flow (vph)	0	26	7	0	313	48	74	1155	198	261	1000	0
Confl. Peds. (#/hr)							2		2	2		2
Turn Type	Perm		Perm	Perm		Perm	pm+pt		Perm	pm+pt		
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		
Actuated Green, G (s)		15.7	15.7		15.7	15.7	27.4	24.5	24.5	35.6	28.7	
Effective Green, g (s)		15.7	15.7		15.7	15.7	27.4	24.5	24.5	35.6	28.7	
Actuated g/C Ratio		0.26	0.26		0.26	0.26	0.46	0.41	0.41	0.60	0.48	
Clearance Time (s)		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		382	419		355	419	265	1462	640	337	1698	
v/s Ratio Prot							0.01	0.33		c0.09	0.29	
v/s Ratio Perm		0.02	0.02		c0.23	0.11	0.12		0.31	c0.37		
v/c Ratio		0.07	0.02		0.88	0.11	0.28	0.79	0.31	0.77	0.59	
Uniform Delay, d1		16.3	16.1		20.9	16.5	9.2	15.2	11.7	9.8	11.0	
Progression Factor		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2		0.1	0.0		21.7	0.1	0.6	3.0	0.3	10.6	0.5	
Delay (s)		16.4	16.1		42.6	16.6	9.7	18.1	12.0	20.4	11.6	
Level of Service		B	B		D	B	A	B	B	C	B	
Approach Delay (s)		16.3			33.1			16.1			13.4	
Approach LOS		B			C			B			B	

Intersection Summary			
HCM Average Control Delay	17.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	59.3	Sum of lost time (s)	8.0
Intersection Capacity Utilization	75.3%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
1: Kaiminani Drive & Queen Kaahumanu Highway

2025 PM Without Project
7/25/2012

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	3539	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.15	1.00
Satd. Flow (perm)	1770	1583	3539	1583	272	3539
Volume (vph)	180	84	1135	387	226	1114
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	196	91	1234	421	246	1211
RTOR Reduction (vph)	0	75	0	221	0	0
Lane Group Flow (vph)	196	16	1234	200	246	1211
Turn Type		Perm		Perm	pm+pt	
Protected Phases	8		2		1	6
Permitted Phases		8		2	6	
Actuated Green, G (s)	8.4	8.4	23.4	23.4	32.8	32.8
Effective Green, g (s)	8.4	8.4	23.4	23.4	32.8	32.8
Actuated g/C Ratio	0.17	0.17	0.48	0.48	0.67	0.67
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	302	270	1683	753	346	2359
v/s Ratio Prot	c0.11		0.35		c0.08	0.34
v/s Ratio Perm		0.06		0.27	c0.40	
v/c Ratio	0.65	0.06	0.73	0.27	0.71	0.51
Uniform Delay, d1	19.0	17.1	10.4	7.7	6.9	4.2
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	4.8	0.1	1.7	0.2	6.7	0.2
Delay (s)	23.8	17.2	12.1	7.9	13.7	4.3
Level of Service	C	B	B	A	B	A
Approach Delay (s)	21.7		11.0			5.9
Approach LOS	C		B			A

Intersection Summary			
HCM Average Control Delay	9.7	HCM Level of Service	A
HCM Volume to Capacity ratio	0.68		
Actuated Cycle Length (s)	49.2	Sum of lost time (s)	8.0
Intersection Capacity Utilization	63.9%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Yield		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	0	274	1340	174	0	1604
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	298	1457	189	0	1743
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	TWLTL					
Median storage veh)	5					
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	2328	728			1457	
vC1, stage 1 conf vol	1457					
vC2, stage 2 conf vol	872					
vCu, unblocked vol	2328	728			1457	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)	5.8					
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	19			100	
cM capacity (veh/h)	179	366			460	

Direction, Lane #	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	298	728	728	189	872	872
Volume Left	0	0	0	0	0	0
Volume Right	298	0	0	189	0	0
cSH	366	1700	1700	1700	1700	1700
Volume to Capacity	0.81	0.43	0.43	0.11	0.51	0.51
Queue Length (ft)	179	0	0	0	0	0
Control Delay (s)	46.2	0.0	0.0	0.0	0.0	0.0
Lane LOS	E					
Approach Delay (s)	46.2	0.0			0.0	
Approach LOS	E					

Intersection Summary			
Average Delay	3.7		
Intersection Capacity Utilization	60.7%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	1.00	0.95	1.00	0.97	0.95
Frpb, ped/bikes	1.00	0.98	1.00	0.98	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1558	3539	1551	3433	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1558	3539	1551	3433	3539
Volume (vph)	544	414	1105	594	358	1154
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	591	450	1201	646	389	1254
RTOR Reduction (vph)	0	0	0	383	0	0
Lane Group Flow (vph)	591	450	1201	263	389	1254
Confl. Peds. (#/hr)		14		8	8	
Turn Type		Free		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		Free		2		
Actuated Green, G (s)	14.0	57.3	23.3	23.3	8.0	35.3
Effective Green, g (s)	14.0	57.3	23.3	23.3	8.0	35.3
Actuated g/C Ratio	0.24	1.00	0.41	0.41	0.14	0.62
Clearance Time (s)	4.0		4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0		3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	839	1558	1439	631	479	2180
v/s Ratio Prot	c0.17		0.34		c0.11	0.35
v/s Ratio Perm		0.29		0.42		
v/c Ratio	0.70	0.29	0.83	0.42	0.81	0.58
Uniform Delay, d1	19.8	0.0	15.3	12.1	23.9	6.5
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	2.7	0.5	4.3	0.4	10.1	0.4
Delay (s)	22.5	0.5	19.6	12.6	34.0	6.9
Level of Service	C	A	B	B	C	A
Approach Delay (s)	13.0		17.2			13.3
Approach LOS	B		B			B

Intersection Summary			
HCM Average Control Delay	14.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.89		
Actuated Cycle Length (s)	57.3	Sum of lost time (s)	12.0
Intersection Capacity Utilization	66.3%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	343	489	17	669	200	74
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	373	532	18	727	217	80
Pedestrians					2	
Lane Width (ft)					12.0	
Walking Speed (ft/s)					4.0	
Percent Blockage					0	
Right turn flare (veh)						6
Median type					None	
Median storage veh)						
Upstream signal (ft)	475					
pX, platoon unblocked						
vC, conflicting volume			906		775	375
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			906		775	375
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			98		33	87
cM capacity (veh/h)			745		326	622

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	373	532	261	485	298
Volume Left	0	0	18	0	217
Volume Right	0	532	0	0	80
cSH	1700	1700	745	1700	446
Volume to Capacity	0.22	0.31	0.02	0.29	0.67
Queue Length (ft)	0	0	2	0	120
Control Delay (s)	0.0	0.0	1.0	0.0	29.2
Lane LOS			A		D
Approach Delay (s)	0.0		0.3		29.2
Approach LOS					D

Intersection Summary			
Average Delay	4.6		
Intersection Capacity Utilization	56.2%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	0.97	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (prot)	1863	1583	1770	1863	3433	1583
Flt Permitted	1.00	1.00	0.59	1.00	0.95	1.00
Satd. Flow (perm)	1863	1583	1107	1863	3433	1583
Volume (vph)	247	122	127	184	479	326
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	268	133	138	200	521	354
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	268	133	138	200	521	354
Turn Type		Free	Perm			Free
Protected Phases	4			8	2	
Permitted Phases		Free	8			Free
Actuated Green, G (s)	7.3	22.8	7.3	7.3	7.5	22.8
Effective Green, g (s)	7.3	22.8	7.3	7.3	7.5	22.8
Actuated g/C Ratio	0.32	1.00	0.32	0.32	0.33	1.00
Clearance Time (s)	4.0		4.0	4.0	4.0	
Vehicle Extension (s)	3.0		3.0	3.0	3.0	
Lane Grp Cap (vph)	596	1583	354	596	1129	1583
v/s Ratio Prot	c0.14			0.11	c0.15	
v/s Ratio Perm		0.08	0.12			0.22
v/c Ratio	0.45	0.08	0.39	0.34	0.46	0.22
Uniform Delay, d1	6.2	0.0	6.0	5.9	6.1	0.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.5	0.1	0.7	0.3	0.3	0.3
Delay (s)	6.7	0.1	6.7	6.2	6.4	0.3
Level of Service	A	A	A	A	A	A
Approach Delay (s)	4.5			6.4	3.9	
Approach LOS	A			A	A	

Intersection Summary			
HCM Average Control Delay	4.6	HCM Level of Service	A
HCM Volume to Capacity ratio	0.46		
Actuated Cycle Length (s)	22.8	Sum of lost time (s)	8.0
Intersection Capacity Utilization	43.7%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0	4.0	4.0		4.0	4.0	4.0		4.0	
Lane Util. Factor		1.00	1.00	1.00	1.00		1.00	1.00	1.00		1.00	
Frt		1.00	0.85	1.00	1.00		1.00	1.00	0.85		1.00	
Flt Protected		1.00	1.00	0.95	1.00		0.95	1.00	1.00		1.00	
Satd. Flow (prot)		1863	1583	1770	1863		1770	1863	1583		1863	
Flt Permitted		1.00	1.00	0.95	1.00		0.75	1.00	1.00		1.00	
Satd. Flow (perm)		1863	1583	1770	1863		1399	1863	1583		1863	
Volume (vph)	0	561	127	180	269	0	34	7	282	0	9	0
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	610	138	196	292	0	37	8	307	0	10	0
RTOR Reduction (vph)	0	0	81	0	0	0	0	0	227	0	0	0
Lane Group Flow (vph)	0	610	57	196	292	0	37	8	80	0	10	0
Turn Type	Prot		Perm	Prot		Perm	Perm		Perm	Perm		Perm
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4			8	2		2	6		6
Actuated Green, G (s)		19.8	19.8	8.0	31.8		8.4	8.4	8.4		8.4	
Effective Green, g (s)		19.8	19.8	8.0	31.8		8.4	8.4	8.4		8.4	
Actuated g/C Ratio		0.41	0.41	0.17	0.66		0.17	0.17	0.17		0.17	
Clearance Time (s)		4.0	4.0	4.0	4.0		4.0	4.0	4.0		4.0	
Vehicle Extension (s)		3.0	3.0	3.0	3.0		3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)		765	650	294	1229		244	325	276		325	
v/s Ratio Prot		c0.33		c0.11	0.16			0.00			0.01	
v/s Ratio Perm			0.09				0.03		0.19			
v/c Ratio		0.80	0.09	0.67	0.24		0.15	0.02	0.29		0.03	
Uniform Delay, d1		12.4	8.7	18.8	3.3		16.9	16.5	17.3		16.5	
Progression Factor		1.00	1.00	1.00	1.00		1.00	1.00	1.00		1.00	
Incremental Delay, d2		5.8	0.1	5.6	0.1		0.3	0.0	0.6		0.0	
Delay (s)		18.2	8.7	24.5	3.4		17.2	16.5	17.9		16.6	
Level of Service		B	A	C	A		B	B	B		B	
Approach Delay (s)		16.5			11.9			17.8			16.6	
Approach LOS		B			B			B			B	

Intersection Summary			
HCM Average Control Delay	15.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	48.2	Sum of lost time (s)	12.0
Intersection Capacity Utilization	58.0%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1770	1583	1770	1863	1863	1583
Flt Permitted	0.95	1.00	0.18	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	331	1863	1863	1583
Volume (vph)	382	246	104	740	552	213
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	415	267	113	804	600	232
RTOR Reduction (vph)	0	187	0	0	0	120
Lane Group Flow (vph)	415	80	113	804	600	112
Turn Type		Perm	pm+pt			Perm
Protected Phases	4		5	2	6	
Permitted Phases		4	2			6
Actuated Green, G (s)	15.5	15.5	28.5	28.5	21.6	21.6
Effective Green, g (s)	15.5	15.5	28.5	28.5	21.6	21.6
Actuated g/C Ratio	0.30	0.30	0.55	0.55	0.42	0.42
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	528	472	262	1021	774	658
v/s Ratio Prot	c0.23		0.02	c0.43	0.32	
v/s Ratio Perm		0.17	0.21			0.15
v/c Ratio	0.79	0.17	0.43	0.79	0.78	0.17
Uniform Delay, d1	16.7	13.5	8.3	9.3	13.1	9.6
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	7.6	0.2	1.1	4.1	4.9	0.1
Delay (s)	24.3	13.7	9.4	13.4	18.0	9.7
Level of Service	C	B	A	B	B	A
Approach Delay (s)	20.1			12.9	15.7	
Approach LOS	C			B	B	

Intersection Summary			
HCM Average Control Delay	15.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	52.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	66.8%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor		1.00	1.00		1.00	1.00	1.00	0.95	1.00	1.00	0.95	
Frpb, ped/bikes		1.00	1.00		1.00	1.00	1.00	1.00	0.98	1.00	1.00	
Flpb, ped/bikes		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt		1.00	0.85		1.00	0.85	1.00	1.00	0.85	1.00	1.00	
Flt Protected		0.96	1.00		0.95	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1795	1583		1778	1583	1770	3539	1548	1770	3523	
Flt Permitted		0.41	1.00		0.67	1.00	0.07	1.00	1.00	0.07	1.00	
Satd. Flow (perm)		770	1583		1257	1583	139	3539	1548	129	3523	
Volume (vph)	59	19	71	412	20	192	60	1276	264	143	1564	44
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	64	21	77	448	22	209	65	1387	287	155	1700	48
RTOR Reduction (vph)	0	0	49	0	0	66	0	0	158	0	1	0
Lane Group Flow (vph)	0	85	28	0	470	143	65	1387	129	155	1747	0
Confl. Peds. (#/hr)							2		2	2		2
Turn Type	Perm		Perm	Perm		Perm	pm+pt		Perm	pm+pt		
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		
Actuated Green, G (s)		44.0	44.0		44.0	44.0	56.9	53.7	53.7	67.2	60.0	
Effective Green, g (s)		44.0	44.0		44.0	44.0	56.9	53.7	53.7	67.2	60.0	
Actuated g/C Ratio		0.37	0.37		0.37	0.37	0.48	0.45	0.45	0.56	0.50	
Clearance Time (s)		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		284	584		464	584	110	1594	697	204	1773	
v/s Ratio Prot							0.02	0.39		c0.06	c0.50	
v/s Ratio Perm		0.11	0.05		c0.37	0.13	0.27		0.19	0.37		
v/c Ratio		0.30	0.05		1.01	0.24	0.59	0.87	0.19	0.76	0.99	
Uniform Delay, d1		26.7	24.2		37.6	26.1	28.3	29.6	19.6	28.4	29.2	
Progression Factor		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2		0.6	0.0		45.1	0.2	8.2	5.5	0.1	15.0	17.8	
Delay (s)		27.3	24.2		82.7	26.3	36.5	35.1	19.8	43.4	46.9	
Level of Service		C	C		F	C	D	D	B	D	D	
Approach Delay (s)		25.8			65.3			32.6			46.6	
Approach LOS		C			E			C			D	

Intersection Summary			
HCM Average Control Delay	43.3	HCM Level of Service	D
HCM Volume to Capacity ratio	1.00		
Actuated Cycle Length (s)	119.2	Sum of lost time (s)	12.0
Intersection Capacity Utilization	88.5%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Appendix K – Intersection Operations Analysis Worksheets for 2025 Without Project Conditions, with Mitigation Measures

HCM Signalized Intersection Capacity Analysis
1: Kaiminani Drive & Queen Kaahumanu Highway

2025 AM Without Project+Mit
7/25/2012

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	3539	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.19	1.00
Satd. Flow (perm)	1770	1583	3539	1583	351	3539
Volume (vph)	480	244	869	109	33	830
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	522	265	945	118	36	902
RTOR Reduction (vph)	0	125	0	76	0	0
Lane Group Flow (vph)	522	140	945	42	36	902
Turn Type		Perm		Perm	pm+pt	
Protected Phases	8		2		1	6
Permitted Phases		8		2	6	
Actuated Green, G (s)	17.7	17.7	17.2	17.2	22.4	22.4
Effective Green, g (s)	17.7	17.7	17.2	17.2	22.4	22.4
Actuated g/C Ratio	0.37	0.37	0.36	0.36	0.47	0.47
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	651	583	1266	566	199	1648
v/s Ratio Prot	c0.29		c0.27		0.00	c0.25
v/s Ratio Perm		0.17		0.07	0.08	
v/c Ratio	0.80	0.24	0.75	0.07	0.18	0.55
Uniform Delay, d1	13.6	10.5	13.5	10.2	8.5	9.2
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	7.1	0.2	2.4	0.1	0.4	0.4
Delay (s)	20.7	10.8	16.0	10.3	9.0	9.6
Level of Service	C	B	B	B	A	A
Approach Delay (s)	17.3		15.3			9.6
Approach LOS	B		B			A

Intersection Summary			
HCM Average Control Delay	14.0	HCM Level of Service	B
HCM Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	48.1	Sum of lost time (s)	12.0
Intersection Capacity Utilization	60.7%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Synchro 6 Report
Page 1

Katz, Okitsu & Associates


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AM (2025nP)                Thu Jul 26, 2012 10:19:30                Page 3-1
-------------------------------------------------------------------------------
                            JB23054 - Kaloko Makai
                                 Kona, Hawaii
              2025 Without Project Conditions With Mitigations
-------------------------------------------------------------------------------
                       Level Of Service Computation Report
           2000 HCM Unsignalized Method (Future Volume Alternative)
*******************************************************************************
Intersection #2 Queen Kaahumanu Hwy. @ Hulikoa Dr.
*******************************************************************************
Average Delay (sec/veh):      0.0       Worst Case Level Of Service: A[  7.2]
*******************************************************************************
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Uncontrolled     Uncontrolled     Yield Sign       Yield Sign
Rights:           Include          Include          Include          Ignore
Lanes:        0  0  2  0  1    0  1  1  0  0    0  0  0  0  0    0  0  1! 0  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:        0  590   218     0  835     0     0    0     0     0    0   182
Growth Adj:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Initial Bse:     0  590   218     0  835     0     0    0     0     0    0   182
Added Vol:       0  291    61    20  436     0     0    0     0    42    0    23
PasserByVol:     0    0    20   -20   62     0     0    0     0   -42    0    42
Initial Fut:     0  881   299     0 1333     0     0    0     0     0    0   247
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
PHF Volume:      0  881   299     0 1333     0     0    0     0     0    0     0
Reduct Vol:      0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:     0  881   299     0 1333     0     0    0     0     0    0     0
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx   6.8  6.5   6.9
FollowUpTim:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx   3.5  4.0   3.3
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  1548 2214   441
Potent Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx   107   44   570
Move Cap.:   xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx   107   44   570
Volume/Cap:  xxxx xxxx  xxxx  xxxx xxxx  xxxx  xxxx xxxx  xxxx  0.00 0.00  0.00
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:   xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Control Del:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
LOS by Move:     *    *     *     *    *     *     *    *     *     *    *     *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx    0 xxxxx
SharedQueue:xxxxx xxxx xxxxx   0.0 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Shrd ConDel:xxxxx xxxx xxxxx   7.2 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Shared LOS:      *    *     *     A    *     *     *    *     *     *    *     *
ApproachDel:    xxxxxx            xxxxxx            xxxxxx            xxxxxx
ApproachLOS:         *                 *                 *                 *
*******************************************************************************
Note: Queue reported is the number of cars per lane.
*******************************************************************************

  Traffix 8.0.0715 (c) 2008 Dowling Assoc. Licensed to KOA CORP, MONTEREY PK
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Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	1.00	0.95	1.00	0.97	0.95
Frpb, ped/bikes	1.00	0.98	1.00	0.98	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1558	3539	1553	3433	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1558	3539	1553	3433	3539
Volume (vph)	275	270	752	433	382	1032
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	299	293	817	471	415	1122
RTOR Reduction (vph)	0	0	0	309	0	0
Lane Group Flow (vph)	299	293	817	162	415	1122
Confl. Peds. (#/hr)		14		8	8	
Turn Type		Free		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		Free		2		
Actuated Green, G (s)	9.9	46.8	16.1	16.1	8.8	28.9
Effective Green, g (s)	9.9	46.8	16.1	16.1	8.8	28.9
Actuated g/C Ratio	0.21	1.00	0.34	0.34	0.19	0.62
Clearance Time (s)	4.0		4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0		3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	726	1558	1217	534	646	2185
v/s Ratio Prot	c0.09		0.23		c0.12	0.32
v/s Ratio Perm		0.19		0.30		
v/c Ratio	0.41	0.19	0.67	0.30	0.64	0.51
Uniform Delay, d1	15.9	0.0	13.1	11.2	17.5	5.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.4	0.3	1.5	0.3	2.2	0.2
Delay (s)	16.3	0.3	14.6	11.6	19.7	5.2
Level of Service	B	A	B	B	B	A
Approach Delay (s)	8.4		13.5			9.1
Approach LOS	A		B			A

Intersection Summary			
HCM Average Control Delay	10.6	HCM Level of Service	B
HCM Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	46.8	Sum of lost time (s)	12.0
Intersection Capacity Utilization	51.6%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	322	363	29	339	225	18
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	350	395	32	368	245	20
Pedestrians					2	
Lane Width (ft)					12.0	
Walking Speed (ft/s)					4.0	
Percent Blockage					0	
Right turn flare (veh)						6
Median type					None	
Median storage veh)						
Upstream signal (ft)	475					
pX, platoon unblocked						
vC, conflicting volume			747		599	352
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			747		599	352
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			96		41	97
cM capacity (veh/h)			856		416	643

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	350	395	154	246	264
Volume Left	0	0	32	0	245
Volume Right	0	395	0	0	20
cSH	1700	1700	856	1700	449
Volume to Capacity	0.21	0.23	0.04	0.14	0.59
Queue Length (ft)	0	0	3	0	92
Control Delay (s)	0.0	0.0	2.2	0.0	24.2
Lane LOS			A		C
Approach Delay (s)	0.0		0.9		24.2
Approach LOS					C

Intersection Summary			
Average Delay	4.8		
Intersection Capacity Utilization	49.6%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	0.97	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (prot)	1863	1583	1770	1863	3433	1583
Flt Permitted	1.00	1.00	0.67	1.00	0.95	1.00
Satd. Flow (perm)	1863	1583	1243	1863	3433	1583
Volume (vph)	130	198	202	243	134	77
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	141	215	220	264	146	84
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	141	215	220	264	146	84
Turn Type		Free	Perm			Free
Protected Phases	4			8	2	
Permitted Phases		Free	8			Free
Actuated Green, G (s)	6.2	18.9	6.2	6.2	4.7	18.9
Effective Green, g (s)	6.2	18.9	6.2	6.2	4.7	18.9
Actuated g/C Ratio	0.33	1.00	0.33	0.33	0.25	1.00
Clearance Time (s)	4.0		4.0	4.0	4.0	
Vehicle Extension (s)	3.0		3.0	3.0	3.0	
Lane Grp Cap (vph)	611	1583	408	611	854	1583
v/s Ratio Prot	0.08			0.14	0.04	
v/s Ratio Perm		0.14	c0.18			0.05
v/c Ratio	0.23	0.14	0.54	0.43	0.17	0.05
Uniform Delay, d1	4.6	0.0	5.2	5.0	5.6	0.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.2	0.2	1.4	0.5	0.1	0.1
Delay (s)	4.8	0.2	6.6	5.5	5.7	0.1
Level of Service	A	A	A	A	A	A
Approach Delay (s)	2.0			6.0	3.6	
Approach LOS	A			A	A	

Intersection Summary			
HCM Average Control Delay	4.1	HCM Level of Service	A
HCM Volume to Capacity ratio	0.30		
Actuated Cycle Length (s)	18.9	Sum of lost time (s)	4.0
Intersection Capacity Utilization	31.9%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0	4.0	4.0		4.0	4.0	4.0		4.0	
Lane Util. Factor		1.00	1.00	1.00	1.00		1.00	1.00	1.00		1.00	
Frt		1.00	0.85	1.00	1.00		1.00	1.00	0.85		1.00	
Flt Protected		1.00	1.00	0.95	1.00		0.95	1.00	1.00		1.00	
Satd. Flow (prot)		1863	1583	1770	1863		1770	1863	1583		1863	
Flt Permitted		1.00	1.00	0.95	1.00		0.75	1.00	1.00		1.00	
Satd. Flow (perm)		1863	1583	1770	1863		1397	1863	1583		1863	
Volume (vph)	0	164	26	189	437	0	129	9	64	0	11	0
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	178	28	205	475	0	140	10	70	0	12	0
RTOR Reduction (vph)	0	0	22	0	0	0	0	0	55	0	0	0
Lane Group Flow (vph)	0	178	6	205	475	0	140	10	15	0	12	0
Turn Type	Prot		Perm	Prot		Perm	Perm		Perm	Perm		Perm
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4			8	2		2	6		6
Actuated Green, G (s)		7.3	7.3	6.8	18.1		7.3	7.3	7.3		7.3	
Effective Green, g (s)		7.3	7.3	6.8	18.1		7.3	7.3	7.3		7.3	
Actuated g/C Ratio		0.22	0.22	0.20	0.54		0.22	0.22	0.22		0.22	
Clearance Time (s)		4.0	4.0	4.0	4.0		4.0	4.0	4.0		4.0	
Vehicle Extension (s)		3.0	3.0	3.0	3.0		3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)		407	346	360	1010		305	407	346		407	
v/s Ratio Prot		0.10		0.12	c0.26			0.01			0.01	
v/s Ratio Perm			0.02				c0.10		0.04			
v/c Ratio		0.44	0.02	0.57	0.47		0.46	0.02	0.04		0.03	
Uniform Delay, d1		11.3	10.2	12.0	4.7		11.3	10.3	10.3		10.3	
Progression Factor		1.00	1.00	1.00	1.00		1.00	1.00	1.00		1.00	
Incremental Delay, d2		0.8	0.0	2.1	0.3		1.1	0.0	0.1		0.0	
Delay (s)		12.0	10.3	14.0	5.1		12.4	10.3	10.4		10.3	
Level of Service		B	B	B	A		B	B	B		B	
Approach Delay (s)		11.8			7.8			11.7			10.3	
Approach LOS		B			A			B			B	

Intersection Summary			
HCM Average Control Delay	9.3	HCM Level of Service	A
HCM Volume to Capacity ratio	0.47		
Actuated Cycle Length (s)	33.4	Sum of lost time (s)	8.0
Intersection Capacity Utilization	50.1%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1770	1583	1770	1863	1863	1583
Flt Permitted	0.95	1.00	0.04	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	70	1863	1863	1583
Volume (vph)	110	103	150	378	1307	270
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	120	112	163	411	1421	293
RTOR Reduction (vph)	0	101	0	0	0	25
Lane Group Flow (vph)	120	11	163	411	1421	268
Turn Type		Perm	pm+pt			Perm
Protected Phases	4		5	2	6	
Permitted Phases		4	2			6
Actuated Green, G (s)	13.5	13.5	116.0	116.0	103.0	103.0
Effective Green, g (s)	13.5	13.5	116.0	116.0	103.0	103.0
Actuated g/C Ratio	0.10	0.10	0.84	0.84	0.75	0.75
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	174	155	170	1572	1396	1186
v/s Ratio Prot	0.07		c0.06	0.22	c0.76	
v/s Ratio Perm		0.07	0.75			0.19
v/c Ratio	0.69	0.07	0.96	0.26	1.02	0.23
Uniform Delay, d1	60.0	56.3	66.1	2.2	17.2	5.2
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	10.8	0.2	56.2	0.1	28.7	0.1
Delay (s)	70.8	56.5	122.4	2.2	45.9	5.3
Level of Service	E	E	F	A	D	A
Approach Delay (s)	63.9			36.4	39.0	
Approach LOS	E			D	D	

Intersection Summary			
HCM Average Control Delay	40.7	HCM Level of Service	D
HCM Volume to Capacity ratio	0.98		
Actuated Cycle Length (s)	137.5	Sum of lost time (s)	12.0
Intersection Capacity Utilization	93.2%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor		1.00	1.00		1.00	1.00	1.00	0.95	1.00	1.00	0.95	
Frpb, ped/bikes		1.00	1.00		1.00	1.00	1.00	1.00	0.98	1.00	1.00	
Flpb, ped/bikes		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt		1.00	0.85		1.00	0.85	1.00	1.00	0.85	1.00	0.99	
Flt Protected		0.97	1.00		0.96	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1800	1583		1779	1583	1769	3539	1548	1770	3508	
Flt Permitted		0.77	1.00		0.72	1.00	0.23	1.00	1.00	0.14	1.00	
Satd. Flow (perm)		1443	1583		1342	1583	432	3539	1548	261	3508	
Volume (vph)	17	7	24	270	18	166	68	1063	441	240	878	48
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	18	8	26	293	20	180	74	1155	479	261	954	52
RTOR Reduction (vph)	0	0	19	0	0	132	0	0	281	0	6	0
Lane Group Flow (vph)	0	26	7	0	313	48	74	1155	198	261	1000	0
Confl. Peds. (#/hr)							2		2	2		2
Turn Type	Perm		Perm	Perm		Perm	pm+pt		Perm	pm+pt		
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		
Actuated Green, G (s)		15.7	15.7		15.7	15.7	27.4	24.5	24.5	35.6	28.7	
Effective Green, g (s)		15.7	15.7		15.7	15.7	27.4	24.5	24.5	35.6	28.7	
Actuated g/C Ratio		0.26	0.26		0.26	0.26	0.46	0.41	0.41	0.60	0.48	
Clearance Time (s)		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		382	419		355	419	265	1462	640	337	1698	
v/s Ratio Prot							0.01	0.33		c0.09	0.29	
v/s Ratio Perm		0.02	0.02		c0.23	0.11	0.12		0.31	c0.37		
v/c Ratio		0.07	0.02		0.88	0.11	0.28	0.79	0.31	0.77	0.59	
Uniform Delay, d1		16.3	16.1		20.9	16.5	9.2	15.2	11.7	9.8	11.0	
Progression Factor		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2		0.1	0.0		21.7	0.1	0.6	3.0	0.3	10.6	0.5	
Delay (s)		16.4	16.1		42.6	16.6	9.7	18.1	12.0	20.4	11.6	
Level of Service		B	B		D	B	A	B	B	C	B	
Approach Delay (s)		16.3			33.1			16.1			13.4	
Approach LOS		B			C			B			B	

Intersection Summary			
HCM Average Control Delay	17.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	59.3	Sum of lost time (s)	8.0
Intersection Capacity Utilization	75.3%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
1: Kaiminani Drive & Queen Kaahumanu Highway

2025 PM Without Project+Mit
7/25/2012

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	3539	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.15	1.00
Satd. Flow (perm)	1770	1583	3539	1583	272	3539
Volume (vph)	180	84	1135	387	226	1114
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	196	91	1234	421	246	1211
RTOR Reduction (vph)	0	75	0	221	0	0
Lane Group Flow (vph)	196	16	1234	200	246	1211
Turn Type		Perm		Perm	pm+pt	
Protected Phases	8		2		1	6
Permitted Phases		8		2	6	
Actuated Green, G (s)	8.4	8.4	23.4	23.4	32.8	32.8
Effective Green, g (s)	8.4	8.4	23.4	23.4	32.8	32.8
Actuated g/C Ratio	0.17	0.17	0.48	0.48	0.67	0.67
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	302	270	1683	753	346	2359
v/s Ratio Prot	c0.11		0.35		c0.08	0.34
v/s Ratio Perm		0.06		0.27	c0.40	
v/c Ratio	0.65	0.06	0.73	0.27	0.71	0.51
Uniform Delay, d1	19.0	17.1	10.4	7.7	6.9	4.2
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	4.8	0.1	1.7	0.2	6.7	0.2
Delay (s)	23.8	17.2	12.1	7.9	13.7	4.3
Level of Service	C	B	B	A	B	A
Approach Delay (s)	21.7		11.0			5.9
Approach LOS	C		B			A

Intersection Summary			
HCM Average Control Delay	9.7	HCM Level of Service	A
HCM Volume to Capacity ratio	0.68		
Actuated Cycle Length (s)	49.2	Sum of lost time (s)	8.0
Intersection Capacity Utilization	63.9%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Synchro 6 Report
Page 1

Katz, Okitsu & Associates


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PM (2025nP)                 Thu Jul 26, 2012 10:20:00                 Page 3-1
-------------------------------------------------------------------------------
                              JB23054 - Kaloko Makai
                                   Kona, Hawaii
                 2025 Without Project Conditions With Mitigations
-------------------------------------------------------------------------------
                         Level Of Service Computation Report
             2000 HCM Unsignalized Method (Future Volume Alternative)
*******************************************************************************
Intersection #2 Queen Kaahumanu Hwy. @ Hulikoa Dr.
*******************************************************************************
Average Delay (sec/veh):      0.0       Worst Case Level Of Service: A[  7.2]
*******************************************************************************
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Uncontrolled     Uncontrolled     Yield Sign       Yield Sign
Rights:           Include          Include          Include          Ignore
Lanes:        0  0  2  0  1    0  1  1  0  0    0  0  0  0  0    0  0  1! 0  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:        0  719   122     0 1068     0     0    0     0     0    0   205
Growth Adj:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Initial Bse:     0  719   122     0 1068     0     0    0     0     0    0   205
Added Vol:       0  621    39    13  478     0     0    0     0    45    0    24
PasserByVol:     0    0    13   -13   58     0     0    0     0   -45    0    45
Initial Fut:     0 1340   174     0 1604     0     0    0     0     0    0   274
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
PHF Volume:      0 1340   174     0 1604     0     0    0     0     0    0     0
Reduct Vol:      0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:     0 1340   174     0 1604     0     0    0     0     0    0     0
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx   6.8  6.5   6.9
FollowUpTim:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx   3.5  4.0   3.3
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  2142 2944   670
Potent Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx    43   15   404
Move Cap.:   xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx    43   15   404
Volume/Cap:  xxxx xxxx  xxxx  xxxx xxxx  xxxx  xxxx xxxx  xxxx  0.00 0.00  0.00
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:   xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Control Del:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
LOS by Move:     *    *     *     *    *     *     *    *     *     *    *     *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx    0 xxxxx
SharedQueue:xxxxx xxxx xxxxx   0.0 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Shrd ConDel:xxxxx xxxx xxxxx   7.2 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Shared LOS:      *    *     *     A    *     *     *    *     *     *    *     *
ApproachDel:    xxxxxx            xxxxxx            xxxxxx            xxxxxx
ApproachLOS:         *                 *                 *                 *
*******************************************************************************
Note: Queue reported is the number of cars per lane.
*******************************************************************************

  Traffix 8.0.0715 (c) 2008 Dowling Assoc. Licensed to KOA CORP, MONTEREY PK
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Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	1.00	0.95	1.00	0.97	0.95
Frpb, ped/bikes	1.00	0.98	1.00	0.98	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1558	3539	1551	3433	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1558	3539	1551	3433	3539
Volume (vph)	544	414	1105	594	358	1154
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	591	450	1201	646	389	1254
RTOR Reduction (vph)	0	0	0	383	0	0
Lane Group Flow (vph)	591	450	1201	263	389	1254
Confl. Peds. (#/hr)		14		8	8	
Turn Type		Free		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		Free		2		
Actuated Green, G (s)	14.0	57.3	23.3	23.3	8.0	35.3
Effective Green, g (s)	14.0	57.3	23.3	23.3	8.0	35.3
Actuated g/C Ratio	0.24	1.00	0.41	0.41	0.14	0.62
Clearance Time (s)	4.0		4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0		3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	839	1558	1439	631	479	2180
v/s Ratio Prot	c0.17		0.34		c0.11	0.35
v/s Ratio Perm		0.29		0.42		
v/c Ratio	0.70	0.29	0.83	0.42	0.81	0.58
Uniform Delay, d1	19.8	0.0	15.3	12.1	23.9	6.5
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	2.7	0.5	4.3	0.4	10.1	0.4
Delay (s)	22.5	0.5	19.6	12.6	34.0	6.9
Level of Service	C	A	B	B	C	A
Approach Delay (s)	13.0		17.2			13.3
Approach LOS	B		B			B

Intersection Summary			
HCM Average Control Delay	14.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.89		
Actuated Cycle Length (s)	57.3	Sum of lost time (s)	12.0
Intersection Capacity Utilization	66.3%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	343	489	17	669	200	74
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	373	532	18	727	217	80
Pedestrians					2	
Lane Width (ft)					12.0	
Walking Speed (ft/s)					4.0	
Percent Blockage					0	
Right turn flare (veh)						6
Median type					None	
Median storage veh)						
Upstream signal (ft)	475					
pX, platoon unblocked						
vC, conflicting volume			906		775	375
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			906		775	375
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			98		33	87
cM capacity (veh/h)			745		326	622

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	373	532	261	485	298
Volume Left	0	0	18	0	217
Volume Right	0	532	0	0	80
cSH	1700	1700	745	1700	446
Volume to Capacity	0.22	0.31	0.02	0.29	0.67
Queue Length (ft)	0	0	2	0	120
Control Delay (s)	0.0	0.0	1.0	0.0	29.2
Lane LOS			A		D
Approach Delay (s)	0.0		0.3		29.2
Approach LOS					D

Intersection Summary			
Average Delay	4.6		
Intersection Capacity Utilization	56.2%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	0.97	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (prot)	1863	1583	1770	1863	3433	1583
Flt Permitted	1.00	1.00	0.59	1.00	0.95	1.00
Satd. Flow (perm)	1863	1583	1107	1863	3433	1583
Volume (vph)	247	122	127	184	479	326
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	268	133	138	200	521	354
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	268	133	138	200	521	354
Turn Type		Free	Perm			Free
Protected Phases	4			8	2	
Permitted Phases		Free	8			Free
Actuated Green, G (s)	7.3	22.8	7.3	7.3	7.5	22.8
Effective Green, g (s)	7.3	22.8	7.3	7.3	7.5	22.8
Actuated g/C Ratio	0.32	1.00	0.32	0.32	0.33	1.00
Clearance Time (s)	4.0		4.0	4.0	4.0	
Vehicle Extension (s)	3.0		3.0	3.0	3.0	
Lane Grp Cap (vph)	596	1583	354	596	1129	1583
v/s Ratio Prot	c0.14			0.11	c0.15	
v/s Ratio Perm		0.08	0.12			0.22
v/c Ratio	0.45	0.08	0.39	0.34	0.46	0.22
Uniform Delay, d1	6.2	0.0	6.0	5.9	6.1	0.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.5	0.1	0.7	0.3	0.3	0.3
Delay (s)	6.7	0.1	6.7	6.2	6.4	0.3
Level of Service	A	A	A	A	A	A
Approach Delay (s)	4.5			6.4	3.9	
Approach LOS	A			A	A	

Intersection Summary			
HCM Average Control Delay	4.6	HCM Level of Service	A
HCM Volume to Capacity ratio	0.46		
Actuated Cycle Length (s)	22.8	Sum of lost time (s)	8.0
Intersection Capacity Utilization	43.7%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0	4.0	4.0		4.0	4.0	4.0		4.0	
Lane Util. Factor		1.00	1.00	1.00	1.00		1.00	1.00	1.00		1.00	
Frt		1.00	0.85	1.00	1.00		1.00	1.00	0.85		1.00	
Flt Protected		1.00	1.00	0.95	1.00		0.95	1.00	1.00		1.00	
Satd. Flow (prot)		1863	1583	1770	1863		1770	1863	1583		1863	
Flt Permitted		1.00	1.00	0.95	1.00		0.75	1.00	1.00		1.00	
Satd. Flow (perm)		1863	1583	1770	1863		1399	1863	1583		1863	
Volume (vph)	0	561	127	180	269	0	34	7	282	0	9	0
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	610	138	196	292	0	37	8	307	0	10	0
RTOR Reduction (vph)	0	0	81	0	0	0	0	0	227	0	0	0
Lane Group Flow (vph)	0	610	57	196	292	0	37	8	80	0	10	0
Turn Type	Prot		Perm	Prot		Perm	Perm		Perm	Perm		Perm
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4			8	2		2	6		6
Actuated Green, G (s)		19.8	19.8	8.0	31.8		8.4	8.4	8.4		8.4	
Effective Green, g (s)		19.8	19.8	8.0	31.8		8.4	8.4	8.4		8.4	
Actuated g/C Ratio		0.41	0.41	0.17	0.66		0.17	0.17	0.17		0.17	
Clearance Time (s)		4.0	4.0	4.0	4.0		4.0	4.0	4.0		4.0	
Vehicle Extension (s)		3.0	3.0	3.0	3.0		3.0	3.0	3.0		3.0	
Lane Grp Cap (vph)		765	650	294	1229		244	325	276		325	
v/s Ratio Prot		c0.33		c0.11	0.16			0.00			0.01	
v/s Ratio Perm			0.09				0.03		0.19			
v/c Ratio		0.80	0.09	0.67	0.24		0.15	0.02	0.29		0.03	
Uniform Delay, d1		12.4	8.7	18.8	3.3		16.9	16.5	17.3		16.5	
Progression Factor		1.00	1.00	1.00	1.00		1.00	1.00	1.00		1.00	
Incremental Delay, d2		5.8	0.1	5.6	0.1		0.3	0.0	0.6		0.0	
Delay (s)		18.2	8.7	24.5	3.4		17.2	16.5	17.9		16.6	
Level of Service		B	A	C	A		B	B	B		B	
Approach Delay (s)		16.5			11.9			17.8			16.6	
Approach LOS		B			B			B			B	

Intersection Summary			
HCM Average Control Delay	15.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	48.2	Sum of lost time (s)	12.0
Intersection Capacity Utilization	58.0%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1770	1583	1770	1863	1863	1583
Flt Permitted	0.95	1.00	0.18	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	331	1863	1863	1583
Volume (vph)	382	246	104	740	552	213
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	415	267	113	804	600	232
RTOR Reduction (vph)	0	187	0	0	0	120
Lane Group Flow (vph)	415	80	113	804	600	112
Turn Type		Perm	pm+pt			Perm
Protected Phases	4		5	2	6	
Permitted Phases		4	2			6
Actuated Green, G (s)	15.5	15.5	28.5	28.5	21.6	21.6
Effective Green, g (s)	15.5	15.5	28.5	28.5	21.6	21.6
Actuated g/C Ratio	0.30	0.30	0.55	0.55	0.42	0.42
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	528	472	262	1021	774	658
v/s Ratio Prot	c0.23		0.02	c0.43	0.32	
v/s Ratio Perm		0.17	0.21			0.15
v/c Ratio	0.79	0.17	0.43	0.79	0.78	0.17
Uniform Delay, d1	16.7	13.5	8.3	9.3	13.1	9.6
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	7.6	0.2	1.1	4.1	4.9	0.1
Delay (s)	24.3	13.7	9.4	13.4	18.0	9.7
Level of Service	C	B	A	B	B	A
Approach Delay (s)	20.1			12.9	15.7	
Approach LOS	C			B	B	

Intersection Summary			
HCM Average Control Delay	15.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	52.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	66.8%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor		1.00	1.00		1.00	1.00	1.00	0.95	1.00	1.00	0.95	
Frpb, ped/bikes		1.00	1.00		1.00	1.00	1.00	1.00	0.98	1.00	1.00	
Flpb, ped/bikes		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt		1.00	0.85		1.00	0.85	1.00	1.00	0.85	1.00	1.00	
Flt Protected		0.96	1.00		0.95	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1795	1583		1778	1583	1770	3539	1548	1770	3523	
Flt Permitted		0.41	1.00		0.67	1.00	0.07	1.00	1.00	0.07	1.00	
Satd. Flow (perm)		770	1583		1257	1583	139	3539	1548	129	3523	
Volume (vph)	59	19	71	412	20	192	60	1276	264	143	1564	44
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	64	21	77	448	22	209	65	1387	287	155	1700	48
RTOR Reduction (vph)	0	0	49	0	0	66	0	0	158	0	1	0
Lane Group Flow (vph)	0	85	28	0	470	143	65	1387	129	155	1747	0
Confl. Peds. (#/hr)							2		2	2		2
Turn Type	Perm		Perm	Perm		Perm	pm+pt		Perm	pm+pt		
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		
Actuated Green, G (s)		44.0	44.0		44.0	44.0	56.9	53.7	53.7	67.2	60.0	
Effective Green, g (s)		44.0	44.0		44.0	44.0	56.9	53.7	53.7	67.2	60.0	
Actuated g/C Ratio		0.37	0.37		0.37	0.37	0.48	0.45	0.45	0.56	0.50	
Clearance Time (s)		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		284	584		464	584	110	1594	697	204	1773	
v/s Ratio Prot							0.02	0.39		c0.06	c0.50	
v/s Ratio Perm		0.11	0.05		c0.37	0.13	0.27		0.19	0.37		
v/c Ratio		0.30	0.05		1.01	0.24	0.59	0.87	0.19	0.76	0.99	
Uniform Delay, d1		26.7	24.2		37.6	26.1	28.3	29.6	19.6	28.4	29.2	
Progression Factor		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2		0.6	0.0		45.1	0.2	8.2	5.5	0.1	15.0	17.8	
Delay (s)		27.3	24.2		82.7	26.3	36.5	35.1	19.8	43.4	46.9	
Level of Service		C	C		F	C	D	D	B	D	D	
Approach Delay (s)		25.8			65.3			32.6			46.6	
Approach LOS		C			E			C			D	

Intersection Summary			
HCM Average Control Delay	43.3	HCM Level of Service	D
HCM Volume to Capacity ratio	1.00		
Actuated Cycle Length (s)	119.2	Sum of lost time (s)	12.0
Intersection Capacity Utilization	88.5%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Appendix L – Intersection Operations Analysis Worksheets for 2035 Without Project Conditions, with Existing Geometry

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	3539	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.18	1.00
Satd. Flow (perm)	1770	1583	3539	1583	327	3539
Volume (vph)	480	310	941	109	188	766
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	522	337	1023	118	204	833
RTOR Reduction (vph)	0	134	0	76	0	0
Lane Group Flow (vph)	522	203	1023	42	204	833
Turn Type		Perm		Perm	pm+pt	
Protected Phases	8		2		1	6
Permitted Phases		8		2	6	
Actuated Green, G (s)	17.7	17.7	18.8	18.8	26.8	26.8
Effective Green, g (s)	17.7	17.7	18.8	18.8	26.8	26.8
Actuated g/C Ratio	0.34	0.34	0.36	0.36	0.51	0.51
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	597	534	1267	567	277	1807
v/s Ratio Prot	c0.29		0.29		c0.06	0.24
v/s Ratio Perm		0.21		0.07	c0.32	
v/c Ratio	0.87	0.38	0.81	0.07	0.74	0.46
Uniform Delay, d1	16.4	13.2	15.2	11.1	9.7	8.2
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	13.4	0.5	3.9	0.1	9.8	0.2
Delay (s)	29.8	13.7	19.1	11.2	19.4	8.4
Level of Service	C	B	B	B	B	A
Approach Delay (s)	23.5		18.3			10.6
Approach LOS	C		B			B

Intersection Summary			
HCM Average Control Delay	17.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.77		
Actuated Cycle Length (s)	52.5	Sum of lost time (s)	8.0
Intersection Capacity Utilization	73.0%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

HCM Unsignalized Intersection Capacity Analysis
2: Hulikoa Drive & Queen Kaahumanu Highway

2035 AM Without Project
7/25/2012

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Yield		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	0	247	953	299	0	1268
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	268	1036	325	0	1378
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	TWLTL					
Median storage veh)	5					
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1725	518			1036	
vC1, stage 1 conf vol	1036					
vC2, stage 2 conf vol	689					
vCu, unblocked vol	1725	518			1036	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)	5.8					
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	47			100	
cM capacity (veh/h)	296	503			667	

Direction, Lane #	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	268	518	518	325	689	689
Volume Left	0	0	0	0	0	0
Volume Right	268	0	0	325	0	0
cSH	503	1700	1700	1700	1700	1700
Volume to Capacity	0.53	0.30	0.30	0.19	0.41	0.41
Queue Length (ft)	78	0	0	0	0	0
Control Delay (s)	20.1	0.0	0.0	0.0	0.0	0.0
Lane LOS	C					
Approach Delay (s)	20.1	0.0			0.0	
Approach LOS	C					

Intersection Summary			
Average Delay	1.8		
Intersection Capacity Utilization	48.3%	ICU Level of Service	A
Analysis Period (min)	15		

Katz, Okitsu & Associates

HCM Signalized Intersection Capacity Analysis
3: Hina Lani Street & Queen Kaahumanu Highway

2035 AM Without Project
7/25/2012

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	1.00	0.95	1.00	0.97	0.95
Frpb, ped/bikes	1.00	0.98	1.00	0.98	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1558	3539	1553	3433	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1558	3539	1553	3433	3539
Volume (vph)	275	231	862	433	308	1041
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	299	251	937	471	335	1132
RTOR Reduction (vph)	0	0	0	287	0	0
Lane Group Flow (vph)	299	251	937	184	335	1132
Confl. Peds. (#/hr)		14		8	8	
Turn Type		Free		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		Free		2		
Actuated Green, G (s)	10.1	50.2	19.6	19.6	8.5	32.1
Effective Green, g (s)	10.1	50.2	19.6	19.6	8.5	32.1
Actuated g/C Ratio	0.20	1.00	0.39	0.39	0.17	0.64
Clearance Time (s)	4.0		4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0		3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	691	1558	1382	606	581	2263
v/s Ratio Prot	c0.09		0.26		0.10	c0.32
v/s Ratio Perm		0.16		0.30		
v/c Ratio	0.43	0.16	0.68	0.30	0.58	0.50
Uniform Delay, d1	17.5	0.0	12.7	10.6	19.2	4.8
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.4	0.2	1.3	0.3	1.4	0.2
Delay (s)	18.0	0.2	14.0	10.9	20.6	5.0
Level of Service	B	A	B	B	C	A
Approach Delay (s)	9.9		13.0			8.5
Approach LOS	A		B			A

Intersection Summary			
HCM Average Control Delay	10.6	HCM Level of Service	B
HCM Volume to Capacity ratio	0.64		
Actuated Cycle Length (s)	50.2	Sum of lost time (s)	12.0
Intersection Capacity Utilization	52.5%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Katz, Okitsu & Associates

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	249	363	29	301	225	18
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	271	395	32	327	245	20
Pedestrians					2	
Lane Width (ft)					12.0	
Walking Speed (ft/s)					4.0	
Percent Blockage					0	
Right turn flare (veh)						6
Median type					None	
Median storage veh)						
Upstream signal (ft)	475					
pX, platoon unblocked						
vC, conflicting volume			667		499	273
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			667		499	273
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			97		49	97
cM capacity (veh/h)			917		483	724

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	271	395	141	218	264
Volume Left	0	0	32	0	245
Volume Right	0	395	0	0	20
cSH	1700	1700	917	1700	521
Volume to Capacity	0.16	0.23	0.03	0.13	0.51
Queue Length (ft)	0	0	3	0	71
Control Delay (s)	0.0	0.0	2.3	0.0	19.2
Lane LOS			A		C
Approach Delay (s)	0.0		0.9		19.2
Approach LOS					C

Intersection Summary			
Average Delay	4.2		
Intersection Capacity Utilization	44.7%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	0.97	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (prot)	1863	1583	1770	1863	3433	1583
Flt Permitted	1.00	1.00	0.67	1.00	0.95	1.00
Satd. Flow (perm)	1863	1583	1253	1863	3433	1583
Volume (vph)	121	133	224	218	121	81
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	132	145	243	237	132	88
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	132	145	243	237	132	88
Turn Type		Free	Perm			Free
Protected Phases	4			8	2	
Permitted Phases		Free	8			Free
Actuated Green, G (s)	6.9	17.9	6.9	6.9	3.0	17.9
Effective Green, g (s)	6.9	17.9	6.9	6.9	3.0	17.9
Actuated g/C Ratio	0.39	1.00	0.39	0.39	0.17	1.00
Clearance Time (s)	4.0		4.0	4.0	4.0	
Vehicle Extension (s)	3.0		3.0	3.0	3.0	
Lane Grp Cap (vph)	718	1583	483	718	575	1583
v/s Ratio Prot	0.07			0.13	c0.04	
v/s Ratio Perm		0.09	c0.19			0.06
v/c Ratio	0.18	0.09	0.50	0.33	0.23	0.06
Uniform Delay, d1	3.6	0.0	4.2	3.9	6.4	0.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.1	0.1	0.8	0.3	0.2	0.1
Delay (s)	3.8	0.1	5.0	4.1	6.7	0.1
Level of Service	A	A	A	A	A	A
Approach Delay (s)	1.9			4.6	4.0	
Approach LOS	A			A	A	

Intersection Summary			
HCM Average Control Delay	3.7	HCM Level of Service	A
HCM Volume to Capacity ratio	0.42		
Actuated Cycle Length (s)	17.9	Sum of lost time (s)	8.0
Intersection Capacity Utilization	32.2%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1863	1583	1770	1863	1583	1770	1863	1583	1770	1863	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.30	1.00	1.00	0.67	1.00	1.00
Satd. Flow (perm)	1770	1863	1583	1770	1863	1583	564	1863	1583	1253	1863	1583
Volume (vph)	13	155	26	420	411	25	129	121	141	9	334	65
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	14	168	28	457	447	27	140	132	153	10	363	71
RTOR Reduction (vph)	0	0	23	0	0	12	0	0	117	0	0	54
Lane Group Flow (vph)	14	168	5	457	447	15	140	132	36	10	363	17
Turn Type	Prot		Perm	Prot		Perm	Perm		Perm	Perm		Perm
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4			8	2		2	6		6
Actuated Green, G (s)	0.6	10.2	10.2	20.5	30.1	30.1	13.2	13.2	13.2	13.2	13.2	13.2
Effective Green, g (s)	0.6	10.2	10.2	20.5	30.1	30.1	13.2	13.2	13.2	13.2	13.2	13.2
Actuated g/C Ratio	0.01	0.18	0.18	0.37	0.54	0.54	0.24	0.24	0.24	0.24	0.24	0.24
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	19	340	289	649	1003	852	133	440	374	296	440	374
v/s Ratio Prot	0.01	0.09		c0.26	c0.24			0.07			0.19	
v/s Ratio Perm			0.02			0.02	c0.25		0.10	0.01		0.04
v/c Ratio	0.74	0.49	0.02	0.70	0.45	0.02	1.05	0.30	0.10	0.03	0.82	0.04
Uniform Delay, d1	27.6	20.5	18.7	15.1	7.8	6.0	21.4	17.6	16.7	16.4	20.3	16.5
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	88.4	1.1	0.0	3.5	0.3	0.0	92.8	0.4	0.1	0.0	11.9	0.0
Delay (s)	116.0	21.7	18.8	18.6	8.2	6.0	114.1	17.9	16.8	16.5	32.2	16.5
Level of Service	F	C	B	B	A	A	F	B	B	B	C	B
Approach Delay (s)		27.6			13.2			49.2			29.3	
Approach LOS		C			B			D			C	

Intersection Summary			
HCM Average Control Delay	25.9	HCM Level of Service	C
HCM Volume to Capacity ratio	0.71		
Actuated Cycle Length (s)	55.9	Sum of lost time (s)	8.0
Intersection Capacity Utilization	69.5%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1770	1583	1770	1863	1863	1583
Flt Permitted	0.95	1.00	0.07	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	122	1863	1863	1583
Volume (vph)	187	103	150	291	1078	501
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	203	112	163	316	1172	545
RTOR Reduction (vph)	0	94	0	0	0	89
Lane Group Flow (vph)	203	18	163	316	1172	456
Turn Type		Perm	pm+pt			Perm
Protected Phases	4		5	2	6	
Permitted Phases		4	2			6
Actuated Green, G (s)	13.8	13.8	66.1	66.1	57.1	57.1
Effective Green, g (s)	13.8	13.8	66.1	66.1	57.1	57.1
Actuated g/C Ratio	0.16	0.16	0.75	0.75	0.65	0.65
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	278	249	185	1401	1210	1028
v/s Ratio Prot	c0.11		c0.05	0.17	c0.63	
v/s Ratio Perm		0.07	0.61			0.34
v/c Ratio	0.73	0.07	0.88	0.23	0.97	0.44
Uniform Delay, d1	35.3	31.6	27.6	3.3	14.6	7.6
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	9.5	0.1	35.2	0.1	18.6	0.3
Delay (s)	44.7	31.7	62.8	3.3	33.1	7.9
Level of Service	D	C	E	A	C	A
Approach Delay (s)	40.1			23.6	25.1	
Approach LOS	D			C	C	

Intersection Summary			
HCM Average Control Delay	26.7	HCM Level of Service	C
HCM Volume to Capacity ratio	0.92		
Actuated Cycle Length (s)	87.9	Sum of lost time (s)	12.0
Intersection Capacity Utilization	85.4%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
8: Kealakehe Parkway & Queen Kaahumanu Highway

2035 AM Without Project
7/25/2012

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor		1.00	1.00		1.00	1.00	1.00	0.95	1.00	1.00	0.95	
Frpb, ped/bikes		1.00	1.00		1.00	1.00	1.00	1.00	0.98	1.00	1.00	
Flpb, ped/bikes		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt		1.00	0.85		1.00	0.85	1.00	1.00	0.85	1.00	0.99	
Flt Protected		0.97	1.00		0.96	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1800	1583		1779	1583	1770	3539	1548	1770	3511	
Flt Permitted		0.77	1.00		0.72	1.00	0.19	1.00	1.00	0.14	1.00	
Satd. Flow (perm)		1443	1583		1342	1583	357	3539	1548	252	3511	
Volume (vph)	17	7	24	270	18	152	68	1201	441	199	969	48
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	18	8	26	293	20	165	74	1305	479	216	1053	52
RTOR Reduction (vph)	0	0	19	0	0	120	0	0	271	0	6	0
Lane Group Flow (vph)	0	26	7	0	313	45	74	1305	208	216	1099	0
Confl. Peds. (#/hr)							2		2	2		2
Turn Type	Perm		Perm	Perm		Perm	pm+pt		Perm	pm+pt		
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		
Actuated Green, G (s)		15.8	15.8		15.8	15.8	28.2	25.9	25.9	35.6	29.6	
Effective Green, g (s)		15.8	15.8		15.8	15.8	28.2	25.9	25.9	35.6	29.6	
Actuated g/C Ratio		0.26	0.26		0.26	0.26	0.47	0.43	0.43	0.60	0.50	
Clearance Time (s)		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		382	419		355	419	223	1535	672	303	1741	
v/s Ratio Prot							0.01	c0.37		c0.07	0.31	
v/s Ratio Perm		0.02	0.02		c0.23	0.10	0.14		0.31	0.35		
v/c Ratio		0.07	0.02		0.88	0.11	0.33	0.85	0.31	0.71	0.63	
Uniform Delay, d1		16.4	16.2		21.1	16.6	9.1	15.2	11.1	10.3	11.0	
Progression Factor		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2		0.1	0.0		21.7	0.1	0.9	4.7	0.3	7.7	0.8	
Delay (s)		16.5	16.2		42.7	16.7	10.0	19.9	11.3	18.0	11.8	
Level of Service		B	B		D	B	A	B	B	B	B	
Approach Delay (s)		16.4			33.8			17.3			12.8	
Approach LOS		B			C			B			B	

Intersection Summary			
HCM Average Control Delay	17.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.92		
Actuated Cycle Length (s)	59.7	Sum of lost time (s)	16.0
Intersection Capacity Utilization	76.8%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
1: Kaiminani Drive & Queen Kaahumanu Highway

2035 PM Without Project
7/25/2012

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	3539	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.15	1.00
Satd. Flow (perm)	1770	1583	3539	1583	281	3539
Volume (vph)	180	303	1038	387	363	1131
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	196	329	1128	421	395	1229
RTOR Reduction (vph)	0	264	0	257	0	0
Lane Group Flow (vph)	196	65	1128	164	395	1229
Turn Type		Perm		Perm	pm+pt	
Protected Phases	8		2		1	6
Permitted Phases		8		2	6	
Actuated Green, G (s)	11.5	11.5	22.5	22.5	38.4	38.4
Effective Green, g (s)	11.5	11.5	22.5	22.5	38.4	38.4
Actuated g/C Ratio	0.20	0.20	0.39	0.39	0.66	0.66
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	352	314	1375	615	492	2347
v/s Ratio Prot	0.11		0.32		c0.16	0.35
v/s Ratio Perm		0.21		0.27	c0.37	
v/c Ratio	0.56	0.21	0.82	0.27	0.80	0.52
Uniform Delay, d1	20.9	19.4	15.9	12.1	12.3	5.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.9	0.3	4.1	0.2	9.2	0.2
Delay (s)	22.8	19.7	19.9	12.3	21.4	5.2
Level of Service	C	B	B	B	C	A
Approach Delay (s)	20.9		17.9			9.2
Approach LOS	C		B			A

Intersection Summary			
HCM Average Control Delay	14.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	57.9	Sum of lost time (s)	8.0
Intersection Capacity Utilization	68.8%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Yield		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	0	274	1242	174	0	1621
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	298	1350	189	0	1762
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	TWLTL					
Median storage veh)	5					
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	2231	675			1350	
vC1, stage 1 conf vol	1350					
vC2, stage 2 conf vol	881					
vCu, unblocked vol	2231	675			1350	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)	5.8					
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	25			100	
cM capacity (veh/h)	203	396			506	

Direction, Lane #	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	298	675	675	189	881	881
Volume Left	0	0	0	0	0	0
Volume Right	298	0	0	189	0	0
cSH	396	1700	1700	1700	1700	1700
Volume to Capacity	0.75	0.40	0.40	0.11	0.52	0.52
Queue Length (ft)	152	0	0	0	0	0
Control Delay (s)	36.9	0.0	0.0	0.0	0.0	0.0
Lane LOS	E					
Approach Delay (s)	36.9	0.0			0.0	
Approach LOS	E					

Intersection Summary			
Average Delay	3.1		
Intersection Capacity Utilization	58.0%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	1.00	0.95	1.00	0.97	0.95
Frpb, ped/bikes	1.00	0.98	1.00	0.98	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1558	3539	1551	3433	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1558	3539	1551	3433	3539
Volume (vph)	544	333	1088	594	312	1216
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	591	362	1183	646	339	1322
RTOR Reduction (vph)	0	0	0	385	0	0
Lane Group Flow (vph)	591	362	1183	261	339	1322
Confl. Peds. (#/hr)		14		8	8	
Turn Type		Free		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		Free		2		
Actuated Green, G (s)	13.9	56.7	22.9	22.9	7.9	34.8
Effective Green, g (s)	13.9	56.7	22.9	22.9	7.9	34.8
Actuated g/C Ratio	0.25	1.00	0.40	0.40	0.14	0.61
Clearance Time (s)	4.0		4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0		3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	842	1558	1429	626	478	2172
v/s Ratio Prot	c0.17		0.33		0.10	c0.37
v/s Ratio Perm		0.23		0.42		
v/c Ratio	0.70	0.23	0.83	0.42	0.71	0.61
Uniform Delay, d1	19.5	0.0	15.1	12.1	23.3	6.8
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	2.7	0.3	4.1	0.5	4.8	0.5
Delay (s)	22.2	0.3	19.2	12.6	28.1	7.2
Level of Service	C	A	B	B	C	A
Approach Delay (s)	13.9		16.9			11.5
Approach LOS	B		B			B

Intersection Summary			
HCM Average Control Delay	14.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	56.7	Sum of lost time (s)	12.0
Intersection Capacity Utilization	64.5%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	297	489	17	589	200	74
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	323	532	18	640	217	80
Pedestrians					2	
Lane Width (ft)					12.0	
Walking Speed (ft/s)					4.0	
Percent Blockage					0	
Right turn flare (veh)						6
Median type					None	
Median storage veh)						
Upstream signal (ft)	475					
pX, platoon unblocked						
vC, conflicting volume			856		682	325
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			856		682	325
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			98		42	88
cM capacity (veh/h)			778		374	670

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	323	532	232	427	298
Volume Left	0	0	18	0	217
Volume Right	0	532	0	0	80
cSH	1700	1700	778	1700	512
Volume to Capacity	0.19	0.31	0.02	0.25	0.58
Queue Length (ft)	0	0	2	0	92
Control Delay (s)	0.0	0.0	1.0	0.0	22.8
Lane LOS			A		C
Approach Delay (s)	0.0		0.4		22.8
Approach LOS					C

Intersection Summary			
Average Delay	3.9		
Intersection Capacity Utilization	53.9%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	0.97	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (prot)	1863	1583	1770	1863	3433	1583
Flt Permitted	1.00	1.00	0.61	1.00	0.95	1.00
Satd. Flow (perm)	1863	1583	1139	1863	3433	1583
Volume (vph)	218	105	133	167	415	347
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	237	114	145	182	451	377
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	237	114	145	182	451	377
Turn Type		Free	Perm			Free
Protected Phases	4			8	2	
Permitted Phases		Free	8			Free
Actuated Green, G (s)	7.1	22.2	7.1	7.1	7.1	22.2
Effective Green, g (s)	7.1	22.2	7.1	7.1	7.1	22.2
Actuated g/C Ratio	0.32	1.00	0.32	0.32	0.32	1.00
Clearance Time (s)	4.0		4.0	4.0	4.0	
Vehicle Extension (s)	3.0		3.0	3.0	3.0	
Lane Grp Cap (vph)	596	1583	364	596	1098	1583
v/s Ratio Prot	0.13			0.10	c0.13	
v/s Ratio Perm		0.07	c0.13			0.24
v/c Ratio	0.40	0.07	0.40	0.31	0.41	0.24
Uniform Delay, d1	5.9	0.0	5.9	5.7	5.9	0.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.4	0.1	0.7	0.3	0.3	0.4
Delay (s)	6.3	0.1	6.6	6.0	6.2	0.4
Level of Service	A	A	A	A	A	A
Approach Delay (s)	4.3			6.3	3.5	
Approach LOS	A			A	A	

Intersection Summary			
HCM Average Control Delay	4.3	HCM Level of Service	A
HCM Volume to Capacity ratio	0.40		
Actuated Cycle Length (s)	22.2	Sum of lost time (s)	8.0
Intersection Capacity Utilization	40.7%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1863	1583	1770	1863	1583	1770	1863	1583	1770	1863	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.56	1.00	1.00	0.39	1.00	1.00
Satd. Flow (perm)	1770	1863	1583	1770	1863	1583	1048	1863	1583	730	1863	1583
Volume (vph)	64	532	127	257	252	17	34	266	398	29	184	17
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	70	578	138	279	274	18	37	289	433	32	200	18
RTOR Reduction (vph)	0	0	87	0	0	9	0	0	279	0	0	14
Lane Group Flow (vph)	70	578	51	279	274	9	37	289	154	32	200	4
Turn Type	Prot		Perm	Prot		Perm	Perm		Perm	Perm		Perm
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4			8	2		2	6		6
Actuated Green, G (s)	3.4	21.0	21.0	10.7	28.3	28.3	13.3	13.3	13.3	13.3	13.3	13.3
Effective Green, g (s)	3.4	21.0	21.0	10.7	28.3	28.3	13.3	13.3	13.3	13.3	13.3	13.3
Actuated g/C Ratio	0.06	0.37	0.37	0.19	0.50	0.50	0.23	0.23	0.23	0.23	0.23	0.23
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	106	686	583	332	925	786	245	435	369	170	435	369
v/s Ratio Prot	0.04	c0.31		c0.16	0.15			0.16			0.11	
v/s Ratio Perm			0.09			0.01	0.04		0.27	0.04		0.01
v/c Ratio	0.66	0.84	0.09	0.84	0.30	0.01	0.15	0.66	0.42	0.19	0.46	0.01
Uniform Delay, d1	26.2	16.5	11.7	22.3	8.5	7.3	17.4	19.8	18.6	17.5	18.8	16.8
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	14.4	9.2	0.1	17.1	0.2	0.0	0.3	3.8	0.8	0.5	0.8	0.0
Delay (s)	40.6	25.7	11.8	39.5	8.7	7.3	17.7	23.6	19.3	18.1	19.5	16.8
Level of Service	D	C	B	D	A	A	B	C	B	B	B	B
Approach Delay (s)		24.6			23.7			20.9			19.2	
Approach LOS		C			C			C			B	

Intersection Summary			
HCM Average Control Delay	22.6	HCM Level of Service	C
HCM Volume to Capacity ratio	0.94		
Actuated Cycle Length (s)	57.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	72.9%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1770	1583	1770	1863	1863	1583
Flt Permitted	0.95	1.00	0.19	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	345	1863	1863	1583
Volume (vph)	498	246	104	634	493	290
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	541	267	113	689	536	315
RTOR Reduction (vph)	0	171	0	0	0	192
Lane Group Flow (vph)	541	96	113	689	536	123
Turn Type		Perm	pm+pt			Perm
Protected Phases	4		5	2	6	
Permitted Phases		4	2			6
Actuated Green, G (s)	18.1	18.1	24.5	24.5	17.6	17.6
Effective Green, g (s)	18.1	18.1	24.5	24.5	17.6	17.6
Actuated g/C Ratio	0.36	0.36	0.48	0.48	0.35	0.35
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	633	566	249	902	648	551
v/s Ratio Prot	c0.31		0.03	c0.37	0.29	
v/s Ratio Perm		0.17	0.19			0.20
v/c Ratio	0.85	0.17	0.45	0.76	0.83	0.22
Uniform Delay, d1	15.0	11.1	9.4	10.7	15.1	11.7
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	10.9	0.1	1.3	3.9	8.5	0.2
Delay (s)	25.9	11.2	10.7	14.6	23.6	11.9
Level of Service	C	B	B	B	C	B
Approach Delay (s)	21.1			14.0	19.3	
Approach LOS	C			B	B	

Intersection Summary			
HCM Average Control Delay	18.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	50.6	Sum of lost time (s)	8.0
Intersection Capacity Utilization	69.3%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor		1.00	1.00		1.00	1.00	1.00	0.95	1.00	1.00	0.95	
Frpb, ped/bikes		1.00	1.00		1.00	1.00	1.00	1.00	0.98	1.00	1.00	
Flpb, ped/bikes		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt		1.00	0.85		1.00	0.85	1.00	1.00	0.85	1.00	1.00	
Flt Protected		0.96	1.00		0.95	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1795	1583		1778	1583	1770	3539	1549	1770	3524	
Flt Permitted		0.38	1.00		0.67	1.00	0.06	1.00	1.00	0.06	1.00	
Satd. Flow (perm)		707	1583		1253	1583	116	3539	1549	110	3524	
Volume (vph)	59	19	71	412	20	123	60	1397	264	98	1717	44
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	64	21	77	448	22	134	65	1518	287	107	1866	48
RTOR Reduction (vph)	0	0	46	0	0	39	0	0	144	0	1	0
Lane Group Flow (vph)	0	85	31	0	470	95	65	1518	143	107	1913	0
Confl. Peds. (#/hr)							2		2	2		2
Turn Type	Perm		Perm	Perm		Perm	pm+pt		Perm	pm+pt		
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		
Actuated Green, G (s)		46.0	46.0		46.0	46.0	67.4	64.2	64.2	75.0	68.0	
Effective Green, g (s)		46.0	46.0		46.0	46.0	67.4	64.2	64.2	75.0	68.0	
Actuated g/C Ratio		0.36	0.36		0.36	0.36	0.52	0.50	0.50	0.58	0.53	
Clearance Time (s)		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		252	564		446	564	101	1759	770	154	1855	
v/s Ratio Prot							0.02	0.43		c0.04	c0.54	
v/s Ratio Perm		0.12	0.05		c0.37	0.08	0.32		0.19	0.37		
v/c Ratio		0.34	0.06		1.05	0.17	0.64	0.86	0.19	0.69	1.03	
Uniform Delay, d1		30.4	27.3		41.6	28.5	63.8	28.6	18.0	25.6	30.6	
Progression Factor		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2		0.8	0.0		57.5	0.1	13.2	4.7	0.1	12.8	29.3	
Delay (s)		31.2	27.4		99.1	28.6	77.0	33.3	18.1	38.4	59.9	
Level of Service		C	C		F	C	E	C	B	D	E	
Approach Delay (s)		29.4			83.5			32.5			58.8	
Approach LOS		C			F			C			E	

Intersection Summary			
HCM Average Control Delay	50.4	HCM Level of Service	D
HCM Volume to Capacity ratio	1.04		
Actuated Cycle Length (s)	129.2	Sum of lost time (s)	12.0
Intersection Capacity Utilization	92.7%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Appendix M – Intersection Operations Analysis Worksheets for 2035 Without Project Conditions, with Mitigation Measures

HCM Signalized Intersection Capacity Analysis
1: Kaiminani Drive & Queen Kaahumanu Highway

2035 AM Without Project+Mit
7/25/2012

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	3539	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.18	1.00
Satd. Flow (perm)	1770	1583	3539	1583	327	3539
Volume (vph)	480	310	941	109	188	766
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	522	337	1023	118	204	833
RTOR Reduction (vph)	0	134	0	76	0	0
Lane Group Flow (vph)	522	203	1023	42	204	833
Turn Type		Perm		Perm	pm+pt	
Protected Phases	8		2		1	6
Permitted Phases		8		2	6	
Actuated Green, G (s)	17.7	17.7	18.8	18.8	26.8	26.8
Effective Green, g (s)	17.7	17.7	18.8	18.8	26.8	26.8
Actuated g/C Ratio	0.34	0.34	0.36	0.36	0.51	0.51
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	597	534	1267	567	277	1807
v/s Ratio Prot	c0.29		0.29		c0.06	0.24
v/s Ratio Perm		0.21		0.07	c0.32	
v/c Ratio	0.87	0.38	0.81	0.07	0.74	0.46
Uniform Delay, d1	16.4	13.2	15.2	11.1	9.7	8.2
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	13.4	0.5	3.9	0.1	9.8	0.2
Delay (s)	29.8	13.7	19.1	11.2	19.4	8.4
Level of Service	C	B	B	B	B	A
Approach Delay (s)	23.5		18.3			10.6
Approach LOS	C		B			B

Intersection Summary			
HCM Average Control Delay	17.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.77		
Actuated Cycle Length (s)	52.5	Sum of lost time (s)	8.0
Intersection Capacity Utilization	73.0%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Synchro 6 Report
Page 1

Katz, Okitsu & Associates


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AM (2035nP)                Thu Jul 26, 2012 10:21:12                Page 3-1
-------------------------------------------------------------------------------
                          JB23054 - Kaloko Makai
                                Kona, Hawaii
                       2035 Without Project Conditions
-------------------------------------------------------------------------------
                     Level Of Service Computation Report
          2000 HCM Unsignalized Method (Future Volume Alternative)
*******************************************************************************
Intersection #2 Queen Kaahumanu Hwy. @ Hulikoa Dr.
*******************************************************************************
Average Delay (sec/veh):      0.0       Worst Case Level Of Service: A[  7.2]
*******************************************************************************
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Uncontrolled     Uncontrolled     Yield Sign       Yield Sign
Rights:           Include          Include          Include          Ignore
Lanes:        0  0  2  0  1    0  1  1  0  0    0  0  0  0  0    0  0  1! 0  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:        0  590   218     0  835     0     0    0     0     0    0   182
Growth Adj:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Initial Bse:     0  590   218     0  835     0     0    0     0     0    0   182
Added Vol:       0  363    61    20  371     0     0    0     0    42    0    23
PasserByVol:     0    0    20   -20   62     0     0    0     0   -42    0    42
Initial Fut:     0  953   299     0 1268     0     0    0     0     0    0   247
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
PHF Volume:      0  953   299     0 1268     0     0    0     0     0    0     0
Reduct Vol:      0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:     0  953   299     0 1268     0     0    0     0     0    0     0
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx   6.8  6.5   6.9
FollowUpTim:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx   3.5  4.0   3.3
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  1587 2221   477
Potent Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx   101   44   540
Move Cap.:   xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx   101   44   540
Volume/Cap:  xxxx xxxx  xxxx  xxxx xxxx  xxxx  xxxx xxxx  xxxx  0.00 0.00  0.00
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:   xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Control Del:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
LOS by Move:     *    *     *     *    *     *     *    *     *     *    *     *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx    0 xxxxx
SharedQueue:xxxxx xxxx xxxxx   0.0 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Shrd ConDel:xxxxx xxxx xxxxx   7.2 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Shared LOS:      *    *     *     A    *     *     *    *     *     *    *     *
ApproachDel:    xxxxxx            xxxxxx            xxxxxx            xxxxxx
ApproachLOS:         *                 *                 *                 *
*******************************************************************************
Note: Queue reported is the number of cars per lane.
*******************************************************************************

  Traffix 8.0.0715 (c) 2008 Dowling Assoc. Licensed to KOA CORP, MONTEREY PK
```

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	1.00	0.95	1.00	0.97	0.95
Frpb, ped/bikes	1.00	0.98	1.00	0.98	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1558	3539	1553	3433	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1558	3539	1553	3433	3539
Volume (vph)	275	231	862	433	308	1041
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	299	251	937	471	335	1132
RTOR Reduction (vph)	0	0	0	287	0	0
Lane Group Flow (vph)	299	251	937	184	335	1132
Confl. Peds. (#/hr)		14		8	8	
Turn Type		Free		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		Free		2		
Actuated Green, G (s)	10.1	50.2	19.6	19.6	8.5	32.1
Effective Green, g (s)	10.1	50.2	19.6	19.6	8.5	32.1
Actuated g/C Ratio	0.20	1.00	0.39	0.39	0.17	0.64
Clearance Time (s)	4.0		4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0		3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	691	1558	1382	606	581	2263
v/s Ratio Prot	c0.09		0.26		0.10	c0.32
v/s Ratio Perm		0.16		0.30		
v/c Ratio	0.43	0.16	0.68	0.30	0.58	0.50
Uniform Delay, d1	17.5	0.0	12.7	10.6	19.2	4.8
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.4	0.2	1.3	0.3	1.4	0.2
Delay (s)	18.0	0.2	14.0	10.9	20.6	5.0
Level of Service	B	A	B	B	C	A
Approach Delay (s)	9.9		13.0			8.5
Approach LOS	A		B			A

Intersection Summary			
HCM Average Control Delay	10.6	HCM Level of Service	B
HCM Volume to Capacity ratio	0.64		
Actuated Cycle Length (s)	50.2	Sum of lost time (s)	12.0
Intersection Capacity Utilization	52.5%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	249	363	29	301	225	18
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	271	395	32	327	245	20
Pedestrians					2	
Lane Width (ft)					12.0	
Walking Speed (ft/s)					4.0	
Percent Blockage					0	
Right turn flare (veh)						6
Median type					None	
Median storage veh)						
Upstream signal (ft)	475					
pX, platoon unblocked						
vC, conflicting volume			667		499	273
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			667		499	273
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			97		49	97
cM capacity (veh/h)			917		483	724

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	271	395	141	218	264
Volume Left	0	0	32	0	245
Volume Right	0	395	0	0	20
cSH	1700	1700	917	1700	521
Volume to Capacity	0.16	0.23	0.03	0.13	0.51
Queue Length (ft)	0	0	3	0	71
Control Delay (s)	0.0	0.0	2.3	0.0	19.2
Lane LOS			A		C
Approach Delay (s)	0.0		0.9		19.2
Approach LOS					C

Intersection Summary			
Average Delay	4.2		
Intersection Capacity Utilization	44.7%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	0.97	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (prot)	1863	1583	1770	1863	3433	1583
Flt Permitted	1.00	1.00	0.67	1.00	0.95	1.00
Satd. Flow (perm)	1863	1583	1253	1863	3433	1583
Volume (vph)	121	133	224	218	121	81
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	132	145	243	237	132	88
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	132	145	243	237	132	88
Turn Type		Free	Perm			Free
Protected Phases	4			8	2	
Permitted Phases		Free	8			Free
Actuated Green, G (s)	6.9	17.9	6.9	6.9	3.0	17.9
Effective Green, g (s)	6.9	17.9	6.9	6.9	3.0	17.9
Actuated g/C Ratio	0.39	1.00	0.39	0.39	0.17	1.00
Clearance Time (s)	4.0		4.0	4.0	4.0	
Vehicle Extension (s)	3.0		3.0	3.0	3.0	
Lane Grp Cap (vph)	718	1583	483	718	575	1583
v/s Ratio Prot	0.07			0.13	c0.04	
v/s Ratio Perm		0.09	c0.19			0.06
v/c Ratio	0.18	0.09	0.50	0.33	0.23	0.06
Uniform Delay, d1	3.6	0.0	4.2	3.9	6.4	0.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.1	0.1	0.8	0.3	0.2	0.1
Delay (s)	3.8	0.1	5.0	4.1	6.7	0.1
Level of Service	A	A	A	A	A	A
Approach Delay (s)	1.9			4.6	4.0	
Approach LOS	A			A	A	

Intersection Summary			
HCM Average Control Delay	3.7	HCM Level of Service	A
HCM Volume to Capacity ratio	0.42		
Actuated Cycle Length (s)	17.9	Sum of lost time (s)	8.0
Intersection Capacity Utilization	32.2%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1863	1583	1770	1863	1583	1770	1863	1583	1770	1863	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.30	1.00	1.00	0.67	1.00	1.00
Satd. Flow (perm)	1770	1863	1583	1770	1863	1583	564	1863	1583	1253	1863	1583
Volume (vph)	13	155	26	420	411	25	129	121	141	9	334	65
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	14	168	28	457	447	27	140	132	153	10	363	71
RTOR Reduction (vph)	0	0	23	0	0	12	0	0	117	0	0	54
Lane Group Flow (vph)	14	168	5	457	447	15	140	132	36	10	363	17
Turn Type	Prot		Perm	Prot		Perm	Perm		Perm	Perm		Perm
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4			8	2		2	6		6
Actuated Green, G (s)	0.6	10.2	10.2	20.5	30.1	30.1	13.2	13.2	13.2	13.2	13.2	13.2
Effective Green, g (s)	0.6	10.2	10.2	20.5	30.1	30.1	13.2	13.2	13.2	13.2	13.2	13.2
Actuated g/C Ratio	0.01	0.18	0.18	0.37	0.54	0.54	0.24	0.24	0.24	0.24	0.24	0.24
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	19	340	289	649	1003	852	133	440	374	296	440	374
v/s Ratio Prot	0.01	0.09		c0.26	c0.24			0.07			0.19	
v/s Ratio Perm			0.02			0.02	c0.25		0.10	0.01		0.04
v/c Ratio	0.74	0.49	0.02	0.70	0.45	0.02	1.05	0.30	0.10	0.03	0.82	0.04
Uniform Delay, d1	27.6	20.5	18.7	15.1	7.8	6.0	21.4	17.6	16.7	16.4	20.3	16.5
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	88.4	1.1	0.0	3.5	0.3	0.0	92.8	0.4	0.1	0.0	11.9	0.0
Delay (s)	116.0	21.7	18.8	18.6	8.2	6.0	114.1	17.9	16.8	16.5	32.2	16.5
Level of Service	F	C	B	B	A	A	F	B	B	B	C	B
Approach Delay (s)		27.6			13.2			49.2			29.3	
Approach LOS		C			B			D			C	

Intersection Summary			
HCM Average Control Delay	25.9	HCM Level of Service	C
HCM Volume to Capacity ratio	0.71		
Actuated Cycle Length (s)	55.9	Sum of lost time (s)	8.0
Intersection Capacity Utilization	69.5%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1770	1583	1770	1863	1863	1583
Flt Permitted	0.95	1.00	0.07	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	122	1863	1863	1583
Volume (vph)	187	103	150	291	1078	501
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	203	112	163	316	1172	545
RTOR Reduction (vph)	0	94	0	0	0	89
Lane Group Flow (vph)	203	18	163	316	1172	456
Turn Type		Perm	pm+pt			Perm
Protected Phases	4		5	2	6	
Permitted Phases		4	2			6
Actuated Green, G (s)	13.8	13.8	66.1	66.1	57.1	57.1
Effective Green, g (s)	13.8	13.8	66.1	66.1	57.1	57.1
Actuated g/C Ratio	0.16	0.16	0.75	0.75	0.65	0.65
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	278	249	185	1401	1210	1028
v/s Ratio Prot	c0.11		c0.05	0.17	c0.63	
v/s Ratio Perm		0.07	0.61			0.34
v/c Ratio	0.73	0.07	0.88	0.23	0.97	0.44
Uniform Delay, d1	35.3	31.6	27.6	3.3	14.6	7.6
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	9.5	0.1	35.2	0.1	18.6	0.3
Delay (s)	44.7	31.7	62.8	3.3	33.1	7.9
Level of Service	D	C	E	A	C	A
Approach Delay (s)	40.1			23.6	25.1	
Approach LOS	D			C	C	

Intersection Summary			
HCM Average Control Delay	26.7	HCM Level of Service	C
HCM Volume to Capacity ratio	0.92		
Actuated Cycle Length (s)	87.9	Sum of lost time (s)	12.0
Intersection Capacity Utilization	85.4%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor		1.00	1.00		1.00	1.00	1.00	0.95	1.00	1.00	0.95	
Frpb, ped/bikes		1.00	1.00		1.00	1.00	1.00	1.00	0.98	1.00	1.00	
Flpb, ped/bikes		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt		1.00	0.85		1.00	0.85	1.00	1.00	0.85	1.00	0.99	
Flt Protected		0.97	1.00		0.96	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1800	1583		1779	1583	1770	3539	1548	1770	3511	
Flt Permitted		0.77	1.00		0.72	1.00	0.19	1.00	1.00	0.14	1.00	
Satd. Flow (perm)		1443	1583		1342	1583	357	3539	1548	252	3511	
Volume (vph)	17	7	24	270	18	152	68	1201	441	199	969	48
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	18	8	26	293	20	165	74	1305	479	216	1053	52
RTOR Reduction (vph)	0	0	19	0	0	120	0	0	271	0	6	0
Lane Group Flow (vph)	0	26	7	0	313	45	74	1305	208	216	1099	0
Confl. Peds. (#/hr)							2		2	2		2
Turn Type	Perm		Perm	Perm		Perm	pm+pt		Perm	pm+pt		
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		
Actuated Green, G (s)		15.8	15.8		15.8	15.8	28.2	25.9	25.9	35.6	29.6	
Effective Green, g (s)		15.8	15.8		15.8	15.8	28.2	25.9	25.9	35.6	29.6	
Actuated g/C Ratio		0.26	0.26		0.26	0.26	0.47	0.43	0.43	0.60	0.50	
Clearance Time (s)		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		382	419		355	419	223	1535	672	303	1741	
v/s Ratio Prot							0.01	c0.37		c0.07	0.31	
v/s Ratio Perm		0.02	0.02		c0.23	0.10	0.14		0.31	0.35		
v/c Ratio		0.07	0.02		0.88	0.11	0.33	0.85	0.31	0.71	0.63	
Uniform Delay, d1		16.4	16.2		21.1	16.6	9.1	15.2	11.1	10.3	11.0	
Progression Factor		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2		0.1	0.0		21.7	0.1	0.9	4.7	0.3	7.7	0.8	
Delay (s)		16.5	16.2		42.7	16.7	10.0	19.9	11.3	18.0	11.8	
Level of Service		B	B		D	B	A	B	B	B	B	
Approach Delay (s)		16.4			33.8			17.3			12.8	
Approach LOS		B			C			B			B	

Intersection Summary			
HCM Average Control Delay	17.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.92		
Actuated Cycle Length (s)	59.7	Sum of lost time (s)	16.0
Intersection Capacity Utilization	76.8%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
1: Kaiminani Drive & Queen Kaahumanu Highway

2035 PM Without Project+Mit
7/25/2012

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	3539	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.15	1.00
Satd. Flow (perm)	1770	1583	3539	1583	281	3539
Volume (vph)	180	303	1038	387	363	1131
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	196	329	1128	421	395	1229
RTOR Reduction (vph)	0	264	0	257	0	0
Lane Group Flow (vph)	196	65	1128	164	395	1229
Turn Type		Perm		Perm	pm+pt	
Protected Phases	8		2		1	6
Permitted Phases		8		2	6	
Actuated Green, G (s)	11.5	11.5	22.5	22.5	38.4	38.4
Effective Green, g (s)	11.5	11.5	22.5	22.5	38.4	38.4
Actuated g/C Ratio	0.20	0.20	0.39	0.39	0.66	0.66
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	352	314	1375	615	492	2347
v/s Ratio Prot	0.11		0.32		c0.16	0.35
v/s Ratio Perm		0.21		0.27	c0.37	
v/c Ratio	0.56	0.21	0.82	0.27	0.80	0.52
Uniform Delay, d1	20.9	19.4	15.9	12.1	12.3	5.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.9	0.3	4.1	0.2	9.2	0.2
Delay (s)	22.8	19.7	19.9	12.3	21.4	5.2
Level of Service	C	B	B	B	C	A
Approach Delay (s)	20.9		17.9			9.2
Approach LOS	C		B			A

Intersection Summary			
HCM Average Control Delay	14.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	57.9	Sum of lost time (s)	8.0
Intersection Capacity Utilization	68.8%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Synchro 6 Report
Page 1

Katz, Okitsu & Associates


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PM (2035nP)                Thu Jul 26, 2012 10:21:50                Page 3-1
-------------------------------------------------------------------------------
                          JB23054 - Kaloko Makai
                                Kona, Hawaii
                      2035 Without Project Conditions
-------------------------------------------------------------------------------
                     Level Of Service Computation Report
          2000 HCM Unsignalized Method (Future Volume Alternative)
*******************************************************************************
Intersection #2 Queen Kaahumanu Hwy. @ Hulikoa Dr.
*******************************************************************************
Average Delay (sec/veh):      0.0       Worst Case Level Of Service: A[  7.2]
*******************************************************************************
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Uncontrolled     Uncontrolled     Yield Sign       Yield Sign
Rights:           Include          Include          Include          Ignore
Lanes:        0  0  2  0  1    0  1  1  0  0    0  0  0  0  0    0  0  1! 0  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:        0  719   122     0 1068     0     0    0     0     0    0   205
Growth Adj:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Initial Bse:     0  719   122     0 1068     0     0    0     0     0    0   205
Added Vol:       0  523    39    13  495     0     0    0     0    45    0    24
PasserByVol:     0    0    13   -13   58     0     0    0     0   -45    0    45
Initial Fut:     0 1242   174     0 1621     0     0    0     0     0    0   274
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
PHF Volume:      0 1242   174     0 1621     0     0    0     0     0    0     0
Reduct Vol:      0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:     0 1242   174     0 1621     0     0    0     0     0    0     0
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx   6.8  6.5   6.9
FollowUpTim:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx   3.5  4.0   3.3
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  2053 2863   621
Potent Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx    49   17   435
Move Cap.:   xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx    49   17   435
Volume/Cap:  xxxx xxxx  xxxx  xxxx xxxx  xxxx  xxxx xxxx  xxxx  0.00 0.00  0.00
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:   xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Control Del:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
LOS by Move:     *    *     *     *    *     *     *    *     *     *    *     *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx    0 xxxxx
SharedQueue:xxxxx xxxx xxxxx   0.0 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Shrd ConDel:xxxxx xxxx xxxxx   7.2 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Shared LOS:      *    *     *     A    *     *     *    *     *     *    *     *
ApproachDel:    xxxxxx            xxxxxx            xxxxxx            xxxxxx
ApproachLOS:         *                 *                 *                 *
*******************************************************************************
Note: Queue reported is the number of cars per lane.
*******************************************************************************

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Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	1.00	0.95	1.00	0.97	0.95
Frpb, ped/bikes	1.00	0.98	1.00	0.98	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1558	3539	1551	3433	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1558	3539	1551	3433	3539
Volume (vph)	544	333	1088	594	312	1216
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	591	362	1183	646	339	1322
RTOR Reduction (vph)	0	0	0	385	0	0
Lane Group Flow (vph)	591	362	1183	261	339	1322
Confl. Peds. (#/hr)		14		8	8	
Turn Type		Free		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		Free		2		
Actuated Green, G (s)	13.9	56.7	22.9	22.9	7.9	34.8
Effective Green, g (s)	13.9	56.7	22.9	22.9	7.9	34.8
Actuated g/C Ratio	0.25	1.00	0.40	0.40	0.14	0.61
Clearance Time (s)	4.0		4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0		3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	842	1558	1429	626	478	2172
v/s Ratio Prot	c0.17		0.33		0.10	c0.37
v/s Ratio Perm		0.23		0.42		
v/c Ratio	0.70	0.23	0.83	0.42	0.71	0.61
Uniform Delay, d1	19.5	0.0	15.1	12.1	23.3	6.8
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	2.7	0.3	4.1	0.5	4.8	0.5
Delay (s)	22.2	0.3	19.2	12.6	28.1	7.2
Level of Service	C	A	B	B	C	A
Approach Delay (s)	13.9		16.9			11.5
Approach LOS	B		B			B

Intersection Summary			
HCM Average Control Delay	14.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	56.7	Sum of lost time (s)	12.0
Intersection Capacity Utilization	64.5%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	297	489	17	589	200	74
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	323	532	18	640	217	80
Pedestrians					2	
Lane Width (ft)					12.0	
Walking Speed (ft/s)					4.0	
Percent Blockage					0	
Right turn flare (veh)						6
Median type					None	
Median storage veh)						
Upstream signal (ft)	475					
pX, platoon unblocked						
vC, conflicting volume			856		682	325
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			856		682	325
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			98		42	88
cM capacity (veh/h)			778		374	670

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	323	532	232	427	298
Volume Left	0	0	18	0	217
Volume Right	0	532	0	0	80
cSH	1700	1700	778	1700	512
Volume to Capacity	0.19	0.31	0.02	0.25	0.58
Queue Length (ft)	0	0	2	0	92
Control Delay (s)	0.0	0.0	1.0	0.0	22.8
Lane LOS			A		C
Approach Delay (s)	0.0		0.4		22.8
Approach LOS					C

Intersection Summary			
Average Delay	3.9		
Intersection Capacity Utilization	53.9%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	0.97	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (prot)	1863	1583	1770	1863	3433	1583
Flt Permitted	1.00	1.00	0.61	1.00	0.95	1.00
Satd. Flow (perm)	1863	1583	1139	1863	3433	1583
Volume (vph)	218	105	133	167	415	347
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	237	114	145	182	451	377
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	237	114	145	182	451	377
Turn Type		Free	Perm			Free
Protected Phases	4			8	2	
Permitted Phases		Free	8			Free
Actuated Green, G (s)	7.1	22.2	7.1	7.1	7.1	22.2
Effective Green, g (s)	7.1	22.2	7.1	7.1	7.1	22.2
Actuated g/C Ratio	0.32	1.00	0.32	0.32	0.32	1.00
Clearance Time (s)	4.0		4.0	4.0	4.0	
Vehicle Extension (s)	3.0		3.0	3.0	3.0	
Lane Grp Cap (vph)	596	1583	364	596	1098	1583
v/s Ratio Prot	0.13			0.10	c0.13	
v/s Ratio Perm		0.07	c0.13			0.24
v/c Ratio	0.40	0.07	0.40	0.31	0.41	0.24
Uniform Delay, d1	5.9	0.0	5.9	5.7	5.9	0.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.4	0.1	0.7	0.3	0.3	0.4
Delay (s)	6.3	0.1	6.6	6.0	6.2	0.4
Level of Service	A	A	A	A	A	A
Approach Delay (s)	4.3			6.3	3.5	
Approach LOS	A			A	A	

Intersection Summary			
HCM Average Control Delay	4.3	HCM Level of Service	A
HCM Volume to Capacity ratio	0.40		
Actuated Cycle Length (s)	22.2	Sum of lost time (s)	8.0
Intersection Capacity Utilization	40.7%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1863	1583	1770	1863	1583	1770	1863	1583	1770	1863	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.56	1.00	1.00	0.39	1.00	1.00
Satd. Flow (perm)	1770	1863	1583	1770	1863	1583	1048	1863	1583	730	1863	1583
Volume (vph)	64	532	127	257	252	17	34	266	398	29	184	17
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	70	578	138	279	274	18	37	289	433	32	200	18
RTOR Reduction (vph)	0	0	87	0	0	9	0	0	279	0	0	14
Lane Group Flow (vph)	70	578	51	279	274	9	37	289	154	32	200	4
Turn Type	Prot		Perm	Prot		Perm	Perm		Perm	Perm		Perm
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4			8	2		2	6		6
Actuated Green, G (s)	3.4	21.0	21.0	10.7	28.3	28.3	13.3	13.3	13.3	13.3	13.3	13.3
Effective Green, g (s)	3.4	21.0	21.0	10.7	28.3	28.3	13.3	13.3	13.3	13.3	13.3	13.3
Actuated g/C Ratio	0.06	0.37	0.37	0.19	0.50	0.50	0.23	0.23	0.23	0.23	0.23	0.23
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	106	686	583	332	925	786	245	435	369	170	435	369
v/s Ratio Prot	0.04	c0.31		c0.16	0.15			0.16			0.11	
v/s Ratio Perm			0.09			0.01	0.04		0.27	0.04		0.01
v/c Ratio	0.66	0.84	0.09	0.84	0.30	0.01	0.15	0.66	0.42	0.19	0.46	0.01
Uniform Delay, d1	26.2	16.5	11.7	22.3	8.5	7.3	17.4	19.8	18.6	17.5	18.8	16.8
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	14.4	9.2	0.1	17.1	0.2	0.0	0.3	3.8	0.8	0.5	0.8	0.0
Delay (s)	40.6	25.7	11.8	39.5	8.7	7.3	17.7	23.6	19.3	18.1	19.5	16.8
Level of Service	D	C	B	D	A	A	B	C	B	B	B	B
Approach Delay (s)		24.6			23.7			20.9			19.2	
Approach LOS		C			C			C			B	

Intersection Summary			
HCM Average Control Delay	22.6	HCM Level of Service	C
HCM Volume to Capacity ratio	0.94		
Actuated Cycle Length (s)	57.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	72.9%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1770	1583	1770	1863	1863	1583
Flt Permitted	0.95	1.00	0.19	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	345	1863	1863	1583
Volume (vph)	498	246	104	634	493	290
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	541	267	113	689	536	315
RTOR Reduction (vph)	0	171	0	0	0	192
Lane Group Flow (vph)	541	96	113	689	536	123
Turn Type		Perm	pm+pt			Perm
Protected Phases	4		5	2	6	
Permitted Phases		4	2			6
Actuated Green, G (s)	18.1	18.1	24.5	24.5	17.6	17.6
Effective Green, g (s)	18.1	18.1	24.5	24.5	17.6	17.6
Actuated g/C Ratio	0.36	0.36	0.48	0.48	0.35	0.35
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	633	566	249	902	648	551
v/s Ratio Prot	c0.31		0.03	c0.37	0.29	
v/s Ratio Perm		0.17	0.19			0.20
v/c Ratio	0.85	0.17	0.45	0.76	0.83	0.22
Uniform Delay, d1	15.0	11.1	9.4	10.7	15.1	11.7
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	10.9	0.1	1.3	3.9	8.5	0.2
Delay (s)	25.9	11.2	10.7	14.6	23.6	11.9
Level of Service	C	B	B	B	C	B
Approach Delay (s)	21.1			14.0	19.3	
Approach LOS	C			B	B	

Intersection Summary			
HCM Average Control Delay	18.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	50.6	Sum of lost time (s)	8.0
Intersection Capacity Utilization	69.3%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor		1.00	1.00		1.00	1.00	1.00	0.95	1.00	1.00	0.95	
Frpb, ped/bikes		1.00	1.00		1.00	1.00	1.00	1.00	0.98	1.00	1.00	
Flpb, ped/bikes		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt		1.00	0.85		1.00	0.85	1.00	1.00	0.85	1.00	1.00	
Flt Protected		0.96	1.00		0.95	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1795	1583		1778	1583	1770	3539	1549	1770	3524	
Flt Permitted		0.38	1.00		0.67	1.00	0.06	1.00	1.00	0.06	1.00	
Satd. Flow (perm)		707	1583		1253	1583	116	3539	1549	110	3524	
Volume (vph)	59	19	71	412	20	123	60	1397	264	98	1717	44
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	64	21	77	448	22	134	65	1518	287	107	1866	48
RTOR Reduction (vph)	0	0	46	0	0	39	0	0	144	0	1	0
Lane Group Flow (vph)	0	85	31	0	470	95	65	1518	143	107	1913	0
Confl. Peds. (#/hr)							2		2	2		2
Turn Type	Perm		Perm	Perm		Perm	pm+pt		Perm	pm+pt		
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		
Actuated Green, G (s)		46.0	46.0		46.0	46.0	67.4	64.2	64.2	75.0	68.0	
Effective Green, g (s)		46.0	46.0		46.0	46.0	67.4	64.2	64.2	75.0	68.0	
Actuated g/C Ratio		0.36	0.36		0.36	0.36	0.52	0.50	0.50	0.58	0.53	
Clearance Time (s)		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		252	564		446	564	101	1759	770	154	1855	
v/s Ratio Prot							0.02	0.43		c0.04	c0.54	
v/s Ratio Perm		0.12	0.05		c0.37	0.08	0.32		0.19	0.37		
v/c Ratio		0.34	0.06		1.05	0.17	0.64	0.86	0.19	0.69	1.03	
Uniform Delay, d1		30.4	27.3		41.6	28.5	63.8	28.6	18.0	25.6	30.6	
Progression Factor		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2		0.8	0.0		57.5	0.1	13.2	4.7	0.1	12.8	29.3	
Delay (s)		31.2	27.4		99.1	28.6	77.0	33.3	18.1	38.4	59.9	
Level of Service		C	C		F	C	E	C	B	D	E	
Approach Delay (s)		29.4			83.5			32.5			58.8	
Approach LOS		C			F			C			E	

Intersection Summary			
HCM Average Control Delay	50.4	HCM Level of Service	D
HCM Volume to Capacity ratio	1.04		
Actuated Cycle Length (s)	129.2	Sum of lost time (s)	12.0
Intersection Capacity Utilization	92.7%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Appendix N - Intersection Operations Analysis Worksheets for 2045 Without Project Conditions, with Existing Geometry and Planned Improvements

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	3539	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.14	1.00
Satd. Flow (perm)	1770	1583	3539	1583	264	3539
Volume (vph)	480	310	1104	109	188	875
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	522	337	1200	118	204	951
RTOR Reduction (vph)	0	128	0	72	0	0
Lane Group Flow (vph)	522	209	1200	46	204	951
Turn Type		Perm		Perm	pm+pt	
Protected Phases	8		2		1	6
Permitted Phases		8		2	6	
Actuated Green, G (s)	20.4	20.4	24.2	24.2	33.3	33.3
Effective Green, g (s)	20.4	20.4	24.2	24.2	33.3	33.3
Actuated g/C Ratio	0.33	0.33	0.39	0.39	0.54	0.54
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	585	523	1388	621	267	1910
v/s Ratio Prot	c0.29		c0.34		c0.06	0.27
v/s Ratio Perm		0.21		0.07	0.35	
v/c Ratio	0.89	0.40	0.86	0.07	0.76	0.50
Uniform Delay, d1	19.6	15.9	17.2	11.7	11.6	8.9
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	15.8	0.5	5.9	0.1	12.2	0.2
Delay (s)	35.4	16.4	23.1	11.8	23.9	9.1
Level of Service	D	B	C	B	C	A
Approach Delay (s)	28.0		22.1			11.7
Approach LOS	C		C			B

Intersection Summary			
HCM Average Control Delay	20.0	HCM Level of Service	C
HCM Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	61.7	Sum of lost time (s)	12.0
Intersection Capacity Utilization	77.5%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Yield		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	0	247	1116	299	0	1377
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	268	1213	325	0	1497
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	TWLTL					
Median storage veh)	5					
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1961	607			1213	
vC1, stage 1 conf vol	1213					
vC2, stage 2 conf vol	748					
vCu, unblocked vol	1961	607			1213	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)	5.8					
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	39			100	
cM capacity (veh/h)	241	440			571	

Direction, Lane #	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	268	607	607	325	748	748
Volume Left	0	0	0	0	0	0
Volume Right	268	0	0	325	0	0
cSH	440	1700	1700	1700	1700	1700
Volume to Capacity	0.61	0.36	0.36	0.19	0.44	0.44
Queue Length (ft)	99	0	0	0	0	0
Control Delay (s)	25.2	0.0	0.0	0.0	0.0	0.0
Lane LOS	D					
Approach Delay (s)	25.2	0.0			0.0	
Approach LOS	D					

Intersection Summary			
Average Delay	2.0		
Intersection Capacity Utilization	52.8%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	1.00	0.95	1.00	0.97	0.95
Frpb, ped/bikes	1.00	0.98	1.00	0.98	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1558	3539	1552	3433	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1558	3539	1552	3433	3539
Volume (vph)	275	231	1025	433	308	1150
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	299	251	1114	471	335	1250
RTOR Reduction (vph)	0	0	0	274	0	0
Lane Group Flow (vph)	299	251	1114	197	335	1250
Confl. Peds. (#/hr)		14		8	8	
Turn Type		Free		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		Free		2		
Actuated Green, G (s)	10.2	51.8	21.7	21.7	7.9	33.6
Effective Green, g (s)	10.2	51.8	21.7	21.7	7.9	33.6
Actuated g/C Ratio	0.20	1.00	0.42	0.42	0.15	0.65
Clearance Time (s)	4.0		4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0		3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	676	1558	1483	650	524	2296
v/s Ratio Prot	c0.09		c0.31		0.10	c0.35
v/s Ratio Perm		0.16		0.30		
v/c Ratio	0.44	0.16	0.75	0.30	0.64	0.54
Uniform Delay, d1	18.3	0.0	12.8	10.0	20.6	4.9
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.5	0.2	2.2	0.3	2.6	0.3
Delay (s)	18.8	0.2	15.0	10.3	23.2	5.2
Level of Service	B	A	B	B	C	A
Approach Delay (s)	10.3		13.6			9.0
Approach LOS	B		B			A

Intersection Summary			
HCM Average Control Delay	11.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.65		
Actuated Cycle Length (s)	51.8	Sum of lost time (s)	12.0
Intersection Capacity Utilization	57.0%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	249	363	29	301	225	18
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	271	395	32	327	245	20
Pedestrians					2	
Lane Width (ft)					12.0	
Walking Speed (ft/s)					4.0	
Percent Blockage					0	
Right turn flare (veh)						6
Median type					None	
Median storage veh)						
Upstream signal (ft)	475					
pX, platoon unblocked						
vC, conflicting volume			667		499	273
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			667		499	273
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			97		49	97
cM capacity (veh/h)			917		483	724

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	271	395	141	218	264
Volume Left	0	0	32	0	245
Volume Right	0	395	0	0	20
cSH	1700	1700	917	1700	521
Volume to Capacity	0.16	0.23	0.03	0.13	0.51
Queue Length (ft)	0	0	3	0	71
Control Delay (s)	0.0	0.0	2.3	0.0	19.2
Lane LOS			A		C
Approach Delay (s)	0.0		0.9		19.2
Approach LOS					C

Intersection Summary			
Average Delay	4.2		
Intersection Capacity Utilization	44.7%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	0.97	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (prot)	1863	1583	1770	1863	3433	1583
Flt Permitted	1.00	1.00	0.67	1.00	0.95	1.00
Satd. Flow (perm)	1863	1583	1253	1863	3433	1583
Volume (vph)	121	133	224	218	121	81
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	132	145	243	237	132	88
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	132	145	243	237	132	88
Turn Type		Free	Perm			Free
Protected Phases	4			8	2	
Permitted Phases		Free	8			Free
Actuated Green, G (s)	6.9	17.9	6.9	6.9	3.0	17.9
Effective Green, g (s)	6.9	17.9	6.9	6.9	3.0	17.9
Actuated g/C Ratio	0.39	1.00	0.39	0.39	0.17	1.00
Clearance Time (s)	4.0		4.0	4.0	4.0	
Vehicle Extension (s)	3.0		3.0	3.0	3.0	
Lane Grp Cap (vph)	718	1583	483	718	575	1583
v/s Ratio Prot	0.07			0.13	c0.04	
v/s Ratio Perm		0.09	c0.19			0.06
v/c Ratio	0.18	0.09	0.50	0.33	0.23	0.06
Uniform Delay, d1	3.6	0.0	4.2	3.9	6.4	0.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.1	0.1	0.8	0.3	0.2	0.1
Delay (s)	3.8	0.1	5.0	4.1	6.7	0.1
Level of Service	A	A	A	A	A	A
Approach Delay (s)	1.9			4.6	4.0	
Approach LOS	A			A	A	

Intersection Summary			
HCM Average Control Delay	3.7	HCM Level of Service	A
HCM Volume to Capacity ratio	0.42		
Actuated Cycle Length (s)	17.9	Sum of lost time (s)	8.0
Intersection Capacity Utilization	32.2%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1863	1583	1770	1863	1583	1770	1863	1583	1770	1863	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.28	1.00	1.00	0.65	1.00	1.00
Satd. Flow (perm)	1770	1863	1583	1770	1863	1583	520	1863	1583	1204	1863	1583
Volume (vph)	13	155	26	464	411	25	129	144	156	9	388	65
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	14	168	28	504	447	27	140	157	170	10	422	71
RTOR Reduction (vph)	0	0	23	0	0	14	0	0	115	0	0	48
Lane Group Flow (vph)	14	168	5	504	447	13	140	157	55	10	422	23
Turn Type	Prot		Perm	Prot		Perm	Perm		Perm	Perm		Perm
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4			8	2		2	6		6
Actuated Green, G (s)	0.7	11.2	11.2	22.5	33.0	33.0	21.8	21.8	21.8	21.8	21.8	21.8
Effective Green, g (s)	0.7	11.2	11.2	22.5	33.0	33.0	21.8	21.8	21.8	21.8	21.8	21.8
Actuated g/C Ratio	0.01	0.17	0.17	0.33	0.49	0.49	0.32	0.32	0.32	0.32	0.32	0.32
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	18	309	263	590	911	774	168	602	511	389	602	511
v/s Ratio Prot	0.01	0.09		c0.28	c0.24			0.08			0.23	
v/s Ratio Perm			0.02			0.02	c0.27		0.11	0.01		0.04
v/c Ratio	0.78	0.54	0.02	0.85	0.49	0.02	0.83	0.26	0.11	0.03	0.70	0.04
Uniform Delay, d1	33.3	25.8	23.5	21.0	11.6	8.9	21.2	16.9	16.0	15.6	20.0	15.7
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	107.6	2.0	0.0	11.6	0.4	0.0	28.3	0.2	0.1	0.0	3.7	0.0
Delay (s)	140.9	27.8	23.6	32.5	12.0	8.9	49.5	17.1	16.1	15.6	23.7	15.7
Level of Service	F	C	C	C	B	A	D	B	B	B	C	B
Approach Delay (s)		34.7			22.5			26.5			22.4	
Approach LOS		C			C			C			C	

Intersection Summary			
HCM Average Control Delay	24.5	HCM Level of Service	C
HCM Volume to Capacity ratio	0.74		
Actuated Cycle Length (s)	67.5	Sum of lost time (s)	8.0
Intersection Capacity Utilization	74.8%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1770	1583	1770	1863	1863	1583
Flt Permitted	0.95	1.00	0.04	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	70	1863	1863	1583
Volume (vph)	202	103	150	342	1269	545
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	220	112	163	372	1379	592
RTOR Reduction (vph)	0	98	0	0	0	55
Lane Group Flow (vph)	220	14	163	372	1379	537
Turn Type		Perm	pm+pt			Perm
Protected Phases	4		5	2	6	
Permitted Phases		4	2			6
Actuated Green, G (s)	17.0	17.0	115.0	115.0	102.0	102.0
Effective Green, g (s)	17.0	17.0	115.0	115.0	102.0	102.0
Actuated g/C Ratio	0.12	0.12	0.82	0.82	0.73	0.73
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	215	192	167	1530	1357	1153
v/s Ratio Prot	c0.12		c0.06	0.20	c0.74	
v/s Ratio Perm		0.07	0.74			0.37
v/c Ratio	1.02	0.07	0.98	0.24	1.02	0.47
Uniform Delay, d1	61.5	54.5	67.5	2.8	19.0	7.8
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	67.5	0.2	62.0	0.1	28.5	0.3
Delay (s)	129.0	54.7	129.5	2.9	47.5	8.1
Level of Service	F	D	F	A	D	A
Approach Delay (s)	103.9			41.4	35.7	
Approach LOS	F			D	D	

Intersection Summary			
HCM Average Control Delay	44.8	HCM Level of Service	D
HCM Volume to Capacity ratio	1.01		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	96.3%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
8: Kealakehe Parkway & Queen Kaahumanu Highway

2045 AM Without Project
7/25/2012

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor		1.00	1.00		1.00	1.00	1.00	0.95	1.00	1.00	0.95	
Frpb, ped/bikes		1.00	1.00		1.00	1.00	1.00	1.00	0.98	1.00	1.00	
Flpb, ped/bikes		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt		1.00	0.85		1.00	0.85	1.00	1.00	0.85	1.00	0.99	
Flt Protected		0.97	1.00		0.96	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1800	1583		1779	1583	1770	3539	1548	1770	3513	
Flt Permitted		0.77	1.00		0.72	1.00	0.14	1.00	1.00	0.12	1.00	
Satd. Flow (perm)		1440	1583		1342	1583	266	3539	1548	226	3513	
Volume (vph)	17	7	24	270	18	152	68	1364	441	199	1078	48
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	18	8	26	293	20	165	74	1483	479	216	1172	52
RTOR Reduction (vph)	0	0	19	0	0	103	0	0	248	0	5	0
Lane Group Flow (vph)	0	26	7	0	313	62	74	1483	231	216	1219	0
Confl. Peds. (#/hr)							2		2	2		2
Turn Type	Perm		Perm	Perm		Perm	pm+pt		Perm	pm+pt		
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		
Actuated Green, G (s)		16.4	16.4		16.4	16.4	34.1	31.0	31.0	37.9	32.9	
Effective Green, g (s)		16.4	16.4		16.4	16.4	34.1	31.0	31.0	37.9	32.9	
Actuated g/C Ratio		0.25	0.25		0.25	0.25	0.53	0.48	0.48	0.59	0.51	
Clearance Time (s)		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		367	403		342	403	213	1704	745	253	1795	
v/s Ratio Prot							0.02	0.42		c0.07	0.35	
v/s Ratio Perm		0.02	0.02		c0.23	0.10	0.17		0.31	c0.44		
v/c Ratio		0.07	0.02		0.92	0.15	0.35	0.87	0.31	0.85	0.68	
Uniform Delay, d1		18.2	18.0		23.3	18.6	8.7	14.9	10.2	12.1	11.8	
Progression Factor		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2		0.1	0.0		28.0	0.2	1.0	5.2	0.2	23.3	1.0	
Delay (s)		18.3	18.0		51.4	18.8	9.7	20.1	10.4	35.4	12.8	
Level of Service		B	B		D	B	A	C	B	D	B	
Approach Delay (s)		18.1			40.1			17.4			16.2	
Approach LOS		B			D			B			B	

Intersection Summary			
HCM Average Control Delay	19.7	HCM Level of Service	B
HCM Volume to Capacity ratio	0.90		
Actuated Cycle Length (s)	64.4	Sum of lost time (s)	12.0
Intersection Capacity Utilization	81.3%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
1: Kaiminani Drive & Queen Kaahumanu Highway

2045 PM Without Project
7/25/2012

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	3539	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.12	1.00
Satd. Flow (perm)	1770	1583	3539	1583	227	3539
Volume (vph)	180	303	1183	387	363	1312
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	196	329	1286	421	395	1426
RTOR Reduction (vph)	0	269	0	239	0	0
Lane Group Flow (vph)	196	60	1286	182	395	1426
Turn Type		Perm		Perm	pm+pt	
Protected Phases	8		2		1	6
Permitted Phases		8		2	6	
Actuated Green, G (s)	12.1	12.1	28.8	28.8	46.7	46.7
Effective Green, g (s)	12.1	12.1	28.8	28.8	46.7	46.7
Actuated g/C Ratio	0.18	0.18	0.43	0.43	0.70	0.70
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	321	287	1526	682	480	2474
v/s Ratio Prot	0.11		0.36		c0.17	0.40
v/s Ratio Perm		0.21		0.27	c0.40	
v/c Ratio	0.61	0.21	0.84	0.27	0.82	0.58
Uniform Delay, d1	25.2	23.3	17.0	12.2	16.4	5.1
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	3.4	0.4	4.4	0.2	10.9	0.3
Delay (s)	28.6	23.6	21.4	12.4	27.3	5.4
Level of Service	C	C	C	B	C	A
Approach Delay (s)	25.5		19.2			10.1
Approach LOS	C		B			B

Intersection Summary			
HCM Average Control Delay	15.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	66.8	Sum of lost time (s)	8.0
Intersection Capacity Utilization	72.8%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
2: Hulikoa Drive & Queen Kaahumanu Highway

2045 PM Without Project
7/25/2012

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Yield		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	0	274	1387	174	0	1802
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	298	1508	189	0	1959
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	TWLTL					
Median storage veh)	5					
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	2487	754			1508	
vC1, stage 1 conf vol	1508					
vC2, stage 2 conf vol	979					
vCu, unblocked vol	2487	754			1508	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)	5.8					
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	15			100	
cM capacity (veh/h)	167	352			440	

Direction, Lane #	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	298	754	754	189	979	979
Volume Left	0	0	0	0	0	0
Volume Right	298	0	0	189	0	0
cSH	352	1700	1700	1700	1700	1700
Volume to Capacity	0.85	0.44	0.44	0.11	0.58	0.58
Queue Length (ft)	193	0	0	0	0	0
Control Delay (s)	52.1	0.0	0.0	0.0	0.0	0.0
Lane LOS	F					
Approach Delay (s)	52.1	0.0			0.0	
Approach LOS	F					

Intersection Summary			
Average Delay	3.9		
Intersection Capacity Utilization	62.0%	ICU Level of Service	B
Analysis Period (min)	15		

HCM Signalized Intersection Capacity Analysis
3: Hina Lani Street & Queen Kaahumanu Highway

2045 PM Without Project
7/25/2012

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	1.00	0.95	1.00	0.97	0.95
Frpb, ped/bikes	1.00	0.98	1.00	0.98	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1558	3539	1551	3433	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1558	3539	1551	3433	3539
Volume (vph)	544	333	1233	594	312	1397
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	591	362	1340	646	339	1518
RTOR Reduction (vph)	0	0	0	369	0	0
Lane Group Flow (vph)	591	362	1340	277	339	1518
Confl. Peds. (#/hr)		14		8	8	
Turn Type		Free		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		Free		2		
Actuated Green, G (s)	14.1	58.0	24.9	24.9	7.0	35.9
Effective Green, g (s)	14.1	58.0	24.9	24.9	7.0	35.9
Actuated g/C Ratio	0.24	1.00	0.43	0.43	0.12	0.62
Clearance Time (s)	4.0		4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0		3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	835	1558	1519	666	414	2191
v/s Ratio Prot	c0.17		0.38		0.10	c0.43
v/s Ratio Perm		0.23		0.42		
v/c Ratio	0.71	0.23	0.88	0.42	0.82	0.69
Uniform Delay, d1	20.1	0.0	15.2	11.5	24.9	7.4
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	2.8	0.3	6.4	0.4	11.9	1.0
Delay (s)	22.8	0.3	21.6	11.9	36.8	8.3
Level of Service	C	A	C	B	D	A
Approach Delay (s)	14.3		18.5			13.5
Approach LOS	B		B			B

Intersection Summary			
HCM Average Control Delay	15.7	HCM Level of Service	B
HCM Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	58.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	68.5%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	297	489	17	589	200	74
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	323	532	18	640	217	80
Pedestrians					2	
Lane Width (ft)					12.0	
Walking Speed (ft/s)					4.0	
Percent Blockage					0	
Right turn flare (veh)						6
Median type					None	
Median storage veh)						
Upstream signal (ft)	475					
pX, platoon unblocked						
vC, conflicting volume			856		682	325
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			856		682	325
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			98		42	88
cM capacity (veh/h)			778		374	670

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	323	532	232	427	298
Volume Left	0	0	18	0	217
Volume Right	0	532	0	0	80
cSH	1700	1700	778	1700	512
Volume to Capacity	0.19	0.31	0.02	0.25	0.58
Queue Length (ft)	0	0	2	0	92
Control Delay (s)	0.0	0.0	1.0	0.0	22.8
Lane LOS			A		C
Approach Delay (s)	0.0		0.4		22.8
Approach LOS					C

Intersection Summary			
Average Delay	3.9		
Intersection Capacity Utilization	53.9%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	0.97	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (prot)	1863	1583	1770	1863	3433	1583
Flt Permitted	1.00	1.00	0.61	1.00	0.95	1.00
Satd. Flow (perm)	1863	1583	1139	1863	3433	1583
Volume (vph)	218	105	133	167	415	347
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	237	114	145	182	451	377
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	237	114	145	182	451	377
Turn Type		Free	Perm			Free
Protected Phases	4			8	2	
Permitted Phases		Free	8			Free
Actuated Green, G (s)	7.1	22.2	7.1	7.1	7.1	22.2
Effective Green, g (s)	7.1	22.2	7.1	7.1	7.1	22.2
Actuated g/C Ratio	0.32	1.00	0.32	0.32	0.32	1.00
Clearance Time (s)	4.0		4.0	4.0	4.0	
Vehicle Extension (s)	3.0		3.0	3.0	3.0	
Lane Grp Cap (vph)	596	1583	364	596	1098	1583
v/s Ratio Prot	0.13			0.10	c0.13	
v/s Ratio Perm		0.07	c0.13			0.24
v/c Ratio	0.40	0.07	0.40	0.31	0.41	0.24
Uniform Delay, d1	5.9	0.0	5.9	5.7	5.9	0.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.4	0.1	0.7	0.3	0.3	0.4
Delay (s)	6.3	0.1	6.6	6.0	6.2	0.4
Level of Service	A	A	A	A	A	A
Approach Delay (s)	4.3			6.3	3.5	
Approach LOS	A			A	A	

Intersection Summary			
HCM Average Control Delay	4.3	HCM Level of Service	A
HCM Volume to Capacity ratio	0.40		
Actuated Cycle Length (s)	22.2	Sum of lost time (s)	8.0
Intersection Capacity Utilization	40.7%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1863	1583	1770	1863	1583	1770	1863	1583	1770	1863	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.50	1.00	1.00	0.32	1.00	1.00
Satd. Flow (perm)	1770	1863	1583	1770	1863	1583	933	1863	1583	602	1863	1583
Volume (vph)	64	532	127	272	252	17	34	294	419	29	207	17
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	70	578	138	296	274	18	37	320	455	32	225	18
RTOR Reduction (vph)	0	0	87	0	0	9	0	0	305	0	0	14
Lane Group Flow (vph)	70	578	51	296	274	9	37	320	150	32	225	4
Turn Type	Prot		Perm	Prot		Perm	Perm		Perm	Perm		Perm
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4			8	2		2	6		6
Actuated Green, G (s)	3.3	22.9	22.9	12.2	31.8	31.8	14.4	14.4	14.4	14.4	14.4	14.4
Effective Green, g (s)	3.3	22.9	22.9	12.2	31.8	31.8	14.4	14.4	14.4	14.4	14.4	14.4
Actuated g/C Ratio	0.05	0.37	0.37	0.20	0.52	0.52	0.23	0.23	0.23	0.23	0.23	0.23
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	95	694	589	351	963	819	218	436	371	141	436	371
v/s Ratio Prot	0.04	c0.31		c0.17	0.15			0.17			0.12	
v/s Ratio Perm			0.09			0.01	0.04		0.29	0.05		0.01
v/c Ratio	0.74	0.83	0.09	0.84	0.28	0.01	0.17	0.73	0.40	0.23	0.52	0.01
Uniform Delay, d1	28.7	17.6	12.5	23.7	8.4	7.2	18.8	21.8	19.9	19.0	20.5	18.1
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	25.4	8.5	0.1	16.6	0.2	0.0	0.4	6.3	0.7	0.8	1.0	0.0
Delay (s)	54.1	26.0	12.6	40.3	8.6	7.2	19.2	28.1	20.6	19.9	21.5	18.1
Level of Service	D	C	B	D	A	A	B	C	C	B	C	B
Approach Delay (s)		26.2			24.5			23.5			21.1	
Approach LOS		C			C			C			C	

Intersection Summary			
HCM Average Control Delay	24.3	HCM Level of Service	C
HCM Volume to Capacity ratio	0.95		
Actuated Cycle Length (s)	61.5	Sum of lost time (s)	12.0
Intersection Capacity Utilization	75.2%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1770	1583	1770	1863	1863	1583
Flt Permitted	0.95	1.00	0.14	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	259	1863	1863	1583
Volume (vph)	519	246	104	739	578	305
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	564	267	113	803	628	332
RTOR Reduction (vph)	0	163	0	0	0	137
Lane Group Flow (vph)	564	104	113	803	628	195
Turn Type		Perm	pm+pt			Perm
Protected Phases	4		5	2	6	
Permitted Phases		4	2			6
Actuated Green, G (s)	22.8	22.8	31.7	31.7	24.8	24.8
Effective Green, g (s)	22.8	22.8	31.7	31.7	24.8	24.8
Actuated g/C Ratio	0.36	0.36	0.51	0.51	0.40	0.40
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	646	577	201	945	739	628
v/s Ratio Prot	c0.32		0.03	c0.43	0.34	
v/s Ratio Perm		0.17	0.26			0.21
v/c Ratio	0.87	0.18	0.56	0.85	0.85	0.31
Uniform Delay, d1	18.5	13.5	11.9	13.3	17.2	13.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	12.5	0.2	3.6	7.2	9.0	0.3
Delay (s)	31.0	13.6	15.4	20.6	26.2	13.3
Level of Service	C	B	B	C	C	B
Approach Delay (s)	25.4			19.9	21.7	
Approach LOS	C			B	C	

Intersection Summary			
HCM Average Control Delay	22.2	HCM Level of Service	C
HCM Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	62.5	Sum of lost time (s)	8.0
Intersection Capacity Utilization	74.9%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor		1.00	1.00		1.00	1.00	1.00	0.95	1.00	1.00	0.95	
Frpb, ped/bikes		1.00	1.00		1.00	1.00	1.00	1.00	0.98	1.00	1.00	
Flpb, ped/bikes		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt		1.00	0.85		1.00	0.85	1.00	1.00	0.85	1.00	1.00	
Flt Protected		0.96	1.00		0.95	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1795	1583		1778	1583	1770	3539	1549	1770	3525	
Flt Permitted		0.35	1.00		0.67	1.00	0.06	1.00	1.00	0.06	1.00	
Satd. Flow (perm)		660	1583		1250	1583	109	3539	1549	106	3525	
Volume (vph)	59	19	71	412	20	123	60	1542	264	98	1898	44
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	64	21	77	448	22	134	65	1676	287	107	2063	48
RTOR Reduction (vph)	0	0	43	0	0	40	0	0	136	0	1	0
Lane Group Flow (vph)	0	85	34	0	470	94	65	1676	151	107	2110	0
Confl. Peds. (#/hr)							2		2	2		2
Turn Type	Perm		Perm	Perm		Perm	pm+pt		Perm	pm+pt		
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		
Actuated Green, G (s)		44.0	44.0		44.0	44.0	71.4	68.2	68.2	75.0	70.0	
Effective Green, g (s)		44.0	44.0		44.0	44.0	71.4	68.2	68.2	75.0	70.0	
Actuated g/C Ratio		0.34	0.34		0.34	0.34	0.55	0.53	0.53	0.58	0.54	
Clearance Time (s)		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		225	539		426	539	101	1868	818	126	1910	
v/s Ratio Prot							0.02	0.47		c0.03	c0.60	
v/s Ratio Perm		0.13	0.05		c0.38	0.08	0.34		0.19	0.46		
v/c Ratio		0.38	0.06		1.10	0.18	0.64	0.90	0.19	0.85	1.10	
Uniform Delay, d1		32.2	28.7		42.6	29.9	63.8	27.4	16.0	27.6	29.6	
Progression Factor		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2		1.1	0.0		74.6	0.2	13.2	6.1	0.1	38.3	55.5	
Delay (s)		33.3	28.8		117.2	30.0	77.0	33.5	16.1	65.8	85.1	
Level of Service		C	C		F	C	E	C	B	E	F	
Approach Delay (s)		31.1			97.9			32.4			84.1	
Approach LOS		C			F			C			F	

Intersection Summary			
HCM Average Control Delay	63.2	HCM Level of Service	E
HCM Volume to Capacity ratio	1.11		
Actuated Cycle Length (s)	129.2	Sum of lost time (s)	12.0
Intersection Capacity Utilization	97.7%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Appendix O – Intersection Operations Analysis Worksheets for 2045 Without Project Conditions, with Mitigation Measures

HCM Signalized Intersection Capacity Analysis
1: Kaiminani Drive & Queen Kaahumanu Highway

2045 AM Without Project+Mit
7/25/2012

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	3539	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.14	1.00
Satd. Flow (perm)	1770	1583	3539	1583	264	3539
Volume (vph)	480	310	1104	109	188	875
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	522	337	1200	118	204	951
RTOR Reduction (vph)	0	128	0	72	0	0
Lane Group Flow (vph)	522	209	1200	46	204	951
Turn Type		Perm		Perm	pm+pt	
Protected Phases	8		2		1	6
Permitted Phases		8		2	6	
Actuated Green, G (s)	20.4	20.4	24.2	24.2	33.3	33.3
Effective Green, g (s)	20.4	20.4	24.2	24.2	33.3	33.3
Actuated g/C Ratio	0.33	0.33	0.39	0.39	0.54	0.54
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	585	523	1388	621	267	1910
v/s Ratio Prot	c0.29		c0.34		c0.06	0.27
v/s Ratio Perm		0.21		0.07	0.35	
v/c Ratio	0.89	0.40	0.86	0.07	0.76	0.50
Uniform Delay, d1	19.6	15.9	17.2	11.7	11.6	8.9
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	15.8	0.5	5.9	0.1	12.2	0.2
Delay (s)	35.4	16.4	23.1	11.8	23.9	9.1
Level of Service	D	B	C	B	C	A
Approach Delay (s)	28.0		22.1			11.7
Approach LOS	C		C			B

Intersection Summary			
HCM Average Control Delay	20.0	HCM Level of Service	C
HCM Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	61.7	Sum of lost time (s)	12.0
Intersection Capacity Utilization	77.5%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Synchro 6 Report
Page 1

Katz, Okitsu & Associates


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AM (2045nP)                Thu Jul 26, 2012 10:22:39                Page 3-1
-------------------------------------------------------------------------------
                          JB23054 - Kaloko Makai
                                Kona, Hawaii
                      2045 Without Project Conditions
-------------------------------------------------------------------------------
                     Level Of Service Computation Report
          2000 HCM Unsignalized Method (Future Volume Alternative)
*******************************************************************************
Intersection #2 Queen Kaahumanu Hwy. @ Hulikoa Dr.
*******************************************************************************
Average Delay (sec/veh):      0.0       Worst Case Level Of Service: A[  7.2]
*******************************************************************************
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Uncontrolled     Uncontrolled     Yield Sign       Yield Sign
Rights:           Include          Include          Include          Ignore
Lanes:        0  0  2  0  1    0  1  1  0  0    0  0  0  0  0    0  0  1! 0  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:        0  590   218     0  835     0     0    0     0     0    0   182
Growth Adj:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Initial Bse:     0  590   218     0  835     0     0    0     0     0    0   182
Added Vol:       0  526    61    20  480     0     0    0     0    42    0    23
PasserByVol:     0    0    20   -20   62     0     0    0     0   -42    0    42
Initial Fut:     0 1116   299     0 1377     0     0    0     0     0    0   247
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
PHF Volume:      0 1116   299     0 1377     0     0    0     0     0    0     0
Reduct Vol:      0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:     0 1116   299     0 1377     0     0    0     0     0    0     0
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx   6.8  6.5   6.9
FollowUpTim:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx   3.5  4.0   3.3
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  1805 2493   558
Potent Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx    72   30   478
Move Cap.:   xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx    72   30   478
Volume/Cap:  xxxx xxxx  xxxx  xxxx xxxx  xxxx  xxxx xxxx  xxxx  0.00 0.00  0.00
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:   xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Control Del:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
LOS by Move:     *    *     *     *    *     *     *    *     *     *    *     *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx    0 xxxxx
SharedQueue:xxxxx xxxx xxxxx   0.0 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Shrd ConDel:xxxxx xxxx xxxxx   7.2 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Shared LOS:      *    *     *     A    *     *     *    *     *     *    *     *
ApproachDel:    xxxxxx            xxxxxx            xxxxxx            xxxxxx
ApproachLOS:         *                 *                 *                 *
*******************************************************************************
Note: Queue reported is the number of cars per lane.
*******************************************************************************

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Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	1.00	0.95	1.00	0.97	0.95
Frpb, ped/bikes	1.00	0.98	1.00	0.98	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1558	3539	1552	3433	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1558	3539	1552	3433	3539
Volume (vph)	275	231	1025	433	308	1150
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	299	251	1114	471	335	1250
RTOR Reduction (vph)	0	0	0	274	0	0
Lane Group Flow (vph)	299	251	1114	197	335	1250
Confl. Peds. (#/hr)		14		8	8	
Turn Type		Free		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		Free		2		
Actuated Green, G (s)	10.2	51.8	21.7	21.7	7.9	33.6
Effective Green, g (s)	10.2	51.8	21.7	21.7	7.9	33.6
Actuated g/C Ratio	0.20	1.00	0.42	0.42	0.15	0.65
Clearance Time (s)	4.0		4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0		3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	676	1558	1483	650	524	2296
v/s Ratio Prot	c0.09		c0.31		0.10	c0.35
v/s Ratio Perm		0.16		0.30		
v/c Ratio	0.44	0.16	0.75	0.30	0.64	0.54
Uniform Delay, d1	18.3	0.0	12.8	10.0	20.6	4.9
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.5	0.2	2.2	0.3	2.6	0.3
Delay (s)	18.8	0.2	15.0	10.3	23.2	5.2
Level of Service	B	A	B	B	C	A
Approach Delay (s)	10.3		13.6			9.0
Approach LOS	B		B			A

Intersection Summary			
HCM Average Control Delay	11.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.65		
Actuated Cycle Length (s)	51.8	Sum of lost time (s)	12.0
Intersection Capacity Utilization	57.0%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	249	363	29	301	225	18
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	271	395	32	327	245	20
Pedestrians					2	
Lane Width (ft)					12.0	
Walking Speed (ft/s)					4.0	
Percent Blockage					0	
Right turn flare (veh)						6
Median type					None	
Median storage veh)						
Upstream signal (ft)	475					
pX, platoon unblocked						
vC, conflicting volume			667		499	273
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			667		499	273
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			97		49	97
cM capacity (veh/h)			917		483	724

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	271	395	141	218	264
Volume Left	0	0	32	0	245
Volume Right	0	395	0	0	20
cSH	1700	1700	917	1700	521
Volume to Capacity	0.16	0.23	0.03	0.13	0.51
Queue Length (ft)	0	0	3	0	71
Control Delay (s)	0.0	0.0	2.3	0.0	19.2
Lane LOS			A		C
Approach Delay (s)	0.0		0.9		19.2
Approach LOS					C

Intersection Summary			
Average Delay	4.2		
Intersection Capacity Utilization	44.7%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	0.97	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (prot)	1863	1583	1770	1863	3433	1583
Flt Permitted	1.00	1.00	0.67	1.00	0.95	1.00
Satd. Flow (perm)	1863	1583	1253	1863	3433	1583
Volume (vph)	121	133	224	218	121	81
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	132	145	243	237	132	88
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	132	145	243	237	132	88
Turn Type		Free	Perm			Free
Protected Phases	4			8	2	
Permitted Phases		Free	8			Free
Actuated Green, G (s)	6.9	17.9	6.9	6.9	3.0	17.9
Effective Green, g (s)	6.9	17.9	6.9	6.9	3.0	17.9
Actuated g/C Ratio	0.39	1.00	0.39	0.39	0.17	1.00
Clearance Time (s)	4.0		4.0	4.0	4.0	
Vehicle Extension (s)	3.0		3.0	3.0	3.0	
Lane Grp Cap (vph)	718	1583	483	718	575	1583
v/s Ratio Prot	0.07			0.13	c0.04	
v/s Ratio Perm		0.09	c0.19			0.06
v/c Ratio	0.18	0.09	0.50	0.33	0.23	0.06
Uniform Delay, d1	3.6	0.0	4.2	3.9	6.4	0.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.1	0.1	0.8	0.3	0.2	0.1
Delay (s)	3.8	0.1	5.0	4.1	6.7	0.1
Level of Service	A	A	A	A	A	A
Approach Delay (s)	1.9			4.6	4.0	
Approach LOS	A			A	A	

Intersection Summary			
HCM Average Control Delay	3.7	HCM Level of Service	A
HCM Volume to Capacity ratio	0.42		
Actuated Cycle Length (s)	17.9	Sum of lost time (s)	8.0
Intersection Capacity Utilization	32.2%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1863	1583	1770	1863	1583	1770	1863	1583	1770	1863	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.28	1.00	1.00	0.65	1.00	1.00
Satd. Flow (perm)	1770	1863	1583	1770	1863	1583	520	1863	1583	1204	1863	1583
Volume (vph)	13	155	26	464	411	25	129	144	156	9	388	65
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	14	168	28	504	447	27	140	157	170	10	422	71
RTOR Reduction (vph)	0	0	23	0	0	14	0	0	115	0	0	48
Lane Group Flow (vph)	14	168	5	504	447	13	140	157	55	10	422	23
Turn Type	Prot		Perm	Prot		Perm	Perm		Perm	Perm		Perm
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4			8	2		2	6		6
Actuated Green, G (s)	0.7	11.2	11.2	22.5	33.0	33.0	21.8	21.8	21.8	21.8	21.8	21.8
Effective Green, g (s)	0.7	11.2	11.2	22.5	33.0	33.0	21.8	21.8	21.8	21.8	21.8	21.8
Actuated g/C Ratio	0.01	0.17	0.17	0.33	0.49	0.49	0.32	0.32	0.32	0.32	0.32	0.32
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	18	309	263	590	911	774	168	602	511	389	602	511
v/s Ratio Prot	0.01	0.09		c0.28	c0.24			0.08			0.23	
v/s Ratio Perm			0.02			0.02	c0.27		0.11	0.01		0.04
v/c Ratio	0.78	0.54	0.02	0.85	0.49	0.02	0.83	0.26	0.11	0.03	0.70	0.04
Uniform Delay, d1	33.3	25.8	23.5	21.0	11.6	8.9	21.2	16.9	16.0	15.6	20.0	15.7
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	107.6	2.0	0.0	11.6	0.4	0.0	28.3	0.2	0.1	0.0	3.7	0.0
Delay (s)	140.9	27.8	23.6	32.5	12.0	8.9	49.5	17.1	16.1	15.6	23.7	15.7
Level of Service	F	C	C	C	B	A	D	B	B	B	C	B
Approach Delay (s)		34.7			22.5			26.5			22.4	
Approach LOS		C			C			C			C	

Intersection Summary			
HCM Average Control Delay	24.5	HCM Level of Service	C
HCM Volume to Capacity ratio	0.74		
Actuated Cycle Length (s)	67.5	Sum of lost time (s)	8.0
Intersection Capacity Utilization	74.8%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1770	1583	1770	1863	1863	1583
Flt Permitted	0.95	1.00	0.04	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	70	1863	1863	1583
Volume (vph)	202	103	150	342	1269	545
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	220	112	163	372	1379	592
RTOR Reduction (vph)	0	98	0	0	0	55
Lane Group Flow (vph)	220	14	163	372	1379	537
Turn Type		Perm	pm+pt			Perm
Protected Phases	4		5	2	6	
Permitted Phases		4	2			6
Actuated Green, G (s)	17.0	17.0	115.0	115.0	102.0	102.0
Effective Green, g (s)	17.0	17.0	115.0	115.0	102.0	102.0
Actuated g/C Ratio	0.12	0.12	0.82	0.82	0.73	0.73
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	215	192	167	1530	1357	1153
v/s Ratio Prot	c0.12		c0.06	0.20	c0.74	
v/s Ratio Perm		0.07	0.74			0.37
v/c Ratio	1.02	0.07	0.98	0.24	1.02	0.47
Uniform Delay, d1	61.5	54.5	67.5	2.8	19.0	7.8
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	67.5	0.2	62.0	0.1	28.5	0.3
Delay (s)	129.0	54.7	129.5	2.9	47.5	8.1
Level of Service	F	D	F	A	D	A
Approach Delay (s)	103.9			41.4	35.7	
Approach LOS	F			D	D	

Intersection Summary			
HCM Average Control Delay	44.8	HCM Level of Service	D
HCM Volume to Capacity ratio	1.01		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	96.3%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	1.00		0.97	1.00		1.00	0.95	1.00	1.00	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	0.98	1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.89		1.00	0.87		1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	1649		3433	1614		1770	3539	1548	1770	3513	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1770	1649		3433	1614		1770	3539	1548	1770	3513	
Volume (vph)	17	7	24	270	18	152	68	1364	441	199	1078	48
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	18	8	26	293	20	165	74	1483	479	216	1172	52
RTOR Reduction (vph)	0	24	0	0	140	0	0	0	248	0	3	0
Lane Group Flow (vph)	18	10	0	293	45	0	74	1483	231	216	1221	0
Confl. Peds. (#/hr)							2		2	2		2
Turn Type	Prot			Prot			Prot		Perm	Prot		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases									2			
Actuated Green, G (s)	1.5	5.7		8.1	12.3		6.5	38.9	38.9	11.9	44.3	
Effective Green, g (s)	1.5	5.7		8.1	12.3		6.5	38.9	38.9	11.9	44.3	
Actuated g/C Ratio	0.02	0.07		0.10	0.15		0.08	0.48	0.48	0.15	0.55	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	33	117		345	246		143	1708	747	261	1931	
v/s Ratio Prot	0.01	0.02		c0.09	c0.11		0.04	c0.42		c0.12	0.35	
v/s Ratio Perm									0.31			
v/c Ratio	0.55	0.08		0.85	0.18		0.52	0.87	0.31	0.83	0.63	
Uniform Delay, d1	39.2	35.0		35.6	29.8		35.5	18.6	12.7	33.4	12.5	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	17.2	0.3		17.4	0.4		3.1	5.0	0.2	18.9	0.7	
Delay (s)	56.4	35.3		53.1	30.1		38.7	23.5	12.9	52.3	13.2	
Level of Service	E	D		D	C		D	C	B	D	B	
Approach Delay (s)		42.6			44.2			21.6			19.1	
Approach LOS		D			D			C			B	

Intersection Summary			
HCM Average Control Delay	23.7	HCM Level of Service	C
HCM Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	80.6	Sum of lost time (s)	12.0
Intersection Capacity Utilization	73.1%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	3539	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.12	1.00
Satd. Flow (perm)	1770	1583	3539	1583	227	3539
Volume (vph)	180	303	1183	387	363	1312
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	196	329	1286	421	395	1426
RTOR Reduction (vph)	0	269	0	239	0	0
Lane Group Flow (vph)	196	60	1286	182	395	1426
Turn Type		Perm		Perm	pm+pt	
Protected Phases	8		2		1	6
Permitted Phases		8		2	6	
Actuated Green, G (s)	12.1	12.1	28.8	28.8	46.7	46.7
Effective Green, g (s)	12.1	12.1	28.8	28.8	46.7	46.7
Actuated g/C Ratio	0.18	0.18	0.43	0.43	0.70	0.70
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	321	287	1526	682	480	2474
v/s Ratio Prot	0.11		0.36		c0.17	0.40
v/s Ratio Perm		0.21		0.27	c0.40	
v/c Ratio	0.61	0.21	0.84	0.27	0.82	0.58
Uniform Delay, d1	25.2	23.3	17.0	12.2	16.4	5.1
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	3.4	0.4	4.4	0.2	10.9	0.3
Delay (s)	28.6	23.6	21.4	12.4	27.3	5.4
Level of Service	C	C	C	B	C	A
Approach Delay (s)	25.5		19.2			10.1
Approach LOS	C		B			B

Intersection Summary			
HCM Average Control Delay	15.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	66.8	Sum of lost time (s)	8.0
Intersection Capacity Utilization	72.8%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			


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PM (2045nP)                Thu Jul 26, 2012 10:23:50                Page 3-1
-------------------------------------------------------------------------------
                          JB23054 - Kaloko Makai
                                Kona, Hawaii
                      2045 Without Project Conditions
-------------------------------------------------------------------------------
                     Level Of Service Computation Report
          2000 HCM Unsignalized Method (Future Volume Alternative)
*******************************************************************************
Intersection #2 Queen Kaahumanu Hwy. @ Hulikoa Dr.
*******************************************************************************
Average Delay (sec/veh):      0.0       Worst Case Level Of Service: A[  7.2]
*******************************************************************************
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Uncontrolled     Uncontrolled     Yield Sign       Yield Sign
Rights:           Include          Include          Include          Ignore
Lanes:        0  0  2  0  1    0  1  1  0  0    0  0  0  0  0    0  0  1! 0  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:        0  719   122     0 1068     0     0    0     0     0    0   205
Growth Adj:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Initial Bse:     0  719   122     0 1068     0     0    0     0     0    0   205
Added Vol:       0  668    39    13  676     0     0    0     0    45    0    24
PasserByVol:     0    0    13   -13   58     0     0    0     0   -45    0    45
Initial Fut:     0 1387   174     0 1802     0     0    0     0     0    0   274
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
PHF Volume:      0 1387   174     0 1802     0     0    0     0     0    0     0
Reduct Vol:      0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:     0 1387   174     0 1802     0     0    0     0     0    0     0
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx   6.8  6.5   6.9
FollowUpTim:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx   3.5  4.0   3.3
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  2288 3189   694
Potent Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx    34   10   390
Move Cap.:   xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx    34   10   390
Volume/Cap:  xxxx xxxx  xxxx  xxxx xxxx  xxxx  xxxx xxxx  xxxx  0.00 0.00  0.00
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:   xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Control Del:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
LOS by Move:     *    *     *     *    *     *     *    *     *     *    *     *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx    0 xxxxx
SharedQueue:xxxxx xxxx xxxxx   0.0 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Shrd ConDel:xxxxx xxxx xxxxx   7.2 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Shared LOS:      *    *     *     A    *     *     *    *     *     *    *     *
ApproachDel:    xxxxxx           xxxxxx           xxxxxx           xxxxxx
ApproachLOS:         *                *                *                *
*******************************************************************************
Note: Queue reported is the number of cars per lane.
*******************************************************************************

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Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	1.00	0.95	1.00	0.97	0.95
Frpb, ped/bikes	1.00	0.98	1.00	0.98	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1558	3539	1551	3433	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1558	3539	1551	3433	3539
Volume (vph)	544	333	1233	594	312	1397
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	591	362	1340	646	339	1518
RTOR Reduction (vph)	0	0	0	369	0	0
Lane Group Flow (vph)	591	362	1340	277	339	1518
Confl. Peds. (#/hr)		14		8	8	
Turn Type		Free		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		Free		2		
Actuated Green, G (s)	14.1	58.0	24.9	24.9	7.0	35.9
Effective Green, g (s)	14.1	58.0	24.9	24.9	7.0	35.9
Actuated g/C Ratio	0.24	1.00	0.43	0.43	0.12	0.62
Clearance Time (s)	4.0		4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0		3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	835	1558	1519	666	414	2191
v/s Ratio Prot	c0.17		0.38		0.10	c0.43
v/s Ratio Perm		0.23		0.42		
v/c Ratio	0.71	0.23	0.88	0.42	0.82	0.69
Uniform Delay, d1	20.1	0.0	15.2	11.5	24.9	7.4
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	2.8	0.3	6.4	0.4	11.9	1.0
Delay (s)	22.8	0.3	21.6	11.9	36.8	8.3
Level of Service	C	A	C	B	D	A
Approach Delay (s)	14.3		18.5			13.5
Approach LOS	B		B			B

Intersection Summary			
HCM Average Control Delay	15.7	HCM Level of Service	B
HCM Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	58.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	68.5%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	297	489	17	589	200	74
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	323	532	18	640	217	80
Pedestrians					2	
Lane Width (ft)					12.0	
Walking Speed (ft/s)					4.0	
Percent Blockage					0	
Right turn flare (veh)						6
Median type					None	
Median storage veh)						
Upstream signal (ft)	475					
pX, platoon unblocked						
vC, conflicting volume			856		682	325
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			856		682	325
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			98		42	88
cM capacity (veh/h)			778		374	670

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	323	532	232	427	298
Volume Left	0	0	18	0	217
Volume Right	0	532	0	0	80
cSH	1700	1700	778	1700	512
Volume to Capacity	0.19	0.31	0.02	0.25	0.58
Queue Length (ft)	0	0	2	0	92
Control Delay (s)	0.0	0.0	1.0	0.0	22.8
Lane LOS			A		C
Approach Delay (s)	0.0		0.4		22.8
Approach LOS					C

Intersection Summary			
Average Delay	3.9		
Intersection Capacity Utilization	53.9%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	0.97	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (prot)	1863	1583	1770	1863	3433	1583
Flt Permitted	1.00	1.00	0.61	1.00	0.95	1.00
Satd. Flow (perm)	1863	1583	1139	1863	3433	1583
Volume (vph)	218	105	133	167	415	347
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	237	114	145	182	451	377
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	237	114	145	182	451	377
Turn Type		Free	Perm			Free
Protected Phases	4			8	2	
Permitted Phases		Free	8			Free
Actuated Green, G (s)	7.1	22.2	7.1	7.1	7.1	22.2
Effective Green, g (s)	7.1	22.2	7.1	7.1	7.1	22.2
Actuated g/C Ratio	0.32	1.00	0.32	0.32	0.32	1.00
Clearance Time (s)	4.0		4.0	4.0	4.0	
Vehicle Extension (s)	3.0		3.0	3.0	3.0	
Lane Grp Cap (vph)	596	1583	364	596	1098	1583
v/s Ratio Prot	0.13			0.10	c0.13	
v/s Ratio Perm		0.07	c0.13			0.24
v/c Ratio	0.40	0.07	0.40	0.31	0.41	0.24
Uniform Delay, d1	5.9	0.0	5.9	5.7	5.9	0.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.4	0.1	0.7	0.3	0.3	0.4
Delay (s)	6.3	0.1	6.6	6.0	6.2	0.4
Level of Service	A	A	A	A	A	A
Approach Delay (s)	4.3			6.3	3.5	
Approach LOS	A			A	A	

Intersection Summary			
HCM Average Control Delay	4.3	HCM Level of Service	A
HCM Volume to Capacity ratio	0.40		
Actuated Cycle Length (s)	22.2	Sum of lost time (s)	8.0
Intersection Capacity Utilization	40.7%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1863	1583	1770	1863	1583	1770	1863	1583	1770	1863	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.50	1.00	1.00	0.32	1.00	1.00
Satd. Flow (perm)	1770	1863	1583	1770	1863	1583	933	1863	1583	602	1863	1583
Volume (vph)	64	532	127	272	252	17	34	294	419	29	207	17
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	70	578	138	296	274	18	37	320	455	32	225	18
RTOR Reduction (vph)	0	0	87	0	0	9	0	0	305	0	0	14
Lane Group Flow (vph)	70	578	51	296	274	9	37	320	150	32	225	4
Turn Type	Prot		Perm	Prot		Perm	Perm		Perm	Perm		Perm
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4			8	2		2	6		6
Actuated Green, G (s)	3.3	22.9	22.9	12.2	31.8	31.8	14.4	14.4	14.4	14.4	14.4	14.4
Effective Green, g (s)	3.3	22.9	22.9	12.2	31.8	31.8	14.4	14.4	14.4	14.4	14.4	14.4
Actuated g/C Ratio	0.05	0.37	0.37	0.20	0.52	0.52	0.23	0.23	0.23	0.23	0.23	0.23
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	95	694	589	351	963	819	218	436	371	141	436	371
v/s Ratio Prot	0.04	c0.31		c0.17	0.15			0.17			0.12	
v/s Ratio Perm			0.09			0.01	0.04		0.29	0.05		0.01
v/c Ratio	0.74	0.83	0.09	0.84	0.28	0.01	0.17	0.73	0.40	0.23	0.52	0.01
Uniform Delay, d1	28.7	17.6	12.5	23.7	8.4	7.2	18.8	21.8	19.9	19.0	20.5	18.1
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	25.4	8.5	0.1	16.6	0.2	0.0	0.4	6.3	0.7	0.8	1.0	0.0
Delay (s)	54.1	26.0	12.6	40.3	8.6	7.2	19.2	28.1	20.6	19.9	21.5	18.1
Level of Service	D	C	B	D	A	A	B	C	C	B	C	B
Approach Delay (s)		26.2			24.5			23.5			21.1	
Approach LOS		C			C			C			C	

Intersection Summary			
HCM Average Control Delay	24.3	HCM Level of Service	C
HCM Volume to Capacity ratio	0.95		
Actuated Cycle Length (s)	61.5	Sum of lost time (s)	12.0
Intersection Capacity Utilization	75.2%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1770	1583	1770	1863	1863	1583
Flt Permitted	0.95	1.00	0.14	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	259	1863	1863	1583
Volume (vph)	519	246	104	739	578	305
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	564	267	113	803	628	332
RTOR Reduction (vph)	0	163	0	0	0	137
Lane Group Flow (vph)	564	104	113	803	628	195
Turn Type		Perm	pm+pt			Perm
Protected Phases	4		5	2	6	
Permitted Phases		4	2			6
Actuated Green, G (s)	22.8	22.8	31.7	31.7	24.8	24.8
Effective Green, g (s)	22.8	22.8	31.7	31.7	24.8	24.8
Actuated g/C Ratio	0.36	0.36	0.51	0.51	0.40	0.40
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	646	577	201	945	739	628
v/s Ratio Prot	c0.32		0.03	c0.43	0.34	
v/s Ratio Perm		0.17	0.26			0.21
v/c Ratio	0.87	0.18	0.56	0.85	0.85	0.31
Uniform Delay, d1	18.5	13.5	11.9	13.3	17.2	13.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	12.5	0.2	3.6	7.2	9.0	0.3
Delay (s)	31.0	13.6	15.4	20.6	26.2	13.3
Level of Service	C	B	B	C	C	B
Approach Delay (s)	25.4			19.9	21.7	
Approach LOS	C			B	C	

Intersection Summary			
HCM Average Control Delay	22.2	HCM Level of Service	C
HCM Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	62.5	Sum of lost time (s)	8.0
Intersection Capacity Utilization	74.9%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	1.00		0.97	1.00		1.00	0.95	1.00	1.00	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	0.98	1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.88		1.00	0.87		1.00	1.00	0.85	1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	1643		3433	1623		1770	3539	1549	1770	3525	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1770	1643		3433	1623		1770	3539	1549	1770	3525	
Volume (vph)	59	19	71	412	20	123	60	1542	264	98	1898	44
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	64	21	77	448	22	134	65	1676	287	107	2063	48
RTOR Reduction (vph)	0	59	0	0	111	0	0	0	118	0	1	0
Lane Group Flow (vph)	64	39	0	448	45	0	65	1676	169	107	2110	0
Confl. Peds. (#/hr)							2		2	2		2
Turn Type	Prot			Prot			Prot		Perm	Prot		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases									2			
Actuated Green, G (s)	7.6	9.7		18.0	20.1		5.0	77.9	77.9	10.5	83.4	
Effective Green, g (s)	7.6	9.7		18.0	20.1		5.0	77.9	77.9	10.5	83.4	
Actuated g/C Ratio	0.06	0.07		0.14	0.15		0.04	0.59	0.59	0.08	0.63	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	102	121		468	247		67	2087	913	141	2225	
v/s Ratio Prot	0.04	c0.06		c0.13	0.10		0.04	0.47		c0.06	c0.60	
v/s Ratio Perm									0.19			
v/c Ratio	0.63	0.32		0.96	0.18		0.97	0.80	0.19	0.76	0.95	
Uniform Delay, d1	60.9	58.1		56.7	48.8		63.5	21.1	12.5	59.6	22.4	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	11.5	1.5		30.6	0.4		99.2	2.3	0.1	20.6	9.5	
Delay (s)	72.3	59.6		87.3	49.2		162.6	23.5	12.6	80.2	31.9	
Level of Service	E	E		F	D		F	C	B	F	C	
Approach Delay (s)		64.6			77.4			26.4			34.2	
Approach LOS		E			E			C			C	

Intersection Summary			
HCM Average Control Delay	37.2	HCM Level of Service	D
HCM Volume to Capacity ratio	0.91		
Actuated Cycle Length (s)	132.1	Sum of lost time (s)	12.0
Intersection Capacity Utilization	87.7%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Appendix P – Intersection Operations Analysis Worksheets for 2025 With Project Phase I Conditions, with Existing Geometry and Planned Improvements

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	3539	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.15	1.00
Satd. Flow (perm)	1770	1583	3539	1583	287	3539
Volume (vph)	480	244	1124	109	33	1120
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	522	265	1222	118	36	1217
RTOR Reduction (vph)	0	112	0	70	0	0
Lane Group Flow (vph)	522	153	1222	48	36	1217
Turn Type		Perm		Perm	pm+pt	
Protected Phases	8		2		1	6
Permitted Phases		8		2	6	
Actuated Green, G (s)	18.3	18.3	22.0	22.0	27.4	27.4
Effective Green, g (s)	18.3	18.3	22.0	22.0	27.4	27.4
Actuated g/C Ratio	0.34	0.34	0.41	0.41	0.51	0.51
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	603	539	1450	649	185	1806
v/s Ratio Prot	c0.29		c0.35		0.01	c0.34
v/s Ratio Perm		0.17		0.07	0.09	
v/c Ratio	0.87	0.28	0.84	0.07	0.19	0.67
Uniform Delay, d1	16.6	12.9	14.3	9.7	9.6	9.8
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	12.4	0.3	4.6	0.0	0.5	1.0
Delay (s)	28.9	13.2	18.9	9.7	10.1	10.8
Level of Service	C	B	B	A	B	B
Approach Delay (s)	23.6		18.1			10.8
Approach LOS	C		B			B

Intersection Summary			
HCM Average Control Delay	16.7	HCM Level of Service	B
HCM Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	53.7	Sum of lost time (s)	12.0
Intersection Capacity Utilization	64.3%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Yield		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	0	345	1037	323	0	1623
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	375	1127	351	0	1764
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	TWLTL					
Median storage veh)	5					
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	2009	564			1127	
vC1, stage 1 conf vol	1127					
vC2, stage 2 conf vol	882					
vCu, unblocked vol	2009	564			1127	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)	5.8					
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	20			100	
cM capacity (veh/h)	258	469			615	

Direction, Lane #	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	375	564	564	351	882	882
Volume Left	0	0	0	0	0	0
Volume Right	375	0	0	351	0	0
cSH	469	1700	1700	1700	1700	1700
Volume to Capacity	0.80	0.33	0.33	0.21	0.52	0.52
Queue Length (ft)	184	0	0	0	0	0
Control Delay (s)	36.8	0.0	0.0	0.0	0.0	0.0
Lane LOS	E					
Approach Delay (s)	36.8	0.0			0.0	
Approach LOS	E					

Intersection Summary			
Average Delay	3.8		
Intersection Capacity Utilization	56.7%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	1.00	0.95	1.00	0.97	0.95
Frpb, ped/bikes	1.00	0.98	1.00	0.98	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1558	3539	1548	3433	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1558	3539	1548	3433	3539
Volume (vph)	627	427	775	810	672	1032
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	682	464	842	880	730	1122
RTOR Reduction (vph)	0	0	0	347	0	0
Lane Group Flow (vph)	682	464	842	533	730	1122
Confl. Peds. (#/hr)		14		8	8	
Turn Type		Free		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		Free		2		
Actuated Green, G (s)	16.2	71.4	26.5	26.5	16.7	47.2
Effective Green, g (s)	16.2	71.4	26.5	26.5	16.7	47.2
Actuated g/C Ratio	0.23	1.00	0.37	0.37	0.23	0.66
Clearance Time (s)	4.0		4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0		3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	779	1558	1313	575	803	2340
v/s Ratio Prot	c0.20		0.24		c0.21	0.32
v/s Ratio Perm		0.30		0.57		
v/c Ratio	0.88	0.30	0.64	0.93	0.91	0.48
Uniform Delay, d1	26.6	0.0	18.5	21.5	26.6	6.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	10.8	0.5	1.1	21.1	14.0	0.2
Delay (s)	37.4	0.5	19.6	42.6	40.6	6.2
Level of Service	D	A	B	D	D	A
Approach Delay (s)	22.5		31.4			19.7
Approach LOS	C		C			B

Intersection Summary			
HCM Average Control Delay	24.6	HCM Level of Service	C
HCM Volume to Capacity ratio	1.18		
Actuated Cycle Length (s)	71.4	Sum of lost time (s)	12.0
Intersection Capacity Utilization	76.8%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	990	363	29	849	225	18
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	1076	395	32	923	245	20
Pedestrians					2	
Lane Width (ft)					12.0	
Walking Speed (ft/s)					4.0	
Percent Blockage					0	
Right turn flare (veh)						6
Median type					None	
Median storage veh)						
Upstream signal (ft)	475					
pX, platoon unblocked						
vC, conflicting volume			1473		1603	1078
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1473		1603	1078
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			93		0	91
cM capacity (veh/h)			453		90	214

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	1076	395	339	615	264
Volume Left	0	0	32	0	245
Volume Right	0	395	0	0	20
cSH	1700	1700	453	1700	94
Volume to Capacity	0.63	0.23	0.07	0.36	2.81
Queue Length (ft)	0	0	6	0	630
Control Delay (s)	0.0	0.0	2.3	0.0	915.0
Lane LOS			A		F
Approach Delay (s)	0.0		0.8		915.0
Approach LOS					F

Intersection Summary			
Average Delay	90.2		
Intersection Capacity Utilization	71.2%	ICU Level of Service	C
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0		4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00		0.97	1.00		1.00		1.00
Frt	1.00	1.00	0.85	1.00	0.98		1.00	0.85		1.00		0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95		1.00
Satd. Flow (prot)	1770	1863	1583	1770	1834		3433	1583		1770		1583
Flt Permitted	0.31	1.00	1.00	0.33	1.00		0.95	1.00		0.95		1.00
Satd. Flow (perm)	573	1863	1583	615	1834		3433	1583		1770		1583
Volume (vph)	224	573	198	202	544	62	134	0	77	61	0	209
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	243	623	215	220	591	67	146	0	84	66	0	227
RTOR Reduction (vph)	0	0	0	0	3	0	0	71	0	0	0	202
Lane Group Flow (vph)	243	623	215	220	655	0	146	13	0	66	0	25
Turn Type	Perm		Free	Perm			Prot			Prot		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		Free	8								6
Actuated Green, G (s)	46.8	46.8	74.7	46.8	46.8		7.7	11.4		4.5		8.2
Effective Green, g (s)	46.8	46.8	74.7	46.8	46.8		7.7	11.4		4.5		8.2
Actuated g/C Ratio	0.63	0.63	1.00	0.63	0.63		0.10	0.15		0.06		0.11
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0		4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0		3.0
Lane Grp Cap (vph)	359	1167	1583	385	1149		354	242		107		174
v/s Ratio Prot		0.33			0.36		0.04	0.05		c0.04		
v/s Ratio Perm	c0.42		0.14	0.36								0.14
v/c Ratio	0.68	0.53	0.14	0.57	0.57		0.41	0.05		0.62		0.14
Uniform Delay, d1	9.0	7.8	0.0	8.1	8.1		31.4	27.0		34.3		30.1
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00		1.00
Incremental Delay, d2	5.0	0.5	0.2	2.0	0.7		0.8	0.1		10.1		0.4
Delay (s)	14.0	8.3	0.2	10.2	8.8		32.2	27.1		44.4		30.5
Level of Service	B	A	A	B	A		C	C		D		C
Approach Delay (s)		8.0			9.1			30.3			33.6	
Approach LOS		A			A			C			C	

Intersection Summary			
HCM Average Control Delay	13.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.73		
Actuated Cycle Length (s)	74.7	Sum of lost time (s)	12.0
Intersection Capacity Utilization	65.3%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1863	1583	1770	1863	1583	1770	1863	1583	1770	1863	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.66	1.00	1.00	0.64	1.00	1.00
Satd. Flow (perm)	1770	1863	1583	1770	1863	1583	1237	1863	1583	1200	1863	1583
Volume (vph)	134	313	70	189	550	123	168	160	64	108	134	92
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	146	340	76	205	598	134	183	174	70	117	146	100
RTOR Reduction (vph)	0	0	45	0	0	74	0	0	56	0	0	80
Lane Group Flow (vph)	146	340	31	205	598	60	183	174	14	117	146	20
Turn Type	Prot		Perm	Prot		Perm	Perm		Perm	Perm		Perm
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4			8	2		2	6		6
Actuated Green, G (s)	4.8	19.1	19.1	6.7	21.0	21.0	9.4	9.4	9.4	9.4	9.4	9.4
Effective Green, g (s)	4.8	19.1	19.1	6.7	21.0	21.0	9.4	9.4	9.4	9.4	9.4	9.4
Actuated g/C Ratio	0.10	0.40	0.40	0.14	0.44	0.44	0.20	0.20	0.20	0.20	0.20	0.20
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	180	754	641	251	829	704	246	371	315	239	371	315
v/s Ratio Prot	0.08	0.18		c0.12	c0.32			0.09			0.08	
v/s Ratio Perm			0.05			0.08	c0.15		0.04	0.10		0.06
v/c Ratio	0.81	0.45	0.05	0.82	0.72	0.08	0.74	0.47	0.04	0.49	0.39	0.06
Uniform Delay, d1	20.8	10.2	8.5	19.7	10.7	7.6	17.8	16.7	15.3	16.8	16.4	15.3
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	23.4	0.4	0.0	18.2	3.1	0.1	11.5	0.9	0.1	1.6	0.7	0.1
Delay (s)	44.2	10.7	8.6	37.9	13.8	7.6	29.3	17.6	15.3	18.3	17.1	15.4
Level of Service	D	B	A	D	B	A	C	B	B	B	B	B
Approach Delay (s)		19.1			18.2			22.2			17.0	
Approach LOS		B			B			C			B	

Intersection Summary			
HCM Average Control Delay	19.0	HCM Level of Service	B
HCM Volume to Capacity ratio	0.70		
Actuated Cycle Length (s)	47.2	Sum of lost time (s)	8.0
Intersection Capacity Utilization	66.1%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1770	1583	1770	1863	1863	1583
Flt Permitted	0.95	1.00	0.04	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	75	1863	1863	1583
Volume (vph)	208	211	273	378	1307	382
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	226	229	297	411	1421	415
RTOR Reduction (vph)	0	190	0	0	0	37
Lane Group Flow (vph)	226	39	297	411	1421	378
Turn Type		Perm	pm+pt			Perm
Protected Phases	4		5	2	6	
Permitted Phases		4	2			6
Actuated Green, G (s)	16.0	16.0	116.0	116.0	96.0	96.0
Effective Green, g (s)	16.0	16.0	116.0	116.0	96.0	96.0
Actuated g/C Ratio	0.11	0.11	0.83	0.83	0.69	0.69
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	202	181	256	1544	1277	1085
v/s Ratio Prot	0.13		c0.13	0.22	0.76	
v/s Ratio Perm		0.14	c0.83			0.26
v/c Ratio	1.12	0.21	1.16	0.27	1.11	0.35
Uniform Delay, d1	62.0	56.3	64.2	2.6	22.0	9.1
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	98.9	0.6	106.5	0.1	62.1	0.2
Delay (s)	160.9	56.9	170.7	2.7	84.1	9.3
Level of Service	F	E	F	A	F	A
Approach Delay (s)	108.5			73.2	67.2	
Approach LOS	F			E	E	

Intersection Summary			
HCM Average Control Delay	74.9	HCM Level of Service	E
HCM Volume to Capacity ratio	1.16		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	105.4%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
8: Kealakehe Parkway & Queen Kaahumanu Highway

2025 AM With Project
7/25/2012

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor		1.00	1.00		1.00	1.00	1.00	0.95	1.00	1.00	0.95	
Frpb, ped/bikes		1.00	1.00		1.00	1.00	1.00	1.00	0.98	1.00	1.00	
Flpb, ped/bikes		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt		1.00	0.85		1.00	0.85	1.00	1.00	0.85	1.00	0.99	
Flt Protected		0.97	1.00		0.95	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1800	1583		1778	1583	1770	3539	1548	1770	3516	
Flt Permitted		0.70	1.00		0.72	1.00	0.11	1.00	1.00	0.10	1.00	
Satd. Flow (perm)		1313	1583		1337	1583	197	3539	1548	178	3516	
Volume (vph)	17	7	24	348	18	166	68	1464	530	240	1231	48
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	18	8	26	378	20	180	74	1591	576	261	1338	52
RTOR Reduction (vph)	0	0	19	0	0	82	0	0	307	0	3	0
Lane Group Flow (vph)	0	26	7	0	398	98	74	1591	269	261	1387	0
Confl. Peds. (#/hr)							2		2	2		2
Turn Type	Perm		Perm	Perm		Perm	pm+pt		Perm	pm+pt		
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		
Actuated Green, G (s)		23.0	23.0		23.0	23.0	41.0	37.8	37.8	49.8	42.6	
Effective Green, g (s)		23.0	23.0		23.0	23.0	41.0	37.8	37.8	49.8	42.6	
Actuated g/C Ratio		0.28	0.28		0.28	0.28	0.51	0.47	0.47	0.62	0.53	
Clearance Time (s)		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		374	451		381	451	162	1656	724	267	1854	
v/s Ratio Prot							0.02	0.45		c0.10	0.40	
v/s Ratio Perm		0.02	0.02		c0.30	0.11	0.21		0.37	c0.50		
v/c Ratio		0.07	0.02		1.04	0.22	0.46	0.96	0.37	0.98	0.75	
Uniform Delay, d1		21.1	20.8		28.9	22.0	12.6	20.8	13.9	23.2	14.9	
Progression Factor		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2		0.1	0.0		58.2	0.2	2.0	13.9	0.3	48.3	1.7	
Delay (s)		21.2	20.8		87.1	22.3	14.6	34.7	14.2	71.5	16.6	
Level of Service		C	C		F	C	B	C	B	E	B	
Approach Delay (s)		21.0			66.9			28.8			25.3	
Approach LOS		C			E			C			C	

Intersection Summary			
HCM Average Control Delay	32.3	HCM Level of Service	C
HCM Volume to Capacity ratio	0.98		
Actuated Cycle Length (s)	80.8	Sum of lost time (s)	8.0
Intersection Capacity Utilization	90.7%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
1: Kaiminani Drive & Queen Kaahumanu Highway

2025 PM With Project
7/25/2012

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	3539	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.10	1.00
Satd. Flow (perm)	1770	1583	3539	1583	192	3539
Volume (vph)	180	84	1473	387	226	1414
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	196	91	1601	421	246	1537
RTOR Reduction (vph)	0	77	0	197	0	0
Lane Group Flow (vph)	196	14	1601	224	246	1537
Turn Type		Perm		Perm	pm+pt	
Protected Phases	8		2		1	6
Permitted Phases		8		2	6	
Actuated Green, G (s)	9.8	9.8	34.8	34.8	47.7	47.7
Effective Green, g (s)	9.8	9.8	34.8	34.8	47.7	47.7
Actuated g/C Ratio	0.15	0.15	0.53	0.53	0.73	0.73
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	265	237	1880	841	354	2577
v/s Ratio Prot	c0.11		c0.45		c0.09	0.43
v/s Ratio Perm		0.06		0.27	0.41	
v/c Ratio	0.74	0.06	0.85	0.27	0.69	0.60
Uniform Delay, d1	26.6	23.9	13.1	8.4	14.4	4.3
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	10.3	0.1	3.9	0.2	5.8	0.4
Delay (s)	37.0	24.0	17.1	8.5	20.2	4.7
Level of Service	D	C	B	A	C	A
Approach Delay (s)	32.8		15.3			6.8
Approach LOS	C		B			A

Intersection Summary			
HCM Average Control Delay	12.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.81		
Actuated Cycle Length (s)	65.5	Sum of lost time (s)	12.0
Intersection Capacity Utilization	73.2%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Yield		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	0	404	1548	206	0	1904
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	439	1683	224	0	2070
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	TWLTL					
Median storage veh)	5					
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	2717	841			1683	
vC1, stage 1 conf vol	1683					
vC2, stage 2 conf vol	1035					
vCu, unblocked vol	2717	841			1683	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)	5.8					
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	0			100	
cM capacity (veh/h)	135	308			376	

Direction, Lane #	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	439	841	841	224	1035	1035
Volume Left	0	0	0	0	0	0
Volume Right	439	0	0	224	0	0
cSH	308	1700	1700	1700	1700	1700
Volume to Capacity	1.43	0.49	0.49	0.13	0.61	0.61
Queue Length (ft)	586	0	0	0	0	0
Control Delay (s)	241.8	0.0	0.0	0.0	0.0	0.0
Lane LOS	F					
Approach Delay (s)	241.8	0.0			0.0	
Approach LOS	F					

Intersection Summary			
Average Delay	24.0		
Intersection Capacity Utilization	74.5%	ICU Level of Service	D
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	1.00	0.95	1.00	0.97	0.95
Frpb, ped/bikes	1.00	0.98	1.00	0.97	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1558	3539	1541	3433	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1558	3539	1541	3433	3539
Volume (vph)	1012	622	1138	977	658	1154
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	1100	676	1237	1062	715	1254
RTOR Reduction (vph)	0	0	0	420	0	0
Lane Group Flow (vph)	1100	676	1237	642	715	1254
Confl. Peds. (#/hr)		14		8	8	
Turn Type		Free		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		Free		2		
Actuated Green, G (s)	31.0	100.0	37.0	37.0	20.0	61.0
Effective Green, g (s)	31.0	100.0	37.0	37.0	20.0	61.0
Actuated g/C Ratio	0.31	1.00	0.37	0.37	0.20	0.61
Clearance Time (s)	4.0		4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0		3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	1064	1558	1309	570	687	2159
v/s Ratio Prot	c0.32		0.35		c0.21	0.35
v/s Ratio Perm		0.43		0.69		
v/c Ratio	1.03	0.43	0.94	1.13	1.04	0.58
Uniform Delay, d1	34.5	0.0	30.5	31.5	40.0	11.8
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	36.7	0.9	13.7	77.8	45.4	0.4
Delay (s)	71.2	0.9	44.2	109.3	85.4	12.2
Level of Service	E	A	D	F	F	B
Approach Delay (s)	44.4		74.3			38.8
Approach LOS	D		E			D

Intersection Summary			
HCM Average Control Delay	53.9	HCM Level of Service	D
HCM Volume to Capacity ratio	1.38		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	89.1%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	1026	489	17	1345	200	74
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	1115	532	18	1462	217	80
Pedestrians					2	
Lane Width (ft)					12.0	
Walking Speed (ft/s)					4.0	
Percent Blockage					0	
Right turn flare (veh)						6
Median type					None	
Median storage veh)						
Upstream signal (ft)	475					
pX, platoon unblocked						
vC, conflicting volume			1649		1885	1117
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1649		1885	1117
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			95		0	60
cM capacity (veh/h)			387		59	201

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	1115	532	506	975	298
Volume Left	0	0	18	0	217
Volume Right	0	532	0	0	80
cSH	1700	1700	387	1700	74
Volume to Capacity	0.66	0.31	0.05	0.57	4.04
Queue Length (ft)	0	0	4	0	Err
Control Delay (s)	0.0	0.0	1.5	0.0	Err
Lane LOS			A		F
Approach Delay (s)	0.0		0.5		Err
Approach LOS					F

Intersection Summary			
Average Delay	869.7		
Intersection Capacity Utilization	74.8%	ICU Level of Service	D
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0		4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00		0.97	1.00		1.00		1.00
Frt	1.00	1.00	0.85	1.00	0.98		1.00	0.85		1.00		0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95		1.00
Satd. Flow (prot)	1770	1863	1583	1770	1833		3433	1583		1770		1583
Flt Permitted	0.27	1.00	1.00	0.29	1.00		0.95	1.00		0.95		1.00
Satd. Flow (perm)	511	1863	1583	543	1833		3433	1583		1770		1583
Volume (vph)	279	651	122	127	608	72	479	0	326	75	0	251
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	303	708	133	138	661	78	521	0	354	82	0	273
RTOR Reduction (vph)	0	0	0	0	3	0	0	213	0	0	0	224
Lane Group Flow (vph)	303	708	133	138	736	0	521	141	0	82	0	49
Turn Type	Perm		Free	Perm			Prot			Prot		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		Free	8								6
Actuated Green, G (s)	90.1	90.1	132.9	90.1	90.1		21.0	22.1		8.7		9.8
Effective Green, g (s)	90.1	90.1	132.9	90.1	90.1		21.0	22.1		8.7		9.8
Actuated g/C Ratio	0.68	0.68	1.00	0.68	0.68		0.16	0.17		0.07		0.07
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0		4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0		3.0
Lane Grp Cap (vph)	346	1263	1583	368	1243		542	263		116		117
v/s Ratio Prot		0.38			0.40		c0.15	c0.22		0.05		
v/s Ratio Perm	c0.59		0.08	0.25								0.17
v/c Ratio	0.88	0.56	0.08	0.38	0.59		0.96	0.54		0.71		0.42
Uniform Delay, d1	17.0	11.1	0.0	9.2	11.5		55.5	50.7		60.9		58.8
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00		1.00
Incremental Delay, d2	21.1	0.6	0.1	0.6	0.8		29.0	2.1		17.8		2.4
Delay (s)	38.0	11.7	0.1	9.9	12.3		84.5	52.8		78.7		61.2
Level of Service	D	B	A	A	B		F	D		E		E
Approach Delay (s)		17.3			11.9			71.7			65.3	
Approach LOS		B			B			E			E	

Intersection Summary			
HCM Average Control Delay	35.7	HCM Level of Service	D
HCM Volume to Capacity ratio	1.07		
Actuated Cycle Length (s)	132.9	Sum of lost time (s)	16.0
Intersection Capacity Utilization	89.5%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1863	1583	1770	1863	1583	1770	1863	1583	1770	1863	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.53	1.00	1.00	0.60	1.00	1.00
Satd. Flow (perm)	1770	1863	1583	1770	1863	1583	983	1863	1583	1118	1863	1583
Volume (vph)	106	700	178	180	434	127	86	151	282	143	180	140
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	115	761	193	196	472	138	93	164	307	155	196	152
RTOR Reduction (vph)	0	0	103	0	0	69	0	0	245	0	0	121
Lane Group Flow (vph)	115	761	90	196	472	69	93	164	62	155	196	31
Turn Type	Prot		Perm	Prot		Perm	Perm		Perm	Perm		Perm
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4			8	2		2	6		6
Actuated Green, G (s)	6.9	29.2	29.2	9.0	31.3	31.3	12.7	12.7	12.7	12.7	12.7	12.7
Effective Green, g (s)	6.9	29.2	29.2	9.0	31.3	31.3	12.7	12.7	12.7	12.7	12.7	12.7
Actuated g/C Ratio	0.11	0.46	0.46	0.14	0.50	0.50	0.20	0.20	0.20	0.20	0.20	0.20
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	194	865	735	253	927	788	198	376	320	226	376	320
v/s Ratio Prot	0.06	c0.41		c0.11	0.25			0.09			0.11	
v/s Ratio Perm			0.12			0.09	0.09		0.19	0.14		0.10
v/c Ratio	0.59	0.88	0.12	0.77	0.51	0.09	0.47	0.44	0.19	0.69	0.52	0.10
Uniform Delay, d1	26.7	15.3	9.6	26.0	10.6	8.3	22.1	22.0	20.8	23.3	22.4	20.4
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	4.8	10.2	0.1	13.7	0.4	0.0	1.8	0.8	0.3	8.3	1.3	0.1
Delay (s)	31.5	25.4	9.6	39.7	11.1	8.3	23.9	22.8	21.1	31.6	23.7	20.6
Level of Service	C	C	A	D	B	A	C	C	C	C	C	C
Approach Delay (s)		23.2			17.6			22.1			25.2	
Approach LOS		C			B			C			C	

Intersection Summary			
HCM Average Control Delay	21.8	HCM Level of Service	C
HCM Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	62.9	Sum of lost time (s)	12.0
Intersection Capacity Utilization	76.0%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1770	1583	1770	1863	1863	1583
Flt Permitted	0.95	1.00	0.14	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	253	1863	1863	1583
Volume (vph)	512	389	231	740	552	328
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	557	423	251	804	600	357
RTOR Reduction (vph)	0	227	0	0	0	148
Lane Group Flow (vph)	557	196	251	804	600	209
Turn Type		Perm	pm+pt			Perm
Protected Phases	4		5	2	6	
Permitted Phases		4	2			6
Actuated Green, G (s)	24.0	24.0	37.6	37.6	25.4	25.4
Effective Green, g (s)	24.0	24.0	37.6	37.6	25.4	25.4
Actuated g/C Ratio	0.34	0.34	0.54	0.54	0.36	0.36
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	610	546	315	1006	680	578
v/s Ratio Prot	c0.31		0.09	c0.43	c0.32	
v/s Ratio Perm		0.27	0.34			0.23
v/c Ratio	0.91	0.36	0.80	0.80	0.88	0.36
Uniform Delay, d1	21.8	17.1	13.2	12.9	20.7	16.2
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	18.1	0.4	13.1	4.5	12.9	0.4
Delay (s)	39.9	17.5	26.3	17.5	33.6	16.6
Level of Service	D	B	C	B	C	B
Approach Delay (s)	30.2			19.6	27.2	
Approach LOS	C			B	C	

Intersection Summary			
HCM Average Control Delay	25.5	HCM Level of Service	C
HCM Volume to Capacity ratio	0.90		
Actuated Cycle Length (s)	69.6	Sum of lost time (s)	12.0
Intersection Capacity Utilization	80.2%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor		1.00	1.00		1.00	1.00	1.00	0.95	1.00	1.00	0.95	
Frpb, ped/bikes		1.00	1.00		1.00	1.00	1.00	1.00	0.98	1.00	1.00	
Flpb, ped/bikes		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt		1.00	0.85		1.00	0.85	1.00	1.00	0.85	1.00	1.00	
Flt Protected		0.96	1.00		0.95	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1795	1583		1777	1583	1770	3539	1548	1770	3526	
Flt Permitted		0.27	1.00		0.67	1.00	0.06	1.00	1.00	0.06	1.00	
Satd. Flow (perm)		502	1583		1250	1583	117	3539	1548	110	3526	
Volume (vph)	59	19	71	516	20	192	60	1691	356	143	2032	44
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	64	21	77	561	22	209	65	1838	387	155	2209	48
RTOR Reduction (vph)	0	0	42	0	0	44	0	0	198	0	1	0
Lane Group Flow (vph)	0	85	35	0	583	165	65	1838	189	155	2256	0
Confl. Peds. (#/hr)							2		2	2		2
Turn Type	Perm		Perm	Perm		Perm	pm+pt		Perm	pm+pt		
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		
Actuated Green, G (s)		48.0	48.0		48.0	48.0	67.0	63.8	63.8	74.6	67.6	
Effective Green, g (s)		48.0	48.0		48.0	48.0	67.0	63.8	63.8	74.6	67.6	
Actuated g/C Ratio		0.37	0.37		0.37	0.37	0.51	0.49	0.49	0.57	0.52	
Clearance Time (s)		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		184	581		459	581	100	1726	755	152	1822	
v/s Ratio Prot							0.02	0.52		c0.05	c0.64	
v/s Ratio Perm		0.17	0.05		c0.47	0.13	0.32		0.25	0.53		
v/c Ratio		0.46	0.06		1.27	0.28	0.65	1.06	0.25	1.02	1.24	
Uniform Delay, d1		31.6	26.8		41.4	29.2	64.6	33.5	19.5	64.1	31.6	
Progression Factor		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2		1.8	0.0		137.8	0.3	14.1	41.3	0.2	78.3	112.1	
Delay (s)		33.4	26.8		179.2	29.5	78.7	74.8	19.7	142.4	143.7	
Level of Service		C	C		F	C	E	E	B	F	F	
Approach Delay (s)		30.3			139.7			65.6			143.6	
Approach LOS		C			F			E			F	

Intersection Summary			
HCM Average Control Delay	108.2	HCM Level of Service	F
HCM Volume to Capacity ratio	1.27		
Actuated Cycle Length (s)	130.8	Sum of lost time (s)	12.0
Intersection Capacity Utilization	107.2%	ICU Level of Service	G
Analysis Period (min)	15		

c Critical Lane Group

Appendix Q – Intersection Operations Analysis Worksheets for 2025 With Project Phase I Conditions, with Mitigation Measures

HCM Signalized Intersection Capacity Analysis
1: Kaiminani Drive & Queen Kaahumanu Highway

2025 AM With Project+Mit
7/25/2012

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	3539	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.15	1.00
Satd. Flow (perm)	1770	1583	3539	1583	287	3539
Volume (vph)	480	244	1124	109	33	1120
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	522	265	1222	118	36	1217
RTOR Reduction (vph)	0	112	0	70	0	0
Lane Group Flow (vph)	522	153	1222	48	36	1217
Turn Type		Perm		Perm	pm+pt	
Protected Phases	8		2		1	6
Permitted Phases		8		2	6	
Actuated Green, G (s)	18.3	18.3	22.0	22.0	27.4	27.4
Effective Green, g (s)	18.3	18.3	22.0	22.0	27.4	27.4
Actuated g/C Ratio	0.34	0.34	0.41	0.41	0.51	0.51
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	603	539	1450	649	185	1806
v/s Ratio Prot	c0.29		c0.35		0.01	c0.34
v/s Ratio Perm		0.17		0.07	0.09	
v/c Ratio	0.87	0.28	0.84	0.07	0.19	0.67
Uniform Delay, d1	16.6	12.9	14.3	9.7	9.6	9.8
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	12.4	0.3	4.6	0.0	0.5	1.0
Delay (s)	28.9	13.2	18.9	9.7	10.1	10.8
Level of Service	C	B	B	A	B	B
Approach Delay (s)	23.6		18.1			10.8
Approach LOS	C		B			B

Intersection Summary			
HCM Average Control Delay	16.7	HCM Level of Service	B
HCM Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	53.7	Sum of lost time (s)	12.0
Intersection Capacity Utilization	64.3%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Synchro 6 Report
Page 1

Katz, Okitsu & Associates


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AM (2025+P1)                Thu Jul 26, 2012 10:24:38                  Page 3-1
-------------------------------------------------------------------------------
                              JB23054 - Kaloko Makai
                                   Kona, Hawaii
                        2015 With Project Phase 1 Conditions
-------------------------------------------------------------------------------
                         Level Of Service Computation Report
             2000 HCM Unsignalized Method (Future Volume Alternative)
*******************************************************************************
Intersection #2 Queen Kaahumanu Hwy. @ Hulikoa Dr.
*******************************************************************************
Average Delay (sec/veh):      0.0       Worst Case Level Of Service: A[  7.2]
*******************************************************************************
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Uncontrolled     Uncontrolled     Yield Sign       Yield Sign
Rights:           Include          Include          Include          Ignore
Lanes:        0  0  2  0  1    0  1  1  0  0    0  0  0  0  0    0  0  1! 0  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:        0  590   218     0  835     0     0    0     0     0    0   182
Growth Adj:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Initial Bse:     0  590   218     0  835     0     0    0     0     0    0   182
Added Vol:       0  447    85    20  726     0     0    0     0    42    0   121
PasserByVol:     0    0    20   -20   62     0     0    0     0   -42    0    42
Initial Fut:     0 1037   323     0 1623     0     0    0     0     0    0   345
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
PHF Volume:      0 1037   323     0 1623     0     0    0     0     0    0     0
Reduct Vol:      0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:     0 1037   323     0 1623     0     0    0     0     0    0     0
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx   6.8  6.5   6.9
FollowUpTim:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx   3.5  4.0   3.3
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  1849 2660   519
Potent Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx    67   23   507
Move Cap.:   xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx    67   23   507
Volume/Cap:  xxxx xxxx  xxxx  xxxx xxxx  xxxx  xxxx xxxx  xxxx  0.00 0.00  0.00
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:   xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Control Del:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
LOS by Move:     *    *     *     *    *     *     *    *     *     *    *     *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx    0 xxxxx
SharedQueue:xxxxx xxxx xxxxx   0.0 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Shrd ConDel:xxxxx xxxx xxxxx   7.2 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Shared LOS:      *    *     *     A    *     *     *    *     *     *    *     *
ApproachDel:    xxxxxx            xxxxxx            xxxxxx            xxxxxx
ApproachLOS:         *                 *                 *                 *
*******************************************************************************
Note: Queue reported is the number of cars per lane.
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Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	1.00	0.95	1.00	0.97	0.95
Frpb, ped/bikes	1.00	0.98	1.00	0.98	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1558	3539	1548	3433	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1558	3539	1548	3433	3539
Volume (vph)	627	427	775	810	672	1032
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	682	464	842	880	730	1122
RTOR Reduction (vph)	0	0	0	347	0	0
Lane Group Flow (vph)	682	464	842	533	730	1122
Confl. Peds. (#/hr)		14		8	8	
Turn Type		Free		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		Free		2		
Actuated Green, G (s)	16.2	71.4	26.5	26.5	16.7	47.2
Effective Green, g (s)	16.2	71.4	26.5	26.5	16.7	47.2
Actuated g/C Ratio	0.23	1.00	0.37	0.37	0.23	0.66
Clearance Time (s)	4.0		4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0		3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	779	1558	1313	575	803	2340
v/s Ratio Prot	c0.20		0.24		c0.21	0.32
v/s Ratio Perm		0.30		0.57		
v/c Ratio	0.88	0.30	0.64	0.93	0.91	0.48
Uniform Delay, d1	26.6	0.0	18.5	21.5	26.6	6.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	10.8	0.5	1.1	21.1	14.0	0.2
Delay (s)	37.4	0.5	19.6	42.6	40.6	6.2
Level of Service	D	A	B	D	D	A
Approach Delay (s)	22.5		31.4			19.7
Approach LOS	C		C			B

Intersection Summary			
HCM Average Control Delay	24.6	HCM Level of Service	C
HCM Volume to Capacity ratio	1.18		
Actuated Cycle Length (s)	71.4	Sum of lost time (s)	12.0
Intersection Capacity Utilization	76.8%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	990	363	29	849	0	18
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	1076	395	32	923	0	20
Pedestrians					2	
Lane Width (ft)					12.0	
Walking Speed (ft/s)					4.0	
Percent Blockage					0	
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (ft)	475					
pX, platoon unblocked						
vC, conflicting volume			1473		1603	1078
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1473		1603	1078
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			93		100	91
cM capacity (veh/h)			453		90	214

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	1076	395	339	615	20
Volume Left	0	0	32	0	0
Volume Right	0	395	0	0	20
cSH	1700	1700	453	1700	214
Volume to Capacity	0.63	0.23	0.07	0.36	0.09
Queue Length (ft)	0	0	6	0	7
Control Delay (s)	0.0	0.0	2.3	0.0	23.5
Lane LOS			A		C
Approach Delay (s)	0.0		0.8		23.5
Approach LOS					C

Intersection Summary			
Average Delay	0.5		
Intersection Capacity Utilization	62.1%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0		4.0	4.0		4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	0.95		0.97		1.00	1.00		1.00
Frt	1.00	1.00	0.85	1.00	0.98		1.00		0.85	1.00		0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95		1.00	0.95		1.00
Satd. Flow (prot)	1770	1863	1583	1770	3485		3433		1583	1770		1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95		1.00	0.95		1.00
Satd. Flow (perm)	1770	1863	1583	1770	3485		3433		1583	1770		1583
Volume (vph)	224	573	198	202	544	62	359	0	77	61	0	209
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	243	623	215	220	591	67	390	0	84	66	0	227
RTOR Reduction (vph)	0	0	0	0	9	0	0	0	0	0	0	197
Lane Group Flow (vph)	243	623	215	220	649	0	390	0	84	66	0	30
Turn Type	Prot		Free	Prot			Prot		Free	Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			Free						Free			6
Actuated Green, G (s)	14.3	30.2	81.4	11.1	27.0		13.4		81.4	15.7		10.7
Effective Green, g (s)	14.3	30.2	81.4	11.1	27.0		13.4		81.4	15.7		10.7
Actuated g/C Ratio	0.18	0.37	1.00	0.14	0.33		0.16		1.00	0.19		0.13
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0			4.0		4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0			3.0		3.0
Lane Grp Cap (vph)	311	691	1583	241	1156		565		1583	341		208
v/s Ratio Prot	0.14	c0.33		c0.12	0.19		c0.11			0.04		
v/s Ratio Perm			0.14						0.05			0.14
v/c Ratio	0.78	0.90	0.14	0.91	0.56		0.69		0.05	0.19		0.14
Uniform Delay, d1	32.1	24.2	0.0	34.7	22.3		32.0		0.0	27.5		31.3
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00		1.00	1.00		1.00
Incremental Delay, d2	12.0	15.0	0.2	35.3	0.6		3.6		0.1	0.3		0.3
Delay (s)	44.1	39.2	0.2	69.9	23.0		35.7		0.1	27.8		31.6
Level of Service	D	D	A	E	C		D		A	C		C
Approach Delay (s)		32.5			34.7			29.4			30.8	
Approach LOS		C			C			C			C	

Intersection Summary				
HCM Average Control Delay	32.5	HCM Level of Service	C	
HCM Volume to Capacity ratio	0.84			
Actuated Cycle Length (s)	81.4	Sum of lost time (s)	12.0	
Intersection Capacity Utilization	68.3%	ICU Level of Service	C	
Analysis Period (min)	15			
c Critical Lane Group				

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1863	1583	1770	1863	1583	1770	1863	1583	1770	1863	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.66	1.00	1.00	0.64	1.00	1.00
Satd. Flow (perm)	1770	1863	1583	1770	1863	1583	1237	1863	1583	1200	1863	1583
Volume (vph)	134	313	70	189	550	123	168	160	64	108	134	92
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	146	340	76	205	598	134	183	174	70	117	146	100
RTOR Reduction (vph)	0	0	45	0	0	74	0	0	56	0	0	80
Lane Group Flow (vph)	146	340	31	205	598	60	183	174	14	117	146	20
Turn Type	Prot		Perm	Prot		Perm	Perm		Perm	Perm		Perm
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4			8	2		2	6		6
Actuated Green, G (s)	4.8	19.1	19.1	6.7	21.0	21.0	9.4	9.4	9.4	9.4	9.4	9.4
Effective Green, g (s)	4.8	19.1	19.1	6.7	21.0	21.0	9.4	9.4	9.4	9.4	9.4	9.4
Actuated g/C Ratio	0.10	0.40	0.40	0.14	0.44	0.44	0.20	0.20	0.20	0.20	0.20	0.20
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	180	754	641	251	829	704	246	371	315	239	371	315
v/s Ratio Prot	0.08	0.18		c0.12	c0.32			0.09			0.08	
v/s Ratio Perm			0.05			0.08	c0.15		0.04	0.10		0.06
v/c Ratio	0.81	0.45	0.05	0.82	0.72	0.08	0.74	0.47	0.04	0.49	0.39	0.06
Uniform Delay, d1	20.8	10.2	8.5	19.7	10.7	7.6	17.8	16.7	15.3	16.8	16.4	15.3
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	23.4	0.4	0.0	18.2	3.1	0.1	11.5	0.9	0.1	1.6	0.7	0.1
Delay (s)	44.2	10.7	8.6	37.9	13.8	7.6	29.3	17.6	15.3	18.3	17.1	15.4
Level of Service	D	B	A	D	B	A	C	B	B	B	B	B
Approach Delay (s)		19.1			18.2			22.2			17.0	
Approach LOS		B			B			C			B	

Intersection Summary				
HCM Average Control Delay	19.0	HCM Level of Service	B	
HCM Volume to Capacity ratio	0.70			
Actuated Cycle Length (s)	47.2	Sum of lost time (s)	8.0	
Intersection Capacity Utilization	66.1%	ICU Level of Service	C	
Analysis Period (min)	15			
c Critical Lane Group				

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	1.00	0.97	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	3433	1583	3433	1863	1863	1583
Flt Permitted	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (perm)	3433	1583	3433	1863	1863	1583
Volume (vph)	208	211	273	378	1307	382
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	226	229	297	411	1421	415
RTOR Reduction (vph)	0	66	0	0	0	2
Lane Group Flow (vph)	226	163	297	411	1421	413
Turn Type		pm+ov	Prot			pm+ov
Protected Phases	4	5	5	2	6	4
Permitted Phases		4				6
Actuated Green, G (s)	14.4	27.4	13.0	126.0	109.0	123.4
Effective Green, g (s)	14.4	27.4	13.0	126.0	109.0	123.4
Actuated g/C Ratio	0.10	0.18	0.09	0.85	0.73	0.83
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	333	335	301	1582	1368	1359
v/s Ratio Prot	0.07	c0.06	c0.09	0.22	c0.76	0.03
v/s Ratio Perm		0.08				0.23
v/c Ratio	0.68	0.49	0.99	0.26	1.04	0.30
Uniform Delay, d1	64.8	54.2	67.6	2.2	19.7	2.8
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	5.4	1.1	47.8	0.1	35.0	0.1
Delay (s)	70.2	55.3	115.4	2.3	54.7	2.9
Level of Service	E	E	F	A	D	A
Approach Delay (s)	62.7			49.7	43.0	
Approach LOS	E			D	D	

Intersection Summary			
HCM Average Control Delay	47.6	HCM Level of Service	D
HCM Volume to Capacity ratio	1.00		
Actuated Cycle Length (s)	148.4	Sum of lost time (s)	12.0
Intersection Capacity Utilization	92.5%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	1.00		0.97	1.00		1.00	0.95	1.00	1.00	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	0.98	1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.89		1.00	0.86		1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	1649		3433	1611		1770	3539	1549	1770	3517	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1770	1649		3433	1611		1770	3539	1549	1770	3517	
Volume (vph)	17	7	24	348	18	166	68	1464	530	240	1231	48
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	18	8	26	378	20	180	74	1591	576	261	1338	52
RTOR Reduction (vph)	0	25	0	0	151	0	0	0	286	0	2	0
Lane Group Flow (vph)	18	9	0	378	49	0	74	1591	290	261	1388	0
Confl. Peds. (#/hr)							2		2	2		2
Turn Type	Prot			Prot			Prot		Perm	Prot		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases									2			
Actuated Green, G (s)	1.9	5.8		12.1	16.0		7.2	50.6	50.6	16.1	59.5	
Effective Green, g (s)	1.9	5.8		12.1	16.0		7.2	50.6	50.6	16.1	59.5	
Actuated g/C Ratio	0.02	0.06		0.12	0.16		0.07	0.50	0.50	0.16	0.59	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	33	95		413	256		127	1780	779	283	2080	
v/s Ratio Prot	0.01	0.02		c0.11	c0.12		0.04	c0.45		c0.15	0.40	
v/s Ratio Perm									0.37			
v/c Ratio	0.55	0.10		0.92	0.19		0.58	0.89	0.37	0.92	0.67	
Uniform Delay, d1	48.9	44.9		43.7	36.7		45.2	22.6	15.3	41.6	13.9	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	17.2	0.5		24.5	0.4		6.7	6.2	0.3	33.6	0.8	
Delay (s)	66.1	45.4		68.3	37.0		51.9	28.8	15.6	75.2	14.7	
Level of Service	E	D		E	D		D	C	B	E	B	
Approach Delay (s)		52.5			57.5			26.2			24.3	
Approach LOS		D			E			C			C	

Intersection Summary			
HCM Average Control Delay	29.8	HCM Level of Service	C
HCM Volume to Capacity ratio	0.88		
Actuated Cycle Length (s)	100.6	Sum of lost time (s)	12.0
Intersection Capacity Utilization	80.4%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
1: Kaiminani Drive & Queen Kaahumanu Highway

2025 PM With Project+Mit
7/25/2012

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	3539	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.10	1.00
Satd. Flow (perm)	1770	1583	3539	1583	192	3539
Volume (vph)	180	84	1473	387	226	1414
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	196	91	1601	421	246	1537
RTOR Reduction (vph)	0	77	0	197	0	0
Lane Group Flow (vph)	196	14	1601	224	246	1537
Turn Type		Perm		Perm	pm+pt	
Protected Phases	8		2		1	6
Permitted Phases		8		2	6	
Actuated Green, G (s)	9.8	9.8	34.8	34.8	47.7	47.7
Effective Green, g (s)	9.8	9.8	34.8	34.8	47.7	47.7
Actuated g/C Ratio	0.15	0.15	0.53	0.53	0.73	0.73
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	265	237	1880	841	354	2577
v/s Ratio Prot	c0.11		c0.45		c0.09	0.43
v/s Ratio Perm		0.06		0.27	0.41	
v/c Ratio	0.74	0.06	0.85	0.27	0.69	0.60
Uniform Delay, d1	26.6	23.9	13.1	8.4	14.4	4.3
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	10.3	0.1	3.9	0.2	5.8	0.4
Delay (s)	37.0	24.0	17.1	8.5	20.2	4.7
Level of Service	D	C	B	A	C	A
Approach Delay (s)	32.8		15.3			6.8
Approach LOS	C		B			A

Intersection Summary			
HCM Average Control Delay	12.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.81		
Actuated Cycle Length (s)	65.5	Sum of lost time (s)	12.0
Intersection Capacity Utilization	73.2%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Synchro 6 Report
Page 1

Katz, Okitsu & Associates


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PM (2025+P1)                Thu Jul 26, 2012 10:25:55                  Page 3-1
-------------------------------------------------------------------------------
                              JB23054 - Kaloko Makai
                                   Kona, Hawaii
                        2015 With Project Phase 1 Conditions
-------------------------------------------------------------------------------
                         Level Of Service Computation Report
             2000 HCM Unsignalized Method (Future Volume Alternative)
*******************************************************************************
Intersection #2 Queen Kaahumanu Hwy. @ Hulikoa Dr.
*******************************************************************************
Average Delay (sec/veh):      0.0       Worst Case Level Of Service: A[  7.2]
*******************************************************************************
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Uncontrolled     Uncontrolled     Yield Sign       Yield Sign
Rights:           Include          Include          Include          Ignore
Lanes:        0  0  2  0  1    0  1  1  0  0    0  0  0  0  0    0  0  1! 0  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:        0  719   122     0 1068     0     0    0     0     0    0   205
Growth Adj:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Initial Bse:     0  719   122     0 1068     0     0    0     0     0    0   205
Added Vol:       0  829    71    13  778     0     0    0     0    45    0   154
PasserByVol:     0    0    13   -13   58     0     0    0     0   -45    0    45
Initial Fut:     0 1548   206     0 1904     0     0    0     0     0    0   404
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
PHF Volume:      0 1548   206     0 1904     0     0    0     0     0    0     0
Reduct Vol:      0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:     0 1548   206     0 1904     0     0    0     0     0    0     0
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx   6.8  6.5   6.9
FollowUpTim:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx   3.5  4.0   3.3
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  2500 3452   774
Potent Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx    24    7   346
Move Cap.:   xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx    24    7   346
Volume/Cap:  xxxx xxxx  xxxx  xxxx xxxx  xxxx  xxxx xxxx  xxxx  0.00 0.00  0.00
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:   xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Control Del:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
LOS by Move:     *    *     *     *    *     *     *    *     *     *    *     *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx    0 xxxxx
SharedQueue:xxxxx xxxx xxxxx   0.0 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Shrd ConDel:xxxxx xxxx xxxxx   7.2 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Shared LOS:      *    *     *     A    *     *     *    *     *     *    *     *
ApproachDel:    xxxxxx            xxxxxx            xxxxxx            xxxxxx
ApproachLOS:         *                 *                 *                 *
*******************************************************************************
Note: Queue reported is the number of cars per lane.
*******************************************************************************

  Traffix 8.0.0715 (c) 2008 Dowling Assoc. Licensed to KOA CORP, MONTEREY PK
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Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	1.00	0.95	1.00	0.97	0.95
Frpb, ped/bikes	1.00	0.98	1.00	0.97	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1558	3539	1541	3433	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1558	3539	1541	3433	3539
Volume (vph)	1012	622	1138	977	658	1154
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	1100	676	1237	1062	715	1254
RTOR Reduction (vph)	0	0	0	420	0	0
Lane Group Flow (vph)	1100	676	1237	642	715	1254
Confl. Peds. (#/hr)		14		8	8	
Turn Type		Free		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		Free		2		
Actuated Green, G (s)	31.0	100.0	37.0	37.0	20.0	61.0
Effective Green, g (s)	31.0	100.0	37.0	37.0	20.0	61.0
Actuated g/C Ratio	0.31	1.00	0.37	0.37	0.20	0.61
Clearance Time (s)	4.0		4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0		3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	1064	1558	1309	570	687	2159
v/s Ratio Prot	c0.32		0.35		c0.21	0.35
v/s Ratio Perm		0.43		0.69		
v/c Ratio	1.03	0.43	0.94	1.13	1.04	0.58
Uniform Delay, d1	34.5	0.0	30.5	31.5	40.0	11.8
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	36.7	0.9	13.7	77.8	45.4	0.4
Delay (s)	71.2	0.9	44.2	109.3	85.4	12.2
Level of Service	E	A	D	F	F	B
Approach Delay (s)	44.4		74.3			38.8
Approach LOS	D		E			D

Intersection Summary			
HCM Average Control Delay	53.9	HCM Level of Service	D
HCM Volume to Capacity ratio	1.38		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	89.1%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	1026	489	17	1345	0	74
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	1115	532	18	1462	0	80
Pedestrians					2	
Lane Width (ft)					12.0	
Walking Speed (ft/s)					4.0	
Percent Blockage					0	
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (ft)	475					
pX, platoon unblocked						
vC, conflicting volume			1649		1885	1117
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1649		1885	1117
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			95		100	60
cM capacity (veh/h)			387		59	201

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	1115	532	506	975	80
Volume Left	0	0	18	0	0
Volume Right	0	532	0	0	80
cSH	1700	1700	387	1700	201
Volume to Capacity	0.66	0.31	0.05	0.57	0.40
Queue Length (ft)	0	0	4	0	45
Control Delay (s)	0.0	0.0	1.5	0.0	34.3
Lane LOS			A		D
Approach Delay (s)	0.0		0.5		34.3
Approach LOS					D

Intersection Summary			
Average Delay	1.1		
Intersection Capacity Utilization	74.8%	ICU Level of Service	D
Analysis Period (min)	15		

HCM Signalized Intersection Capacity Analysis
5: Hina Lani Street & Kamanu Street

2025 PM With Project+Mit
7/25/2012

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0		4.0	4.0		4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	0.95		0.97		1.00	1.00		1.00
Frt	1.00	1.00	0.85	1.00	0.98		1.00		0.85	1.00		0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95		1.00	0.95		1.00
Satd. Flow (prot)	1770	1863	1583	1770	3483		3433		1583	1770		1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95		1.00	0.95		1.00
Satd. Flow (perm)	1770	1863	1583	1770	3483		3433		1583	1770		1583
Volume (vph)	279	651	122	127	608	72	679	0	326	75	0	251
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	303	708	133	138	661	78	738	0	354	82	0	273
RTOR Reduction (vph)	0	0	0	0	9	0	0	0	0	0	0	242
Lane Group Flow (vph)	303	708	133	138	730	0	738	0	354	82	0	31
Turn Type	Prot		Free	Prot			Prot		Free	Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			Free						Free			6
Actuated Green, G (s)	19.0	38.1	93.9	8.0	27.1		21.0		93.9	20.6		10.8
Effective Green, g (s)	19.0	38.1	93.9	8.0	27.1		21.0		93.9	20.6		10.8
Actuated g/C Ratio	0.20	0.41	1.00	0.09	0.29		0.22		1.00	0.22		0.12
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0			4.0		4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0			3.0		3.0
Lane Grp Cap (vph)	358	756	1583	151	1005		768		1583	388		182
v/s Ratio Prot	c0.17	c0.38		0.08	0.21		c0.21			0.05		
v/s Ratio Perm			0.08						0.22			0.17
v/c Ratio	0.85	0.94	0.08	0.91	0.73		0.96		0.22	0.21		0.17
Uniform Delay, d1	36.0	26.7	0.0	42.6	30.1		36.0		0.0	30.0		37.5
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00		1.00	1.00		1.00
Incremental Delay, d2	16.6	18.8	0.1	48.2	2.6		23.2		0.3	0.3		0.5
Delay (s)	52.7	45.5	0.1	90.9	32.7		59.3		0.3	30.3		38.0
Level of Service	D	D	A	F	C		E		A	C		D
Approach Delay (s)		42.1			41.9			40.2			36.2	
Approach LOS		D			D			D			D	

Intersection Summary				
HCM Average Control Delay	40.8	HCM Level of Service	D	
HCM Volume to Capacity ratio	0.98			
Actuated Cycle Length (s)	93.9	Sum of lost time (s)	12.0	
Intersection Capacity Utilization	77.3%	ICU Level of Service	D	
Analysis Period (min)	15			
c Critical Lane Group				

HCM Signalized Intersection Capacity Analysis
6: Hina Lani Street & Ane Keahokalole Hwy.

2025 PM With Project+Mit
7/25/2012

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1863	1583	1770	1863	1583	1770	1863	1583	1770	1863	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.53	1.00	1.00	0.60	1.00	1.00
Satd. Flow (perm)	1770	1863	1583	1770	1863	1583	983	1863	1583	1118	1863	1583
Volume (vph)	106	700	178	180	434	127	86	151	282	143	180	140
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	115	761	193	196	472	138	93	164	307	155	196	152
RTOR Reduction (vph)	0	0	103	0	0	69	0	0	245	0	0	121
Lane Group Flow (vph)	115	761	90	196	472	69	93	164	62	155	196	31
Turn Type	Prot		Perm	Prot		Perm	Perm		Perm	Perm		Perm
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4			8	2		2	6		6
Actuated Green, G (s)	6.9	29.2	29.2	9.0	31.3	31.3	12.7	12.7	12.7	12.7	12.7	12.7
Effective Green, g (s)	6.9	29.2	29.2	9.0	31.3	31.3	12.7	12.7	12.7	12.7	12.7	12.7
Actuated g/C Ratio	0.11	0.46	0.46	0.14	0.50	0.50	0.20	0.20	0.20	0.20	0.20	0.20
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	194	865	735	253	927	788	198	376	320	226	376	320
v/s Ratio Prot	0.06	c0.41		c0.11	0.25			0.09			0.11	
v/s Ratio Perm			0.12			0.09	0.09		0.19	0.14		0.10
v/c Ratio	0.59	0.88	0.12	0.77	0.51	0.09	0.47	0.44	0.19	0.69	0.52	0.10
Uniform Delay, d1	26.7	15.3	9.6	26.0	10.6	8.3	22.1	22.0	20.8	23.3	22.4	20.4
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	4.8	10.2	0.1	13.7	0.4	0.0	1.8	0.8	0.3	8.3	1.3	0.1
Delay (s)	31.5	25.4	9.6	39.7	11.1	8.3	23.9	22.8	21.1	31.6	23.7	20.6
Level of Service	C	C	A	D	B	A	C	C	C	C	C	C
Approach Delay (s)		23.2			17.6			22.1			25.2	
Approach LOS		C			B			C			C	

Intersection Summary				
HCM Average Control Delay	21.8	HCM Level of Service	C	
HCM Volume to Capacity ratio	0.87			
Actuated Cycle Length (s)	62.9	Sum of lost time (s)	12.0	
Intersection Capacity Utilization	76.0%	ICU Level of Service	D	
Analysis Period (min)	15			
c Critical Lane Group				

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	1.00	0.97	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	3433	1583	3433	1863	1863	1583
Flt Permitted	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (perm)	3433	1583	3433	1863	1863	1583
Volume (vph)	512	389	231	740	552	328
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	557	423	251	804	600	357
RTOR Reduction (vph)	0	101	0	0	0	22
Lane Group Flow (vph)	557	322	251	804	600	335
Turn Type		pm+ov	Prot			pm+ov
Protected Phases	4	5	5	2	6	4
Permitted Phases		4				6
Actuated Green, G (s)	13.6	20.6	7.0	31.6	20.6	34.2
Effective Green, g (s)	13.6	20.6	7.0	31.6	20.6	34.2
Actuated g/C Ratio	0.26	0.39	0.13	0.59	0.39	0.64
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	878	732	452	1107	721	1137
v/s Ratio Prot	0.16	c0.08	0.07	c0.43	c0.32	0.08
v/s Ratio Perm		0.19				0.15
v/c Ratio	0.63	0.44	0.56	0.73	0.83	0.29
Uniform Delay, d1	17.6	12.0	21.6	7.7	14.7	4.2
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.5	0.4	1.5	2.4	8.1	0.1
Delay (s)	19.1	12.5	23.1	10.1	22.9	4.3
Level of Service	B	B	C	B	C	A
Approach Delay (s)	16.2			13.2	16.0	
Approach LOS	B			B	B	

Intersection Summary			
HCM Average Control Delay	15.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	53.2	Sum of lost time (s)	12.0
Intersection Capacity Utilization	60.2%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	1.00		0.97	1.00		1.00	0.95	1.00	1.00	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	0.98	1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.88		1.00	0.86		1.00	1.00	0.85	1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	1643		3433	1610		1770	3539	1549	1770	3526	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1770	1643		3433	1610		1770	3539	1549	1770	3526	
Volume (vph)	59	19	71	516	20	192	60	1691	356	143	2032	44
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	64	21	77	561	22	209	65	1838	387	155	2209	48
RTOR Reduction (vph)	0	62	0	0	127	0	0	0	169	0	1	0
Lane Group Flow (vph)	64	36	0	561	104	0	65	1838	218	155	2256	0
Confl. Peds. (#/hr)							2		2	2		2
Turn Type	Prot			Prot			Prot		Perm	Prot		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases									2			
Actuated Green, G (s)	8.2	9.7		23.0	24.5		6.0	81.0	81.0	14.0	89.0	
Effective Green, g (s)	8.2	9.7		23.0	24.5		6.0	81.0	81.0	14.0	89.0	
Actuated g/C Ratio	0.06	0.07		0.16	0.17		0.04	0.56	0.56	0.10	0.62	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	101	111		549	274		74	1995	873	172	2184	
v/s Ratio Prot	0.04	0.06		c0.16	c0.14		0.04	0.52		c0.09	c0.64	
v/s Ratio Perm									0.25			
v/c Ratio	0.63	0.33		1.02	0.38		0.88	0.92	0.25	0.90	1.03	
Uniform Delay, d1	66.3	63.9		60.4	52.9		68.5	28.5	15.9	64.2	27.3	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	12.3	1.7		44.1	0.9		64.1	7.6	0.2	41.5	28.4	
Delay (s)	78.6	65.6		104.4	53.7		132.6	36.0	16.1	105.6	55.7	
Level of Service	E	E		F	D		F	D	B	F	E	
Approach Delay (s)		70.7			89.6			35.4			58.9	
Approach LOS		E			F			D			E	

Intersection Summary			
HCM Average Control Delay	54.0	HCM Level of Service	D
HCM Volume to Capacity ratio	0.98		
Actuated Cycle Length (s)	143.7	Sum of lost time (s)	8.0
Intersection Capacity Utilization	94.3%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Appendix R – Intersection Operations Analysis Worksheets for 2035 With Project Phase 2 Conditions, with Existing Geometry and Planned Improvements

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	3539	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.11	1.00
Satd. Flow (perm)	1770	1583	3539	1583	207	3539
Volume (vph)	480	510	1261	109	361	1042
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	522	554	1371	118	392	1133
RTOR Reduction (vph)	0	229	0	71	0	0
Lane Group Flow (vph)	522	325	1371	47	392	1133
Turn Type		Perm		Perm	pm+pt	
Protected Phases	8		2		1	6
Permitted Phases		8		2	6	
Actuated Green, G (s)	23.0	23.0	32.0	32.0	49.0	49.0
Effective Green, g (s)	23.0	23.0	32.0	32.0	49.0	49.0
Actuated g/C Ratio	0.29	0.29	0.40	0.40	0.61	0.61
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	509	455	1416	633	381	2168
v/s Ratio Prot	0.29		0.39		c0.17	0.32
v/s Ratio Perm		0.35		0.07	c0.46	
v/c Ratio	1.03	0.71	0.97	0.07	1.03	0.52
Uniform Delay, d1	28.5	25.5	23.5	14.8	23.9	8.8
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	46.6	5.2	16.7	0.1	53.7	0.2
Delay (s)	75.1	30.8	40.2	14.9	77.6	9.1
Level of Service	E	C	D	B	E	A
Approach Delay (s)	52.3		38.2			26.7
Approach LOS	D		D			C

Intersection Summary			
HCM Average Control Delay	37.6	HCM Level of Service	D
HCM Volume to Capacity ratio	1.07		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	91.5%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Yield		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	0	347	1173	353	0	1545
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	377	1275	384	0	1679
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	TWLTL					
Median storage veh)	5					
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	2115	638			1275	
vC1, stage 1 conf vol	1275					
vC2, stage 2 conf vol	840					
vCu, unblocked vol	2115	638			1275	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)	5.8					
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	10			100	
cM capacity (veh/h)	222	420			540	

Direction, Lane #	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	377	638	638	384	840	840
Volume Left	0	0	0	0	0	0
Volume Right	377	0	0	384	0	0
cSH	420	1700	1700	1700	1700	1700
Volume to Capacity	0.90	0.38	0.38	0.23	0.49	0.49
Queue Length (ft)	238	0	0	0	0	0
Control Delay (s)	54.0	0.0	0.0	0.0	0.0	0.0
Lane LOS	F					
Approach Delay (s)	54.0	0.0			0.0	
Approach LOS	F					

Intersection Summary			
Average Delay	5.5		
Intersection Capacity Utilization	60.6%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	1.00	0.95	1.00	0.97	0.95
Frpb, ped/bikes	1.00	0.98	1.00	0.97	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1558	3539	1543	3433	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1558	3539	1543	3433	3539
Volume (vph)	996	452	916	1000	585	1041
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	1083	491	996	1087	636	1132
RTOR Reduction (vph)	0	0	0	434	0	0
Lane Group Flow (vph)	1083	491	996	653	636	1132
Confl. Peds. (#/hr)		14		8	8	
Turn Type		Free		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		Free		2		
Actuated Green, G (s)	28.0	90.0	34.0	34.0	16.0	54.0
Effective Green, g (s)	28.0	90.0	34.0	34.0	16.0	54.0
Actuated g/C Ratio	0.31	1.00	0.38	0.38	0.18	0.60
Clearance Time (s)	4.0		4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0		3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	1068	1558	1337	583	610	2123
v/s Ratio Prot	c0.32		0.28		c0.19	0.32
v/s Ratio Perm		0.32		0.70		
v/c Ratio	1.01	0.32	0.74	1.12	1.04	0.53
Uniform Delay, d1	31.0	0.0	24.2	28.0	37.0	10.6
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	31.1	0.5	2.3	75.0	48.0	0.3
Delay (s)	62.1	0.5	26.5	103.0	85.0	10.8
Level of Service	E	A	C	F	F	B
Approach Delay (s)	42.9		66.5			37.5
Approach LOS	D		E			D

Intersection Summary			
HCM Average Control Delay	50.2	HCM Level of Service	D
HCM Volume to Capacity ratio	1.39		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	86.1%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	1093	363	29	1242	225	18
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	1188	395	32	1350	245	20
Pedestrians					2	
Lane Width (ft)					12.0	
Walking Speed (ft/s)					4.0	
Percent Blockage					0	
Right turn flare (veh)						6
Median type					None	
Median storage veh)						
Upstream signal (ft)	475					
pX, platoon unblocked						
vC, conflicting volume			1585		1928	1190
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1585		1928	1190
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			92		0	89
cM capacity (veh/h)			410		54	180

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	1188	395	482	900	264
Volume Left	0	0	32	0	245
Volume Right	0	395	0	0	20
cSH	1700	1700	410	1700	57
Volume to Capacity	0.70	0.23	0.08	0.53	4.66
Queue Length (ft)	0	0	6	0	Err
Control Delay (s)	0.0	0.0	2.4	0.0	Err
Lane LOS			A		F
Approach Delay (s)	0.0		0.8		Err
Approach LOS					F

Intersection Summary			
Average Delay	818.5		
Intersection Capacity Utilization	76.7%	ICU Level of Service	D
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0		4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00		0.97	1.00		1.00		1.00
Frt	1.00	1.00	0.85	1.00	0.98		1.00	0.85		1.00		0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95		1.00
Satd. Flow (prot)	1770	1863	1583	1770	1825		3433	1583		1770		1583
Flt Permitted	0.21	1.00	1.00	0.34	1.00		0.95	1.00		0.95		1.00
Satd. Flow (perm)	385	1863	1583	634	1825		3433	1583		1770		1583
Volume (vph)	377	588	133	224	709	112	121	0	81	108	0	451
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	410	639	145	243	771	122	132	0	88	117	0	490
RTOR Reduction (vph)	0	0	0	0	4	0	0	78	0	0	0	210
Lane Group Flow (vph)	410	639	145	243	889	0	132	10	0	117	0	280
Turn Type	Perm		Free	Perm			Prot			Prot		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		Free	8								6
Actuated Green, G (s)	102.0	102.0	145.3	102.0	102.0		11.3	17.0		14.3		20.0
Effective Green, g (s)	102.0	102.0	145.3	102.0	102.0		11.3	17.0		14.3		20.0
Actuated g/C Ratio	0.70	0.70	1.00	0.70	0.70		0.08	0.12		0.10		0.14
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0		4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0		3.0
Lane Grp Cap (vph)	270	1308	1583	445	1281		267	185		174		218
v/s Ratio Prot		0.34			0.49		0.04	0.06		c0.07		
v/s Ratio Perm	c1.06		0.09	0.38								0.31
v/c Ratio	1.52	0.49	0.09	0.55	0.69		0.49	0.06		0.67		1.28
Uniform Delay, d1	21.7	9.8	0.0	10.5	12.6		64.3	57.0		63.2		62.6
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00		1.00
Incremental Delay, d2	251.5	0.3	0.1	1.4	1.7		1.4	0.1		9.8		157.4
Delay (s)	273.1	10.1	0.1	11.8	14.2		65.7	57.1		73.0		220.1
Level of Service	F	B	A	B	B		E	E		E		F
Approach Delay (s)		99.2			13.7			62.3			191.7	
Approach LOS		F			B			E			F	

Intersection Summary			
HCM Average Control Delay	83.7	HCM Level of Service	F
HCM Volume to Capacity ratio	1.56		
Actuated Cycle Length (s)	145.3	Sum of lost time (s)	12.0
Intersection Capacity Utilization	87.6%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1863	1583	1770	1863	1583	1770	1863	1583	1770	1863	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.17	1.00	1.00	0.41	1.00	1.00
Satd. Flow (perm)	1770	1863	1583	1770	1863	1583	309	1863	1583	756	1863	1583
Volume (vph)	168	394	114	467	664	205	203	323	158	200	540	214
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	183	428	124	508	722	223	221	351	172	217	587	233
RTOR Reduction (vph)	0	0	98	0	0	122	0	0	103	0	0	140
Lane Group Flow (vph)	183	428	26	508	722	101	221	351	69	217	587	93
Turn Type	Prot		Perm	Prot		Perm	Perm		Perm	Perm		Perm
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4			8	2		2	6		6
Actuated Green, G (s)	10.0	21.0	21.0	27.0	38.0	38.0	40.0	40.0	40.0	40.0	40.0	40.0
Effective Green, g (s)	10.0	21.0	21.0	27.0	38.0	38.0	40.0	40.0	40.0	40.0	40.0	40.0
Actuated g/C Ratio	0.10	0.21	0.21	0.27	0.38	0.38	0.40	0.40	0.40	0.40	0.40	0.40
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	177	391	332	478	708	602	124	745	633	302	745	633
v/s Ratio Prot	0.10	0.23		c0.29	c0.39			0.19			0.32	
v/s Ratio Perm			0.08			0.14	c0.72		0.11	0.29		0.15
v/c Ratio	1.03	1.09	0.08	1.06	1.02	0.17	1.78	0.47	0.11	0.72	0.79	0.15
Uniform Delay, d1	45.0	39.5	31.7	36.5	31.0	20.5	30.0	22.2	18.8	25.3	26.3	19.1
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	76.8	73.5	0.1	58.8	38.9	0.1	382.5	0.5	0.1	7.9	5.5	0.1
Delay (s)	121.8	113.0	31.8	95.3	69.9	20.7	412.5	22.7	18.9	33.2	31.8	19.2
Level of Service	F	F	C	F	E	C	F	C	B	C	C	B
Approach Delay (s)		101.5			71.2			137.6			29.3	
Approach LOS		F			E			F			C	

Intersection Summary			
HCM Average Control Delay	78.3	HCM Level of Service	E
HCM Volume to Capacity ratio	1.35		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	99.6%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1770	1583	1770	1863	1863	1583
Flt Permitted	0.95	1.00	0.06	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	116	1863	1863	1583
Volume (vph)	388	324	340	291	1078	674
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	422	352	370	316	1172	733
RTOR Reduction (vph)	0	212	0	0	0	102
Lane Group Flow (vph)	422	140	370	316	1172	631
Turn Type		Perm	pm+pt			Perm
Protected Phases	4		5	2	6	
Permitted Phases		4	2			6
Actuated Green, G (s)	23.0	23.0	79.0	79.0	60.0	60.0
Effective Green, g (s)	23.0	23.0	79.0	79.0	60.0	60.0
Actuated g/C Ratio	0.21	0.21	0.72	0.72	0.55	0.55
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	370	331	309	1338	1016	863
v/s Ratio Prot	c0.24		c0.16	0.17	0.63	
v/s Ratio Perm		0.22	c0.69			0.46
v/c Ratio	1.14	0.42	1.20	0.24	1.15	0.73
Uniform Delay, d1	43.5	37.7	49.7	5.3	25.0	18.9
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	90.8	0.9	115.9	0.1	80.5	3.2
Delay (s)	134.3	38.6	165.6	5.4	105.5	22.1
Level of Service	F	D	F	A	F	C
Approach Delay (s)	90.8			91.8	73.4	
Approach LOS	F			F	E	

Intersection Summary			
HCM Average Control Delay	81.2	HCM Level of Service	F
HCM Volume to Capacity ratio	1.17		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	107.1%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor		1.00	1.00		1.00	1.00	1.00	0.95	1.00	1.00	0.95	
Frpb, ped/bikes		1.00	1.00		1.00	1.00	1.00	1.00	0.98	1.00	1.00	
Flpb, ped/bikes		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt		1.00	0.85		1.00	0.85	1.00	1.00	0.85	1.00	1.00	
Flt Protected		0.97	1.00		0.95	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1800	1583		1778	1583	1770	3539	1549	1770	3522	
Flt Permitted		0.59	1.00		0.72	1.00	0.06	1.00	1.00	0.06	1.00	
Satd. Flow (perm)		1105	1583		1333	1583	111	3539	1549	105	3522	
Volume (vph)	17	7	24	430	18	152	68	1822	579	199	1691	48
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	18	8	26	467	20	165	74	1980	629	216	1838	52
RTOR Reduction (vph)	0	0	18	0	0	47	0	0	305	0	1	0
Lane Group Flow (vph)	0	26	8	0	487	118	74	1980	324	216	1889	0
Confl. Peds. (#/hr)							2		2	2		2
Turn Type	Perm		Perm	Perm		Perm	pm+pt		Perm	pm+pt		
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		
Actuated Green, G (s)		42.0	42.0		42.0	42.0	71.0	67.0	67.0	80.0	72.0	
Effective Green, g (s)		42.0	42.0		42.0	42.0	71.0	67.0	67.0	80.0	72.0	
Actuated g/C Ratio		0.32	0.32		0.32	0.32	0.55	0.52	0.52	0.62	0.55	
Clearance Time (s)		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		357	511		431	511	112	1824	798	180	1951	
v/s Ratio Prot							0.02	0.56		c0.08	0.54	
v/s Ratio Perm		0.02	0.02		c0.37	0.10	0.34		0.41	c0.66		
v/c Ratio		0.07	0.02		1.13	0.23	0.66	1.09	0.41	1.20	0.97	
Uniform Delay, d1		30.5	29.9		44.0	32.2	29.7	31.5	19.3	62.7	27.9	
Progression Factor		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2		0.1	0.0		83.8	0.2	13.7	48.4	0.3	131.2	13.5	
Delay (s)		30.6	30.0		127.8	32.4	43.4	79.9	19.6	193.9	41.4	
Level of Service		C	C		F	C	D	E	B	F	D	
Approach Delay (s)		30.3			103.7			64.8			57.0	
Approach LOS		C			F			E			E	

Intersection Summary			
HCM Average Control Delay	66.1	HCM Level of Service	E
HCM Volume to Capacity ratio	1.16		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	102.8%	ICU Level of Service	G
Analysis Period (min)	15		

c Critical Lane Group

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	3539	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.08	1.00
Satd. Flow (perm)	1770	1583	3539	1583	146	3539
Volume (vph)	180	517	1381	387	587	1490
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	196	562	1501	421	638	1620
RTOR Reduction (vph)	0	406	0	235	0	0
Lane Group Flow (vph)	196	156	1501	186	638	1620
Turn Type		Perm		Perm	pm+pt	
Protected Phases	8		2		1	6
Permitted Phases		8		2	6	
Actuated Green, G (s)	15.1	15.1	47.0	47.0	86.0	86.0
Effective Green, g (s)	15.1	15.1	47.0	47.0	86.0	86.0
Actuated g/C Ratio	0.14	0.14	0.43	0.43	0.79	0.79
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	245	219	1525	682	636	2790
v/s Ratio Prot	0.11		0.42		c0.32	0.46
v/s Ratio Perm		0.35		0.27	c0.47	
v/c Ratio	0.80	0.71	0.98	0.27	1.00	0.58
Uniform Delay, d1	45.5	44.9	30.7	20.0	32.6	4.5
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	16.8	10.5	19.2	0.2	36.5	0.3
Delay (s)	62.4	55.4	49.9	20.3	69.0	4.8
Level of Service	E	E	D	C	E	A
Approach Delay (s)	57.2		43.4			23.0
Approach LOS	E		D			C

Intersection Summary			
HCM Average Control Delay	36.2	HCM Level of Service	D
HCM Volume to Capacity ratio	1.22		
Actuated Cycle Length (s)	109.1	Sum of lost time (s)	8.0
Intersection Capacity Utilization	90.7%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Yield		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	0	381	1478	261	0	1980
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	414	1607	284	0	2152
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	TWLTL					
Median storage veh)	5					
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	2683	803			1607	
vC1, stage 1 conf vol	1607					
vC2, stage 2 conf vol	1076					
vCu, unblocked vol	2683	803			1607	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)	5.8					
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	0			100	
cM capacity (veh/h)	148	326			403	

Direction, Lane #	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	414	803	803	284	1076	1076
Volume Left	0	0	0	0	0	0
Volume Right	414	0	0	284	0	0
cSH	326	1700	1700	1700	1700	1700
Volume to Capacity	1.27	0.47	0.47	0.17	0.63	0.63
Queue Length (ft)	478	0	0	0	0	0
Control Delay (s)	176.4	0.0	0.0	0.0	0.0	0.0
Lane LOS	F					
Approach Delay (s)	176.4	0.0			0.0	
Approach LOS	F					

Intersection Summary			
Average Delay	16.4		
Intersection Capacity Utilization	71.1%	ICU Level of Service	C
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	1.00	0.95	1.00	0.97	0.95
Frpb, ped/bikes	1.00	0.98	1.00	0.97	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1558	3539	1536	3433	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1558	3539	1536	3433	3539
Volume (vph)	1315	569	1175	1316	671	1216
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	1429	618	1277	1430	729	1322
RTOR Reduction (vph)	0	0	0	428	0	0
Lane Group Flow (vph)	1429	618	1277	1002	729	1322
Confl. Peds. (#/hr)		14		8	8	
Turn Type		Free		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		Free		2		
Actuated Green, G (s)	39.0	120.0	50.0	50.0	19.0	73.0
Effective Green, g (s)	39.0	120.0	50.0	50.0	19.0	73.0
Actuated g/C Ratio	0.32	1.00	0.42	0.42	0.16	0.61
Clearance Time (s)	4.0		4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0		3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	1116	1558	1475	640	544	2153
v/s Ratio Prot	c0.42		0.36		c0.21	0.37
v/s Ratio Perm		0.40		0.93		
v/c Ratio	1.28	0.40	0.87	1.57	1.34	0.61
Uniform Delay, d1	40.5	0.0	31.9	35.0	50.5	14.7
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	133.2	0.8	5.6	262.0	165.1	0.5
Delay (s)	173.7	0.8	37.5	297.0	215.6	15.2
Level of Service	F	A	D	F	F	B
Approach Delay (s)	121.5		174.6			86.4
Approach LOS	F		F			F

Intersection Summary			
HCM Average Control Delay	132.0	HCM Level of Service	F
HCM Volume to Capacity ratio	1.73		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	108.1%	ICU Level of Service	G
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	1378	489	17	1597	200	74
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	1498	532	18	1736	217	80
Pedestrians					2	
Lane Width (ft)					12.0	
Walking Speed (ft/s)					4.0	
Percent Blockage					0	
Right turn flare (veh)						6
Median type					None	
Median storage veh)						
Upstream signal (ft)	475					
pX, platoon unblocked						
vC, conflicting volume			2031		2405	1500
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			2031		2405	1500
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			93		0	27
cM capacity (veh/h)			275		26	111

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	1498	532	597	1157	298
Volume Left	0	0	18	0	217
Volume Right	0	532	0	0	80
cSH	1700	1700	275	1700	32
Volume to Capacity	0.88	0.31	0.07	0.68	9.18
Queue Length (ft)	0	0	5	0	Err
Control Delay (s)	0.0	0.0	2.5	0.0	Err
Lane LOS			A		F
Approach Delay (s)	0.0		0.8		Err
Approach LOS					F

Intersection Summary			
Average Delay	730.0		
Intersection Capacity Utilization	90.3%	ICU Level of Service	E
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0		4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00		0.97	1.00		1.00		1.00
Frt	1.00	1.00	0.85	1.00	0.98		1.00	0.85		1.00		0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95		1.00
Satd. Flow (prot)	1770	1863	1583	1770	1822		3433	1583		1770		1583
Flt Permitted	0.17	1.00	1.00	0.19	1.00		0.95	1.00		0.95		1.00
Satd. Flow (perm)	320	1863	1583	348	1822		3433	1583		1770		1583
Volume (vph)	501	798	105	133	704	120	415	0	347	129	0	471
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	545	867	114	145	765	130	451	0	377	140	0	512
RTOR Reduction (vph)	0	0	0	0	4	0	0	149	0	0	0	178
Lane Group Flow (vph)	545	867	114	145	891	0	451	228	0	140	0	334
Turn Type	Perm		Free	Perm			Prot			Prot		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		Free	8								6
Actuated Green, G (s)	98.0	98.0	150.0	98.0	98.0		17.0	28.0		12.0		23.0
Effective Green, g (s)	98.0	98.0	150.0	98.0	98.0		17.0	28.0		12.0		23.0
Actuated g/C Ratio	0.65	0.65	1.00	0.65	0.65		0.11	0.19		0.08		0.15
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0		4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0		3.0
Lane Grp Cap (vph)	209	1217	1583	227	1190		389	295		142		243
v/s Ratio Prot		0.47			0.49		c0.13	0.24		0.08		
v/s Ratio Perm	c1.71		0.07	0.42								0.32
v/c Ratio	2.61	0.71	0.07	0.64	0.75		1.16	0.77		0.99		1.38
Uniform Delay, d1	26.0	16.9	0.0	15.5	17.6		66.5	58.0		68.9		63.5
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00		1.00
Incremental Delay, d2	737.2	2.0	0.1	5.8	2.6		96.7	11.9		70.7		192.7
Delay (s)	763.2	18.9	0.1	21.3	20.3		163.2	69.9		139.6		256.2
Level of Service	F	B	A	C	C		F	E		F		F
Approach Delay (s)		283.3			20.4			120.7			231.1	
Approach LOS		F			C			F			F	

Intersection Summary			
HCM Average Control Delay	174.0	HCM Level of Service	F
HCM Volume to Capacity ratio	2.35		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	114.1%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1863	1583	1770	1863	1583	1770	1863	1583	1770	1863	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.28	1.00	1.00	0.20	1.00	1.00
Satd. Flow (perm)	1770	1863	1583	1770	1863	1583	520	1863	1583	372	1863	1583
Volume (vph)	234	829	218	291	542	232	130	498	452	244	424	199
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	254	901	237	316	589	252	141	541	491	265	461	216
RTOR Reduction (vph)	0	0	80	0	0	107	0	0	193	0	0	130
Lane Group Flow (vph)	254	901	157	316	589	145	141	541	298	265	461	86
Turn Type	Prot		Perm	Prot		Perm	Perm		Perm	Perm		Perm
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4			8	2		2	6		6
Actuated Green, G (s)	19.0	49.0	49.0	17.0	47.0	47.0	52.0	52.0	52.0	52.0	52.0	52.0
Effective Green, g (s)	19.0	49.0	49.0	17.0	47.0	47.0	52.0	52.0	52.0	52.0	52.0	52.0
Actuated g/C Ratio	0.15	0.38	0.38	0.13	0.36	0.36	0.40	0.40	0.40	0.40	0.40	0.40
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	259	702	597	231	674	572	208	745	633	149	745	633
v/s Ratio Prot	0.14	c0.48		c0.18	0.32			0.29			0.25	
v/s Ratio Perm			0.15			0.16	0.27		0.31	c0.71		0.14
v/c Ratio	0.98	1.28	0.26	1.37	0.87	0.25	0.68	0.73	0.47	1.78	0.62	0.14
Uniform Delay, d1	55.3	40.5	28.0	56.5	38.7	29.2	32.1	33.0	28.8	39.0	31.1	24.8
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	50.3	138.3	0.2	190.7	12.1	0.2	8.5	3.5	0.6	376.0	1.5	0.1
Delay (s)	105.6	178.8	28.2	247.2	50.8	29.4	40.6	36.5	29.4	415.0	32.6	24.9
Level of Service	F	F	C	F	D	C	D	D	C	F	C	C
Approach Delay (s)		139.8			99.8			34.0			138.4	
Approach LOS		F			F			C			F	

Intersection Summary			
HCM Average Control Delay	103.0	HCM Level of Service	F
HCM Volume to Capacity ratio	1.46		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	112.8%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1770	1583	1770	1863	1863	1583
Flt Permitted	0.95	1.00	0.16	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	298	1863	1863	1583
Volume (vph)	712	482	352	634	493	515
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	774	524	383	689	536	560
RTOR Reduction (vph)	0	253	0	0	0	251
Lane Group Flow (vph)	774	271	383	689	536	309
Turn Type		Perm	pm+pt			Perm
Protected Phases	4		5	2	6	
Permitted Phases		4	2			6
Actuated Green, G (s)	31.0	31.0	36.0	36.0	21.0	21.0
Effective Green, g (s)	31.0	31.0	36.0	36.0	21.0	21.0
Actuated g/C Ratio	0.41	0.41	0.48	0.48	0.28	0.28
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	732	654	359	894	522	443
v/s Ratio Prot	c0.44		c0.16	0.37	0.29	
v/s Ratio Perm		0.33	0.36			0.35
v/c Ratio	1.06	0.41	1.07	0.77	1.03	0.70
Uniform Delay, d1	22.0	15.6	19.4	16.1	27.0	24.2
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	49.5	0.4	66.4	4.2	46.4	4.8
Delay (s)	71.5	16.0	85.8	20.2	73.4	28.9
Level of Service	E	B	F	C	E	C
Approach Delay (s)	49.1			43.6	50.7	
Approach LOS	D			D	D	

Intersection Summary			
HCM Average Control Delay	47.9	HCM Level of Service	D
HCM Volume to Capacity ratio	1.13		
Actuated Cycle Length (s)	75.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	94.9%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor		1.00	1.00		1.00	1.00	1.00	0.95	1.00	1.00	0.95	
Frpb, ped/bikes		1.00	1.00		1.00	1.00	1.00	1.00	0.98	1.00	1.00	
Flpb, ped/bikes		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt		1.00	0.85		1.00	0.85	1.00	1.00	0.85	1.00	1.00	
Flt Protected		0.96	1.00		0.95	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1795	1583		1777	1583	1770	3539	1549	1770	3529	
Flt Permitted		0.17	1.00		0.66	1.00	0.05	1.00	1.00	0.05	1.00	
Satd. Flow (perm)		311	1583		1235	1583	94	3539	1549	94	3529	
Volume (vph)	59	19	71	583	20	123	60	2206	444	98	2489	44
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	64	21	77	634	22	134	65	2398	483	107	2705	48
RTOR Reduction (vph)	0	0	34	0	0	25	0	0	211	0	1	0
Lane Group Flow (vph)	0	85	43	0	656	109	65	2398	272	107	2752	0
Confl. Peds. (#/hr)							2		2	2		2
Turn Type	Perm		Perm	Perm		Perm	pm+pt		Perm	pm+pt		
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		
Actuated Green, G (s)		55.0	55.0		55.0	55.0	83.0	79.0	79.0	83.0	79.0	
Effective Green, g (s)		55.0	55.0		55.0	55.0	83.0	79.0	79.0	83.0	79.0	
Actuated g/C Ratio		0.37	0.37		0.37	0.37	0.55	0.53	0.53	0.55	0.53	
Clearance Time (s)		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		114	580		453	580	97	1864	816	97	1859	
v/s Ratio Prot							0.02	0.68		c0.03	c0.78	
v/s Ratio Perm		0.27	0.05		c0.53	0.08	0.35		0.31	0.58		
v/c Ratio		0.75	0.07		1.45	0.19	0.67	1.29	0.33	1.10	1.48	
Uniform Delay, d1		41.4	30.9		47.5	32.3	73.8	35.5	20.4	75.2	35.5	
Progression Factor		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2		23.0	0.1		213.8	0.2	16.7	133.1	0.2	121.9	219.1	
Delay (s)		64.4	31.0		261.3	32.5	90.4	168.6	20.6	197.1	254.6	
Level of Service		E	C		F	C	F	F	C	F	F	
Approach Delay (s)		48.5			222.5			142.6			252.5	
Approach LOS		D			F			F			F	

Intersection Summary			
HCM Average Control Delay	196.2	HCM Level of Service	F
HCM Volume to Capacity ratio	1.46		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	123.6%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Appendix S – Intersection Operations Analysis Worksheets for 2035 With Project Phase 2 Conditions, with Mitigation Measures

HCM Signalized Intersection Capacity Analysis
1: Kaiminani Drive & Queen Kaahumanu Highway

2035 AM With Project+Mit
7/25/2012

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	3539	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.11	1.00
Satd. Flow (perm)	1770	1583	3539	1583	207	3539
Volume (vph)	480	510	1261	109	361	1042
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	522	554	1371	118	392	1133
RTOR Reduction (vph)	0	229	0	71	0	0
Lane Group Flow (vph)	522	325	1371	47	392	1133
Turn Type		Perm		Perm	pm+pt	
Protected Phases	8		2		1	6
Permitted Phases		8		2	6	
Actuated Green, G (s)	23.0	23.0	32.0	32.0	49.0	49.0
Effective Green, g (s)	23.0	23.0	32.0	32.0	49.0	49.0
Actuated g/C Ratio	0.29	0.29	0.40	0.40	0.61	0.61
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	509	455	1416	633	381	2168
v/s Ratio Prot	0.29		0.39		c0.17	0.32
v/s Ratio Perm		0.35		0.07	c0.46	
v/c Ratio	1.03	0.71	0.97	0.07	1.03	0.52
Uniform Delay, d1	28.5	25.5	23.5	14.8	23.9	8.8
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	46.6	5.2	16.7	0.1	53.7	0.2
Delay (s)	75.1	30.8	40.2	14.9	77.6	9.1
Level of Service	E	C	D	B	E	A
Approach Delay (s)	52.3		38.2			26.7
Approach LOS	D		D			C

Intersection Summary			
HCM Average Control Delay	37.6	HCM Level of Service	D
HCM Volume to Capacity ratio	1.07		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	91.5%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			


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AM (2035+P2)                Thu Jul 26, 2012 10:26:37                  Page 3-1
-------------------------------------------------------------------------------
                              JB23054 - Kaloko Makai
                                   Kona, Hawaii
                        2025 With Project Phase 2 Conditions
-------------------------------------------------------------------------------
                         Level Of Service Computation Report
             2000 HCM Unsignalized Method (Future Volume Alternative)
*******************************************************************************
Intersection #2 Queen Kaahumanu Hwy. @ Hulikoa Dr.
*******************************************************************************
Average Delay (sec/veh):      0.0       Worst Case Level Of Service: A[  7.2]
*******************************************************************************
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Uncontrolled     Uncontrolled     Yield Sign       Yield Sign
Rights:           Include          Include          Include          Ignore
Lanes:        0  0  2  0  1    0  1  1  0  0    0  0  0  0  0    0  0  1! 0  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:        0  590   218     0  835     0     0    0     0     0    0   182
Growth Adj:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Initial Bse:     0  590   218     0  835     0     0    0     0     0    0   182
Added Vol:       0  583   115    20  648     0     0    0     0    42    0   123
PasserByVol:     0    0    20   -20   62     0     0    0     0   -42    0    42
Initial Fut:     0 1173   353     0 1545     0     0    0     0     0    0   347
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
PHF Volume:      0 1173   353     0 1545     0     0    0     0     0    0     0
Reduct Vol:      0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:     0 1173   353     0 1545     0     0    0     0     0    0     0
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx   6.8  6.5   6.9
FollowUpTim:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx   3.5  4.0   3.3
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  1946 2718   587
Potent Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx    58   21   458
Move Cap.:   xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx    58   21   458
Volume/Cap:  xxxx xxxx  xxxx  xxxx xxxx  xxxx  xxxx xxxx  xxxx  0.00 0.00  0.00
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:   xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Control Del:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
LOS by Move:     *    *     *     *    *     *     *    *     *     *    *     *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx    0 xxxxx
SharedQueue:xxxxx xxxx xxxxx   0.0 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Shrd ConDel:xxxxx xxxx xxxxx   7.2 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Shared LOS:      *    *     *     A    *     *     *    *     *     *    *     *
ApproachDel:    xxxxxx            xxxxxx            xxxxxx            xxxxxx
ApproachLOS:         *                 *                 *                 *
*******************************************************************************
Note: Queue reported is the number of cars per lane.
*******************************************************************************

  Traffix 8.0.0715 (c) 2008 Dowling Assoc. Licensed to KOA CORP, MONTEREY PK
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Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	1.00	0.91	0.88	0.97	0.91
Frpb, ped/bikes	1.00	0.97	1.00	0.96	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1538	5085	2687	3433	5085
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1538	5085	2687	3433	5085
Volume (vph)	996	452	916	1000	585	1041
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	1083	491	996	1087	636	1132
RTOR Reduction (vph)	0	325	0	802	0	0
Lane Group Flow (vph)	1083	166	996	285	636	1132
Confl. Peds. (#/hr)		14		8	8	
Turn Type		Perm		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	22.0	22.0	17.0	17.0	13.9	34.9
Effective Green, g (s)	22.0	22.0	17.0	17.0	13.9	34.9
Actuated g/C Ratio	0.34	0.34	0.26	0.26	0.21	0.54
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	1164	521	1332	704	735	2734
v/s Ratio Prot	0.32		0.20		c0.19	0.22
v/s Ratio Perm		0.32		0.40		
v/c Ratio	0.93	0.32	0.75	0.40	0.87	0.41
Uniform Delay, d1	20.7	15.9	22.0	19.8	24.6	8.9
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	13.0	0.4	2.3	0.4	10.4	0.1
Delay (s)	33.7	16.3	24.3	20.2	35.0	9.0
Level of Service	C	B	C	C	D	A
Approach Delay (s)	28.3		22.1			18.4
Approach LOS	C		C			B

Intersection Summary			
HCM Average Control Delay	22.7	HCM Level of Service	C
HCM Volume to Capacity ratio	1.12		
Actuated Cycle Length (s)	64.9	Sum of lost time (s)	12.0
Intersection Capacity Utilization	72.8%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	1093	363	29	1242	0	18
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	1188	395	32	1350	0	20
Pedestrians					2	
Lane Width (ft)					12.0	
Walking Speed (ft/s)					4.0	
Percent Blockage					0	
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (ft)	475					
pX, platoon unblocked						
vC, conflicting volume			1585		1928	596
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1585		1928	596
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			92		100	96
cM capacity (veh/h)			410		54	446

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	NB 1
Volume Total	594	594	395	482	900	20
Volume Left	0	0	0	32	0	0
Volume Right	0	0	395	0	0	20
cSH	1700	1700	1700	410	1700	446
Volume to Capacity	0.35	0.35	0.23	0.08	0.53	0.04
Queue Length (ft)	0	0	0	6	0	3
Control Delay (s)	0.0	0.0	0.0	2.4	0.0	13.4
Lane LOS				A		B
Approach Delay (s)	0.0			0.8		13.4
Approach LOS						B

Intersection Summary			
Average Delay	0.5		
Intersection Capacity Utilization	64.5%	ICU Level of Service	C
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0		4.0	4.0		4.0
Lane Util. Factor	0.97	0.95		1.00	0.95	1.00	0.97		1.00	1.00		1.00
Frt	1.00	0.97		1.00	1.00	0.85	1.00		0.85	1.00		0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95		1.00	0.95		1.00
Satd. Flow (prot)	3433	3441		1770	3539	1583	3433		1583	1770		1583
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95		1.00	0.95		1.00
Satd. Flow (perm)	3433	3441		1770	3539	1583	3433		1583	1770		1583
Volume (vph)	377	588	133	224	709	112	346	0	81	108	0	451
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	410	639	145	243	771	122	376	0	88	117	0	490
RTOR Reduction (vph)	0	23	0	0	0	85	0	0	73	0	0	0
Lane Group Flow (vph)	410	761	0	243	771	37	376	0	15	117	0	490
Turn Type	Prot			Prot		Perm	Prot		Perm	Prot		Free
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases						8			2			Free
Actuated Green, G (s)	10.4	17.8		11.8	19.2	19.2	15.7		11.0	7.2		63.8
Effective Green, g (s)	10.4	17.8		11.8	19.2	19.2	15.7		11.0	7.2		63.8
Actuated g/C Ratio	0.16	0.28		0.18	0.30	0.30	0.25		0.17	0.11		1.00
Clearance Time (s)	4.0	4.0		4.0	4.0	4.0	4.0		4.0	4.0		
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0		3.0	3.0		
Lane Grp Cap (vph)	560	960		327	1065	476	845		273	200		1583
v/s Ratio Prot	0.12	c0.23		c0.14	0.22		c0.11			c0.07		
v/s Ratio Perm						0.08			0.06			0.31
v/c Ratio	0.73	0.79		0.74	0.72	0.08	0.44		0.06	0.58		0.31
Uniform Delay, d1	25.4	21.3		24.6	19.9	16.0	20.4		22.1	26.9		0.0
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00		1.00
Incremental Delay, d2	4.9	4.6		8.8	2.5	0.1	0.4		0.1	4.3		0.5
Delay (s)	30.3	25.8		33.4	22.4	16.0	20.7		22.1	31.2		0.5
Level of Service	C	C		C	C	B	C		C	C		A
Approach Delay (s)		27.4			24.1			21.0			6.4	
Approach LOS		C			C			C			A	

Intersection Summary			
HCM Average Control Delay	21.7	HCM Level of Service	C
HCM Volume to Capacity ratio	0.64		
Actuated Cycle Length (s)	63.8	Sum of lost time (s)	12.0
Intersection Capacity Utilization	59.4%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	3539	1583	3433	3539	1583	1770	1863	1583	1770	1863	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	3539	1583	3433	3539	1583	1770	1863	1583	1770	1863	1583
Volume (vph)	168	394	114	467	664	205	203	323	158	200	540	214
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	183	428	124	508	722	223	221	351	172	217	587	233
RTOR Reduction (vph)	0	0	102	0	0	173	0	0	0	0	0	153
Lane Group Flow (vph)	183	428	22	508	722	50	221	351	172	217	587	80
Turn Type	Prot		Perm	Prot		Perm	Prot		Free	Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4			8			Free			6
Actuated Green, G (s)	10.0	15.5	15.5	14.0	19.5	19.5	12.0	28.9	87.6	13.2	30.1	30.1
Effective Green, g (s)	10.0	15.5	15.5	14.0	19.5	19.5	12.0	28.9	87.6	13.2	30.1	30.1
Actuated g/C Ratio	0.11	0.18	0.18	0.16	0.22	0.22	0.14	0.33	1.00	0.15	0.34	0.34
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	202	626	280	549	788	352	242	615	1583	267	640	544
v/s Ratio Prot	0.10	0.12		c0.15	c0.20		c0.12	0.19		0.12	c0.32	
v/s Ratio Perm			0.08			0.14			0.11			0.15
v/c Ratio	0.91	0.68	0.08	0.93	0.92	0.14	0.91	0.57	0.11	0.81	0.92	0.15
Uniform Delay, d1	38.3	33.8	30.1	36.3	33.3	27.3	37.3	24.2	0.0	36.0	27.6	19.9
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	38.0	3.1	0.1	21.6	15.2	0.2	35.2	1.3	0.1	17.0	18.0	0.1
Delay (s)	76.3	36.8	30.2	57.9	48.5	27.5	72.5	25.5	0.1	53.0	45.5	20.0
Level of Service	E	D	C	E	D	C	E	C	A	D	D	C
Approach Delay (s)		45.6			48.5			33.6			41.4	
Approach LOS		D			D			C			D	

Intersection Summary			
HCM Average Control Delay	43.3	HCM Level of Service	D
HCM Volume to Capacity ratio	0.89		
Actuated Cycle Length (s)	87.6	Sum of lost time (s)	12.0
Intersection Capacity Utilization	80.7%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	1.00	0.97	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	3433	1583	3433	1863	1863	1583
Flt Permitted	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (perm)	3433	1583	3433	1863	1863	1583
Volume (vph)	388	324	340	291	1078	674
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	422	352	370	316	1172	733
RTOR Reduction (vph)	0	62	0	0	0	3
Lane Group Flow (vph)	422	290	370	316	1172	730
Turn Type		pm+ov	Prot			pm+ov
Protected Phases	4	5	5	2	6	4
Permitted Phases		4				6
Actuated Green, G (s)	15.6	26.6	11.0	76.0	61.0	76.6
Effective Green, g (s)	15.6	26.6	11.0	76.0	61.0	76.6
Actuated g/C Ratio	0.16	0.27	0.11	0.76	0.61	0.77
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	538	486	379	1422	1141	1281
v/s Ratio Prot	0.12	c0.08	c0.11	0.17	c0.63	0.09
v/s Ratio Perm		0.14				0.37
v/c Ratio	0.78	0.60	0.98	0.22	1.03	0.57
Uniform Delay, d1	40.4	31.8	44.2	3.4	19.3	4.7
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	7.4	2.0	39.5	0.1	33.8	0.6
Delay (s)	47.8	33.8	83.7	3.4	53.1	5.3
Level of Service	D	C	F	A	D	A
Approach Delay (s)	41.4			46.7	34.7	
Approach LOS	D			D	C	

Intersection Summary			
HCM Average Control Delay	38.7	HCM Level of Service	D
HCM Volume to Capacity ratio	0.98		
Actuated Cycle Length (s)	99.6	Sum of lost time (s)	12.0
Intersection Capacity Utilization	87.5%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	1.00		0.97	1.00		1.00	0.91	1.00	1.00	0.91	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	0.98	1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.89		1.00	0.87		1.00	1.00	0.85	1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	1649		3433	1614		1770	5085	1558	1770	5061	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1770	1649		3433	1614		1770	5085	1558	1770	5061	
Volume (vph)	17	7	24	430	18	152	68	1822	579	199	1691	48
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	18	8	26	467	20	165	74	1980	629	216	1838	52
RTOR Reduction (vph)	0	24	0	0	132	0	0	0	255	0	3	0
Lane Group Flow (vph)	18	10	0	467	53	0	74	1980	374	216	1887	0
Confl. Peds. (#/hr)							2		2	2		2
Turn Type	Prot			Prot			Prot		pm+ov	Prot		
Protected Phases	7	4		3	8		5	2	3	1	6	
Permitted Phases									2			
Actuated Green, G (s)	1.5	5.7		12.1	16.3		4.7	36.1	48.2	11.1	42.5	
Effective Green, g (s)	1.5	5.7		12.1	16.3		4.7	36.1	48.2	11.1	42.5	
Actuated g/C Ratio	0.02	0.07		0.15	0.20		0.06	0.45	0.60	0.14	0.52	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	33	116		513	325		103	2266	1004	243	2655	
v/s Ratio Prot	0.01	0.02		c0.14	c0.11		0.04	c0.39	c0.09	c0.12	0.37	
v/s Ratio Perm									0.31			
v/c Ratio	0.55	0.08		0.91	0.16		0.72	0.87	0.37	0.89	0.71	
Uniform Delay, d1	39.4	35.2		33.9	26.7		37.5	20.4	8.5	34.3	14.6	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	17.2	0.3		20.3	0.2		21.2	4.1	0.2	29.9	0.9	
Delay (s)	56.6	35.5		54.2	27.0		58.7	24.4	8.8	64.3	15.5	
Level of Service	E	D		D	C		E	C	A	E	B	
Approach Delay (s)		42.8			46.5			21.7			20.5	
Approach LOS		D			D			C			C	

Intersection Summary			
HCM Average Control Delay	24.4	HCM Level of Service	C
HCM Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	81.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	75.2%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
1: Kaiminani Drive & Queen Kaahumanu Highway

2035 PM With Project+Mit
7/25/2012

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	3539	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.08	1.00
Satd. Flow (perm)	1770	1583	3539	1583	146	3539
Volume (vph)	180	517	1381	387	587	1490
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	196	562	1501	421	638	1620
RTOR Reduction (vph)	0	406	0	235	0	0
Lane Group Flow (vph)	196	156	1501	186	638	1620
Turn Type		Perm		Perm	pm+pt	
Protected Phases	8		2		1	6
Permitted Phases		8		2	6	
Actuated Green, G (s)	15.1	15.1	47.0	47.0	86.0	86.0
Effective Green, g (s)	15.1	15.1	47.0	47.0	86.0	86.0
Actuated g/C Ratio	0.14	0.14	0.43	0.43	0.79	0.79
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	245	219	1525	682	636	2790
v/s Ratio Prot	0.11		0.42		c0.32	0.46
v/s Ratio Perm		0.35		0.27	c0.47	
v/c Ratio	0.80	0.71	0.98	0.27	1.00	0.58
Uniform Delay, d1	45.5	44.9	30.7	20.0	32.6	4.5
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	16.8	10.5	19.2	0.2	36.5	0.3
Delay (s)	62.4	55.4	49.9	20.3	69.0	4.8
Level of Service	E	E	D	C	E	A
Approach Delay (s)	57.2		43.4			23.0
Approach LOS	E		D			C

Intersection Summary			
HCM Average Control Delay	36.2	HCM Level of Service	D
HCM Volume to Capacity ratio	1.22		
Actuated Cycle Length (s)	109.1	Sum of lost time (s)	8.0
Intersection Capacity Utilization	90.7%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			


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PM (2035+P2)                Thu Jul 26, 2012 10:27:31                  Page 3-1
-------------------------------------------------------------------------------
                              JB23054 - Kaloko Makai
                                   Kona, Hawaii
                        2025 With Project Phase 2 Conditions
-------------------------------------------------------------------------------
                         Level Of Service Computation Report
             2000 HCM Unsignalized Method (Future Volume Alternative)
*******************************************************************************
Intersection #2 Queen Kaahumanu Hwy. @ Hulikoa Dr.
*******************************************************************************
Average Delay (sec/veh):      0.0       Worst Case Level Of Service: A[  7.2]
*******************************************************************************
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Uncontrolled     Uncontrolled     Yield Sign       Yield Sign
Rights:           Include          Include          Include          Ignore
Lanes:        0  0  2  0  1    0  1  1  0  0    0  0  0  0  0    0  0  1! 0  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:        0  719   122     0 1068     0     0    0     0     0    0   205
Growth Adj:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Initial Bse:     0  719   122     0 1068     0     0    0     0     0    0   205
Added Vol:       0  759   126    13  854     0     0    0     0    45    0   131
PasserByVol:     0    0    13   -13   58     0     0    0     0   -45    0    45
Initial Fut:     0 1478   261     0 1980     0     0    0     0     0    0   381
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
PHF Volume:      0 1478   261     0 1980     0     0    0     0     0    0     0
Reduct Vol:      0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:     0 1478   261     0 1980     0     0    0     0     0    0     0
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx   6.8  6.5   6.9
FollowUpTim:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx   3.5  4.0   3.3
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  2468 3458   739
Potent Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx    26    7   364
Move Cap.:   xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx    26    7   364
Volume/Cap:  xxxx xxxx  xxxx  xxxx xxxx  xxxx  xxxx xxxx  xxxx  0.00 0.00  0.00
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:   xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Control Del:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
LOS by Move:     *    *     *     *    *     *     *    *     *     *    *     *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx    0 xxxxx
SharedQueue:xxxxx xxxx xxxxx   0.0 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Shrd ConDel:xxxxx xxxx xxxxx   7.2 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Shared LOS:      *    *     *     A    *     *     *    *     *     *    *     *
ApproachDel:    xxxxxx            xxxxxx            xxxxxx            xxxxxx
ApproachLOS:         *                 *                 *                 *
*******************************************************************************
Note: Queue reported is the number of cars per lane.
*******************************************************************************

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Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	1.00	0.91	0.88	0.97	0.91
Frpb, ped/bikes	1.00	0.96	1.00	0.96	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1524	5085	2663	3433	5085
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1524	5085	2663	3433	5085
Volume (vph)	1315	569	1175	1316	671	1216
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	1429	618	1277	1430	729	1322
RTOR Reduction (vph)	0	288	0	944	0	0
Lane Group Flow (vph)	1429	330	1277	487	729	1322
Confl. Peds. (#/hr)		14		8	8	
Turn Type		Perm		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	41.0	41.0	26.0	26.0	21.0	51.0
Effective Green, g (s)	41.0	41.0	26.0	26.0	21.0	51.0
Actuated g/C Ratio	0.41	0.41	0.26	0.26	0.21	0.51
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	1408	625	1322	692	721	2593
v/s Ratio Prot	c0.42		0.25		c0.21	0.26
v/s Ratio Perm		0.41		0.54		
v/c Ratio	1.01	0.53	0.97	0.70	1.01	0.51
Uniform Delay, d1	29.5	22.2	36.6	33.5	39.5	16.2
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	27.8	0.8	17.1	3.2	36.3	0.2
Delay (s)	57.3	23.0	53.7	36.8	75.8	16.4
Level of Service	E	C	D	D	E	B
Approach Delay (s)	46.9		44.7			37.5
Approach LOS	D		D			D

Intersection Summary			
HCM Average Control Delay	43.2	HCM Level of Service	D
HCM Volume to Capacity ratio	1.32		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	89.4%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	1378	489	17	1597	0	74
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	1498	532	18	1736	0	80
Pedestrians					2	
Lane Width (ft)					12.0	
Walking Speed (ft/s)					4.0	
Percent Blockage					0	
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (ft)	475					
pX, platoon unblocked						
vC, conflicting volume			2031		2405	751
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			2031		2405	751
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			93		100	77
cM capacity (veh/h)			275		26	353

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	NB 1
Volume Total	749	749	532	597	1157	80
Volume Left	0	0	0	18	0	0
Volume Right	0	0	532	0	0	80
cSH	1700	1700	1700	275	1700	353
Volume to Capacity	0.44	0.44	0.31	0.07	0.68	0.23
Queue Length (ft)	0	0	0	5	0	22
Control Delay (s)	0.0	0.0	0.0	2.5	0.0	18.2
Lane LOS				A		C
Approach Delay (s)	0.0			0.8		18.2
Approach LOS						C

Intersection Summary			
Average Delay	0.8		
Intersection Capacity Utilization	81.8%	ICU Level of Service	D
Analysis Period (min)	15		

HCM Signalized Intersection Capacity Analysis
5: Hina Lani Street & Kamanu Street

2035 PM With Project+Mit
7/25/2012

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0		4.0	4.0		4.0
Lane Util. Factor	0.97	0.95		1.00	0.95	1.00	0.97		1.00	1.00		1.00
Frt	1.00	0.98		1.00	1.00	0.85	1.00		0.85	1.00		0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95		1.00	0.95		1.00
Satd. Flow (prot)	3433	3478		1770	3539	1583	3433		1583	1770		1583
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95		1.00	0.95		1.00
Satd. Flow (perm)	3433	3478		1770	3539	1583	3433		1583	1770		1583
Volume (vph)	501	798	105	133	704	120	615	0	347	129	0	471
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	545	867	114	145	765	130	668	0	377	140	0	512
RTOR Reduction (vph)	0	10	0	0	0	96	0	0	228	0	0	0
Lane Group Flow (vph)	545	971	0	145	765	34	668	0	149	140	0	512
Turn Type	Prot			Prot		Perm	Prot		Perm	Prot		Free
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases						8			2			Free
Actuated Green, G (s)	14.9	25.4		8.8	19.3	19.3	20.6		15.9	7.3		73.4
Effective Green, g (s)	14.9	25.4		8.8	19.3	19.3	20.6		15.9	7.3		73.4
Actuated g/C Ratio	0.20	0.35		0.12	0.26	0.26	0.28		0.22	0.10		1.00
Clearance Time (s)	4.0	4.0		4.0	4.0	4.0	4.0		4.0	4.0		
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0		3.0	3.0		
Lane Grp Cap (vph)	697	1204		212	931	416	963		343	176		1583
v/s Ratio Prot	c0.16	c0.28		0.08	0.22		c0.19			0.08		
v/s Ratio Perm						0.08			0.24			0.32
v/c Ratio	0.78	0.81		0.68	0.82	0.08	0.69		0.43	0.80		0.32
Uniform Delay, d1	27.7	21.8		31.0	25.4	20.4	23.6		24.9	32.3		0.0
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00		1.00
Incremental Delay, d2	5.7	4.0		8.8	5.9	0.1	2.2		0.9	21.5		0.5
Delay (s)	33.4	25.8		39.8	31.3	20.5	25.8		25.7	53.8		0.5
Level of Service	C	C		D	C	C	C		C	D		A
Approach Delay (s)		28.5			31.2			25.8			12.0	
Approach LOS		C			C			C			B	

Intersection Summary				
HCM Average Control Delay	26.0	HCM Level of Service	C	
HCM Volume to Capacity ratio	0.86			
Actuated Cycle Length (s)	73.4	Sum of lost time (s)	12.0	
Intersection Capacity Utilization	68.0%	ICU Level of Service	C	
Analysis Period (min)	15			
c Critical Lane Group				

HCM Signalized Intersection Capacity Analysis
6: Hina Lani Street & Ane Keahokalole Hwy.

2035 PM With Project+Mit
7/25/2012

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	3539	1583	3433	3539	1583	1770	1863	1583	1770	1863	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	3539	1583	3433	3539	1583	1770	1863	1583	1770	1863	1583
Volume (vph)	234	829	218	291	542	232	130	498	452	244	424	199
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	254	901	237	316	589	252	141	541	491	265	461	216
RTOR Reduction (vph)	0	0	174	0	0	198	0	0	0	0	0	149
Lane Group Flow (vph)	254	901	63	316	589	54	141	541	491	265	461	67
Turn Type	Prot		Perm	Prot		Perm	Prot		Free	Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4			8			Free			6
Actuated Green, G (s)	11.0	20.0	20.0	7.0	16.0	16.0	8.6	21.0	75.0	11.0	23.4	23.4
Effective Green, g (s)	11.0	20.0	20.0	7.0	16.0	16.0	8.6	21.0	75.0	11.0	23.4	23.4
Actuated g/C Ratio	0.15	0.27	0.27	0.09	0.21	0.21	0.11	0.28	1.00	0.15	0.31	0.31
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	260	944	422	320	755	338	203	522	1583	260	581	494
v/s Ratio Prot	c0.14	c0.25		0.09	0.17		0.08	c0.29		c0.15	0.25	
v/s Ratio Perm			0.15			0.16			0.31			0.14
v/c Ratio	0.98	0.95	0.15	0.99	0.78	0.16	0.69	1.04	0.31	1.02	0.79	0.14
Uniform Delay, d1	31.9	27.1	21.0	34.0	27.8	24.0	31.9	27.0	0.0	32.0	23.6	18.5
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	48.9	19.1	0.2	46.5	5.2	0.2	9.9	49.1	0.5	60.8	7.3	0.1
Delay (s)	80.8	46.1	21.2	80.4	33.1	24.2	41.8	76.1	0.5	92.8	30.9	18.7
Level of Service	F	D	C	F	C	C	D	E	A	F	C	B
Approach Delay (s)		48.2			44.1			40.3			45.5	
Approach LOS		D			D			D			D	

Intersection Summary				
HCM Average Control Delay	44.7	HCM Level of Service	D	
HCM Volume to Capacity ratio	1.02			
Actuated Cycle Length (s)	75.0	Sum of lost time (s)	16.0	
Intersection Capacity Utilization	84.3%	ICU Level of Service	E	
Analysis Period (min)	15			
c Critical Lane Group				

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	1.00	0.97	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	3433	1583	3433	1863	1863	1583
Flt Permitted	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (perm)	3433	1583	3433	1863	1863	1583
Volume (vph)	712	482	352	634	493	515
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	774	524	383	689	536	560
RTOR Reduction (vph)	0	79	0	0	0	12
Lane Group Flow (vph)	774	445	383	689	536	548
Turn Type		pm+ov	Prot			pm+ov
Protected Phases	4	5	5	2	6	4
Permitted Phases		4				6
Actuated Green, G (s)	15.2	23.2	8.0	29.7	17.7	32.9
Effective Green, g (s)	15.2	23.2	8.0	29.7	17.7	32.9
Actuated g/C Ratio	0.29	0.44	0.15	0.56	0.33	0.62
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	986	814	519	1046	623	1104
v/s Ratio Prot	c0.23	c0.10	0.11	0.37	c0.29	0.15
v/s Ratio Perm		0.23				0.21
v/c Ratio	0.78	0.55	0.74	0.66	0.86	0.50
Uniform Delay, d1	17.3	11.0	21.4	8.1	16.4	5.5
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	4.2	0.8	5.4	1.5	11.7	0.4
Delay (s)	21.5	11.7	26.9	9.6	28.1	5.8
Level of Service	C	B	C	A	C	A
Approach Delay (s)	17.6			15.8	16.7	
Approach LOS	B			B	B	

Intersection Summary			
HCM Average Control Delay	16.7	HCM Level of Service	B
HCM Volume to Capacity ratio	0.76		
Actuated Cycle Length (s)	52.9	Sum of lost time (s)	8.0
Intersection Capacity Utilization	66.3%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	1.00		0.97	1.00		1.00	0.91	1.00	1.00	0.91	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	0.98	1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.88		1.00	0.87		1.00	1.00	0.85	1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	1643		3433	1623		1770	5085	1558	1770	5070	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1770	1643		3433	1623		1770	5085	1558	1770	5070	
Volume (vph)	59	19	71	583	20	123	60	2206	444	98	2489	44
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	64	21	77	634	22	134	65	2398	483	107	2705	48
RTOR Reduction (vph)	0	53	0	0	119	0	0	0	123	0	1	0
Lane Group Flow (vph)	64	45	0	634	37	0	65	2398	360	107	2752	0
Confl. Peds. (#/hr)							2		2	2		2
Turn Type	Prot			Prot			Prot		pm+ov	Prot		
Protected Phases	7	4		3	8		5	2	3	1	6	
Permitted Phases									2			
Actuated Green, G (s)	20.4	9.2		25.9	14.7		5.0	74.0	99.9	9.0	78.0	
Effective Green, g (s)	20.4	9.2		25.9	14.7		5.0	74.0	99.9	9.0	78.0	
Actuated g/C Ratio	0.15	0.07		0.19	0.11		0.04	0.55	0.74	0.07	0.58	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	269	113		663	178		66	2806	1161	119	2949	
v/s Ratio Prot	0.04	0.06		c0.18	c0.10		0.04	c0.47	0.08	0.06	c0.54	
v/s Ratio Perm									0.23			
v/c Ratio	0.24	0.40		0.96	0.21		0.98	0.85	0.31	0.90	0.93	
Uniform Delay, d1	50.0	59.8		53.5	54.4		64.5	25.5	5.7	62.1	25.7	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.5	2.3		24.4	0.6		104.8	2.7	0.2	51.9	6.3	
Delay (s)	50.5	62.1		77.9	55.0		169.3	28.2	5.8	114.0	31.9	
Level of Service	D	E		E	D		F	C	A	F	C	
Approach Delay (s)		57.5			73.4			27.7			35.0	
Approach LOS		E			E			C			C	

Intersection Summary			
HCM Average Control Delay	36.8	HCM Level of Service	D
HCM Volume to Capacity ratio	0.90		
Actuated Cycle Length (s)	134.1	Sum of lost time (s)	8.0
Intersection Capacity Utilization	87.7%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Appendix T – Intersection Operations Analysis Worksheets for 2045 With Project Phase 3 Conditions, with Existing Geometry and Planned Improvements

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	3539	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.08	1.00
Satd. Flow (perm)	1770	1583	3539	1583	141	3539
Volume (vph)	480	588	1549	109	412	1232
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	522	639	1684	118	448	1339
RTOR Reduction (vph)	0	236	0	65	0	0
Lane Group Flow (vph)	522	403	1684	53	448	1339
Turn Type		Perm		Perm	pm+pt	
Protected Phases	8		2		1	6
Permitted Phases		8		2	6	
Actuated Green, G (s)	29.0	29.0	49.0	49.0	73.0	73.0
Effective Green, g (s)	29.0	29.0	49.0	49.0	73.0	73.0
Actuated g/C Ratio	0.26	0.26	0.45	0.45	0.66	0.66
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	467	417	1576	705	390	2349
v/s Ratio Prot	0.29		0.48		c0.21	0.38
v/s Ratio Perm		0.40		0.07	c0.56	
v/c Ratio	1.12	0.97	1.07	0.07	1.15	0.57
Uniform Delay, d1	40.5	40.0	30.5	17.5	47.2	10.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	77.9	35.2	43.5	0.0	92.7	0.3
Delay (s)	118.4	75.3	74.0	17.5	139.9	10.3
Level of Service	F	E	E	B	F	B
Approach Delay (s)	94.6		70.3			42.8
Approach LOS	F		E			D

Intersection Summary			
HCM Average Control Delay	65.9	HCM Level of Service	E
HCM Volume to Capacity ratio	1.24		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	102.2%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

HCM Unsignalized Intersection Capacity Analysis
2: Hulikoa Drive & Queen Kaahumanu Highway

2045 AM With Project
7/25/2012

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Yield		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	0	375	1433	363	0	1735
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	408	1558	395	0	1886
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	TWLTL					
Median storage veh)	5					
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	2501	779			1558	
vC1, stage 1 conf vol	1558					
vC2, stage 2 conf vol	943					
vCu, unblocked vol	2501	779			1558	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)	5.8					
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	0			100	
cM capacity (veh/h)	158	339			421	

Direction, Lane #	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	408	779	779	395	943	943
Volume Left	0	0	0	0	0	0
Volume Right	408	0	0	395	0	0
cSH	339	1700	1700	1700	1700	1700
Volume to Capacity	1.20	0.46	0.46	0.23	0.55	0.55
Queue Length (ft)	435	0	0	0	0	0
Control Delay (s)	150.0	0.0	0.0	0.0	0.0	0.0
Lane LOS	F					
Approach Delay (s)	150.0	0.0			0.0	
Approach LOS	F					

Intersection Summary			
Average Delay	14.4		
Intersection Capacity Utilization	69.5%	ICU Level of Service	C
Analysis Period (min)	15		

HCM Signalized Intersection Capacity Analysis
3: Hina Lani Street & Queen Kaahumanu Highway

2045 AM With Project
7/25/2012

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	1.00	0.95	1.00	0.97	0.95
Frpb, ped/bikes	1.00	0.98	1.00	0.97	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1558	3539	1539	3433	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1558	3539	1539	3433	3539
Volume (vph)	1277	548	1089	1174	666	1150
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	1388	596	1184	1276	724	1250
RTOR Reduction (vph)	0	0	0	448	0	0
Lane Group Flow (vph)	1388	596	1184	828	724	1250
Confl. Peds. (#/hr)		14		8	8	
Turn Type		Free		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		Free		2		
Actuated Green, G (s)	37.0	110.0	43.0	43.0	18.0	65.0
Effective Green, g (s)	37.0	110.0	43.0	43.0	18.0	65.0
Actuated g/C Ratio	0.34	1.00	0.39	0.39	0.16	0.59
Clearance Time (s)	4.0		4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0		3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	1155	1558	1383	602	562	2091
v/s Ratio Prot	c0.40		0.33		c0.21	0.35
v/s Ratio Perm		0.38		0.83		
v/c Ratio	1.20	0.38	0.86	1.38	1.29	0.60
Uniform Delay, d1	36.5	0.0	30.7	33.5	46.0	14.2
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	99.3	0.7	5.4	179.5	142.7	0.5
Delay (s)	135.8	0.7	36.1	213.0	188.7	14.7
Level of Service	F	A	D	F	F	B
Approach Delay (s)	95.2		127.9			78.5
Approach LOS	F		F			E

Intersection Summary			
HCM Average Control Delay	102.6	HCM Level of Service	F
HCM Volume to Capacity ratio	1.62		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	99.2%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	1348	363	29	1620	225	18
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	1465	395	32	1761	245	20
Pedestrians					2	
Lane Width (ft)					12.0	
Walking Speed (ft/s)					4.0	
Percent Blockage					0	
Right turn flare (veh)						6
Median type					None	
Median storage veh)						
Upstream signal (ft)	475					
pX, platoon unblocked						
vC, conflicting volume			1862		2411	1467
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1862		2411	1467
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			90		0	83
cM capacity (veh/h)			320		25	117

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	1465	395	618	1174	264
Volume Left	0	0	32	0	245
Volume Right	0	395	0	0	20
cSH	1700	1700	320	1700	26
Volume to Capacity	0.86	0.23	0.10	0.69	10.12
Queue Length (ft)	0	0	8	0	Err
Control Delay (s)	0.0	0.0	3.4	0.0	Err
Lane LOS			A		F
Approach Delay (s)	0.0		1.2		Err
Approach LOS					F

Intersection Summary			
Average Delay	674.9		
Intersection Capacity Utilization	90.1%	ICU Level of Service	E
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0		4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00		0.97	1.00		1.00		1.00
Frt	1.00	1.00	0.85	1.00	0.98		1.00	0.85		1.00		0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95		1.00
Satd. Flow (prot)	1770	1863	1583	1770	1831		3433	1583		1770		1583
Flt Permitted	0.13	1.00	1.00	0.13	1.00		0.95	1.00		0.95		1.00
Satd. Flow (perm)	238	1863	1583	238	1831		3433	1583		1770		1583
Volume (vph)	447	774	133	224	1072	138	121	0	81	113	0	466
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	486	841	145	243	1165	150	132	0	88	123	0	507
RTOR Reduction (vph)	0	0	0	0	6	0	0	67	0	0	0	118
Lane Group Flow (vph)	486	841	145	243	1309	0	132	21	0	123	0	389
Turn Type	Perm		Free	Perm			Prot			Prot		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		Free	8								6
Actuated Green, G (s)	31.3	31.3	67.0	31.3	31.3		7.5	16.0		7.7		16.2
Effective Green, g (s)	31.3	31.3	67.0	31.3	31.3		7.5	16.0		7.7		16.2
Actuated g/C Ratio	0.47	0.47	1.00	0.47	0.47		0.11	0.24		0.11		0.24
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0		4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0		3.0
Lane Grp Cap (vph)	111	870	1583	111	855		384	378		203		383
v/s Ratio Prot		0.45			0.72		0.04	0.06		c0.07		
v/s Ratio Perm	c2.04		0.09	1.02								0.32
v/c Ratio	4.38	0.97	0.09	2.19	1.53		0.34	0.06		0.61		1.02
Uniform Delay, d1	17.8	17.3	0.0	17.8	17.8		27.5	19.7		28.2		25.4
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00		1.00
Incremental Delay, d2	1541.0	22.5	0.1	563.5	244.9		0.5	0.1		5.0		50.3
Delay (s)	1558.9	39.8	0.1	581.3	262.8		28.0	19.7		33.2		75.7
Level of Service	F	D	A	F	F		C	B		C		E
Approach Delay (s)		537.4			312.5			24.7			67.4	
Approach LOS		F			F			C			E	

Intersection Summary			
HCM Average Control Delay	341.7	HCM Level of Service	F
HCM Volume to Capacity ratio	2.76		
Actuated Cycle Length (s)	67.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	112.5%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1863	1583	1770	1863	1583	1770	1863	1583	1770	1863	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.11	1.00	1.00	0.35	1.00	1.00
Satd. Flow (perm)	1770	1863	1583	1770	1863	1583	212	1863	1583	657	1863	1583
Volume (vph)	186	543	127	604	919	248	220	374	235	216	611	243
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	202	590	138	657	999	270	239	407	255	235	664	264
RTOR Reduction (vph)	0	0	72	0	0	82	0	0	147	0	0	121
Lane Group Flow (vph)	202	590	66	657	999	188	239	407	108	235	664	143
Turn Type	Prot		Perm	Prot		Perm	Perm		Perm	Perm		Perm
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4			8	2		2	6		6
Actuated Green, G (s)	11.0	31.0	31.0	32.0	52.0	52.0	55.0	55.0	55.0	55.0	55.0	55.0
Effective Green, g (s)	11.0	31.0	31.0	32.0	52.0	52.0	55.0	55.0	55.0	55.0	55.0	55.0
Actuated g/C Ratio	0.08	0.24	0.24	0.25	0.40	0.40	0.42	0.42	0.42	0.42	0.42	0.42
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	150	444	377	436	745	633	90	788	670	278	788	670
v/s Ratio Prot	0.11	0.32		c0.37	c0.54			0.22			0.36	
v/s Ratio Perm			0.09			0.17	c1.13		0.16	0.36		0.17
v/c Ratio	1.35	1.33	0.18	1.51	1.34	0.30	2.66	0.52	0.16	0.85	0.84	0.21
Uniform Delay, d1	59.5	49.5	39.3	49.0	39.0	26.6	37.5	27.7	23.2	33.7	33.6	23.8
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	193.6	162.9	0.2	239.8	162.4	0.3	775.8	0.6	0.1	20.4	8.2	0.2
Delay (s)	253.1	212.4	39.6	288.8	201.4	26.8	813.3	28.3	23.3	54.0	41.8	23.9
Level of Service	F	F	D	F	F	C	F	C	C	D	D	C
Approach Delay (s)		195.6			206.7			235.1			40.2	
Approach LOS		F			F			F			D	

Intersection Summary			
HCM Average Control Delay	170.5	HCM Level of Service	F
HCM Volume to Capacity ratio	1.96		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	119.7%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1770	1583	1770	1863	1863	1583
Flt Permitted	0.95	1.00	0.05	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	87	1863	1863	1583
Volume (vph)	481	410	396	342	1269	769
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	523	446	430	372	1379	836
RTOR Reduction (vph)	0	200	0	0	0	73
Lane Group Flow (vph)	523	246	430	372	1379	763
Turn Type		Perm	pm+pt			Perm
Protected Phases	4		5	2	6	
Permitted Phases		4	2			6
Actuated Green, G (s)	34.0	34.0	108.0	108.0	82.0	82.0
Effective Green, g (s)	34.0	34.0	108.0	108.0	82.0	82.0
Actuated g/C Ratio	0.23	0.23	0.72	0.72	0.55	0.55
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	401	359	309	1341	1018	865
v/s Ratio Prot	c0.30		c0.20	0.20	0.74	
v/s Ratio Perm		0.28	c0.80			0.53
v/c Ratio	1.30	0.68	1.39	0.28	1.35	0.88
Uniform Delay, d1	58.0	53.1	66.2	7.3	34.0	29.8
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	154.0	5.3	194.9	0.1	166.1	10.5
Delay (s)	212.0	58.4	261.1	7.5	200.1	40.3
Level of Service	F	E	F	A	F	D
Approach Delay (s)	141.3			143.4	139.8	
Approach LOS	F			F	F	

Intersection Summary			
HCM Average Control Delay	140.9	HCM Level of Service	F
HCM Volume to Capacity ratio	1.35		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	125.4%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor		1.00	1.00		1.00	1.00	1.00	0.95	1.00	1.00	0.95	
Frpb, ped/bikes		1.00	1.00		1.00	1.00	1.00	1.00	0.98	1.00	1.00	
Flpb, ped/bikes		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt		1.00	0.85		1.00	0.85	1.00	1.00	0.85	1.00	1.00	
Flt Protected		0.97	1.00		0.95	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1800	1583		1777	1583	1770	3539	1549	1770	3526	
Flt Permitted		0.50	1.00		0.71	1.00	0.06	1.00	1.00	0.06	1.00	
Satd. Flow (perm)		940	1583		1331	1583	110	3539	1549	103	3526	
Volume (vph)	17	7	24	492	18	152	68	2169	620	199	2081	48
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	18	8	26	535	20	165	74	2358	674	216	2262	52
RTOR Reduction (vph)	0	0	18	0	0	41	0	0	321	0	1	0
Lane Group Flow (vph)	0	26	8	0	555	124	74	2358	353	216	2313	0
Confl. Peds. (#/hr)							2		2	2		2
Turn Type	Perm		Perm	Perm		Perm	pm+pt		Perm	pm+pt		
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		
Actuated Green, G (s)		42.0	42.0		42.0	42.0	72.0	68.0	68.0	80.0	72.0	
Effective Green, g (s)		42.0	42.0		42.0	42.0	72.0	68.0	68.0	80.0	72.0	
Actuated g/C Ratio		0.32	0.32		0.32	0.32	0.55	0.52	0.52	0.62	0.55	
Clearance Time (s)		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		304	511		430	511	112	1851	810	166	1953	
v/s Ratio Prot							0.02	0.67		c0.08	0.66	
v/s Ratio Perm		0.03	0.02		c0.42	0.10	0.35		0.44	c0.72		
v/c Ratio		0.09	0.02		1.29	0.24	0.66	1.27	0.44	1.30	1.18	
Uniform Delay, d1		30.6	29.9		44.0	32.3	63.7	31.0	19.1	63.2	29.0	
Progression Factor		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2		0.1	0.0		147.3	0.2	13.7	127.6	0.4	172.4	88.4	
Delay (s)		30.8	30.0		191.3	32.6	77.4	158.6	19.5	235.5	117.4	
Level of Service		C	C		F	C	E	F	B	F	F	
Approach Delay (s)		30.4			154.9			126.5			127.5	
Approach LOS		C			F			F			F	

Intersection Summary			
HCM Average Control Delay	129.3	HCM Level of Service	F
HCM Volume to Capacity ratio	1.28		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	115.9%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	3539	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.06	1.00
Satd. Flow (perm)	1770	1583	3539	1583	110	3539
Volume (vph)	180	580	1626	387	669	1802
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	196	630	1767	421	727	1959
RTOR Reduction (vph)	0	409	0	188	0	0
Lane Group Flow (vph)	196	221	1767	233	727	1959
Turn Type		Perm		Perm	pm+pt	
Protected Phases	8		2		1	6
Permitted Phases		8		2	6	
Actuated Green, G (s)	17.0	17.0	64.0	64.0	115.0	115.0
Effective Green, g (s)	17.0	17.0	64.0	64.0	115.0	115.0
Actuated g/C Ratio	0.12	0.12	0.46	0.46	0.82	0.82
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	215	192	1618	724	648	2907
v/s Ratio Prot	0.11		0.50		c0.38	0.55
v/s Ratio Perm		0.40		0.27	c0.55	
v/c Ratio	0.91	1.15	1.09	0.32	1.12	0.67
Uniform Delay, d1	60.8	61.5	38.0	24.2	48.7	5.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	37.9	112.4	52.0	0.3	73.9	0.6
Delay (s)	98.6	173.9	90.0	24.4	122.6	5.6
Level of Service	F	F	F	C	F	A
Approach Delay (s)	156.0		77.4			37.3
Approach LOS	F		E			D

Intersection Summary			
HCM Average Control Delay	69.9	HCM Level of Service	E
HCM Volume to Capacity ratio	1.39		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	102.0%	ICU Level of Service	G
Analysis Period (min)	15		

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
2: Hulikoa Drive & Queen Kaahumanu Highway

2045 PM With Project
7/25/2012

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Yield		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	0	404	1701	269	0	2292
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	439	1849	292	0	2491
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	TWLTL					
Median storage veh)	5					
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	3095	924			1849	
vC1, stage 1 conf vol	1849					
vC2, stage 2 conf vol	1246					
vCu, unblocked vol	3095	924			1849	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)	5.8					
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	0			100	
cM capacity (veh/h)	109	271			324	

Direction, Lane #	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	439	924	924	292	1246	1246
Volume Left	0	0	0	0	0	0
Volume Right	439	0	0	292	0	0
cSH	271	1700	1700	1700	1700	1700
Volume to Capacity	1.62	0.54	0.54	0.17	0.73	0.73
Queue Length (ft)	677	0	0	0	0	0
Control Delay (s)	328.2	0.0	0.0	0.0	0.0	0.0
Lane LOS	F					
Approach Delay (s)	328.2	0.0			0.0	
Approach LOS	F					

Intersection Summary			
Average Delay	28.4		
Intersection Capacity Utilization	78.7%	ICU Level of Service	D
Analysis Period (min)	15		

HCM Signalized Intersection Capacity Analysis
3: Hina Lani Street & Queen Kaahumanu Highway

2045 PM With Project
7/25/2012

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	1.00	0.95	1.00	0.97	0.95
Frpb, ped/bikes	1.00	0.98	1.00	0.97	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1558	3539	1532	3433	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1558	3539	1532	3433	3539
Volume (vph)	1542	647	1328	1602	802	1397
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	1676	703	1443	1741	872	1518
RTOR Reduction (vph)	0	0	0	414	0	0
Lane Group Flow (vph)	1676	703	1443	1327	872	1518
Confl. Peds. (#/hr)		14		8	8	
Turn Type		Free		Perm	Prot	
Protected Phases	8		2		1	6
Permitted Phases		Free		2		
Actuated Green, G (s)	45.0	140.0	61.0	61.0	22.0	87.0
Effective Green, g (s)	45.0	140.0	61.0	61.0	22.0	87.0
Actuated g/C Ratio	0.32	1.00	0.44	0.44	0.16	0.62
Clearance Time (s)	4.0		4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0		3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	1103	1558	1542	668	539	2199
v/s Ratio Prot	c0.49		0.41		c0.25	0.43
v/s Ratio Perm		0.45		1.14		
v/c Ratio	1.52	0.45	0.94	1.99	1.62	0.69
Uniform Delay, d1	47.5	0.0	37.6	39.5	59.0	17.6
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	238.5	0.9	11.0	449.6	286.5	0.9
Delay (s)	286.0	0.9	48.6	489.1	345.5	18.5
Level of Service	F	A	D	F	F	B
Approach Delay (s)	201.7		289.4			137.8
Approach LOS	F		F			F

Intersection Summary			
HCM Average Control Delay	217.6	HCM Level of Service	F
HCM Volume to Capacity ratio	2.05		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	129.6%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	1795	489	17	1900	200	74
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	1951	532	18	2065	217	80
Pedestrians					2	
Lane Width (ft)					12.0	
Walking Speed (ft/s)					4.0	
Percent Blockage					0	
Right turn flare (veh)						6
Median type					None	
Median storage veh)						
Upstream signal (ft)	475					
pX, platoon unblocked						
vC, conflicting volume			2485		3023	1953
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			2485		3023	1953
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			90		0	0
cM capacity (veh/h)			182		9	54

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	1951	532	707	1377	298
Volume Left	0	0	18	0	217
Volume Right	0	532	0	0	80
cSH	1700	1700	182	1700	12
Volume to Capacity	1.15	0.31	0.10	0.81	25.19
Queue Length (ft)	0	0	8	0	Err
Control Delay (s)	0.0	0.0	5.2	0.0	Err
Lane LOS			A		F
Approach Delay (s)	0.0		1.8		Err
Approach LOS					F

Intersection Summary			
Average Delay	613.0		
Intersection Capacity Utilization	112.2%	ICU Level of Service	H
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0		4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00		0.97	1.00		1.00		1.00
Frt	1.00	1.00	0.85	1.00	0.98		1.00	0.85		1.00		0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95		1.00
Satd. Flow (prot)	1770	1863	1583	1770	1830		3433	1583		1770		1583
Flt Permitted	0.12	1.00	1.00	0.12	1.00		0.95	1.00		0.95		1.00
Satd. Flow (perm)	226	1863	1583	226	1830		3433	1583		1770		1583
Volume (vph)	519	1197	105	133	944	127	415	0	347	153	0	534
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	564	1301	114	145	1026	138	451	0	377	166	0	580
RTOR Reduction (vph)	0	0	0	0	6	0	0	39	0	0	0	32
Lane Group Flow (vph)	564	1301	114	145	1158	0	451	338	0	166	0	548
Turn Type	Perm		Free	Perm			Prot			Prot		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		Free	8								6
Actuated Green, G (s)	33.0	33.0	78.4	33.0	33.0		14.4	23.7		9.7		19.0
Effective Green, g (s)	33.0	33.0	78.4	33.0	33.0		14.4	23.7		9.7		19.0
Actuated g/C Ratio	0.42	0.42	1.00	0.42	0.42		0.18	0.30		0.12		0.24
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0		4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0		3.0
Lane Grp Cap (vph)	95	784	1583	95	770		631	479		219		384
v/s Ratio Prot		0.70			0.64		c0.13	0.24		0.09		
v/s Ratio Perm	c2.50		0.07	0.64								0.37
v/c Ratio	5.94	1.66	0.07	1.53	1.50		0.71	0.71		0.76		1.43
Uniform Delay, d1	22.7	22.7	0.0	22.7	22.7		30.1	24.3		33.2		29.7
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00		1.00
Incremental Delay, d2	2244.1	302.4	0.1	282.9	233.6		3.8	4.7		13.9		206.9
Delay (s)	2266.8	325.1	0.1	305.6	256.3		33.9	28.9		47.1		236.6
Level of Service	F	F	A	F	F		C	C		D		F
Approach Delay (s)		859.8			261.8			31.7			194.5	
Approach LOS		F			F			C			F	

Intersection Summary			
HCM Average Control Delay	455.7	HCM Level of Service	F
HCM Volume to Capacity ratio	3.53		
Actuated Cycle Length (s)	78.4	Sum of lost time (s)	12.0
Intersection Capacity Utilization	129.4%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1863	1583	1770	1863	1583	1770	1863	1583	1770	1863	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.25	1.00	1.00	0.17	1.00	1.00
Satd. Flow (perm)	1770	1863	1583	1770	1863	1583	459	1863	1583	324	1863	1583
Volume (vph)	270	1106	237	380	710	252	145	549	570	286	477	227
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	293	1202	258	413	772	274	158	597	620	311	518	247
RTOR Reduction (vph)	0	0	65	0	0	87	0	0	133	0	0	143
Lane Group Flow (vph)	293	1202	193	413	772	187	158	597	487	311	518	105
Turn Type	Prot		Perm	Prot		Perm	Perm		Perm	Perm		Perm
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4			8	2		2	6		6
Actuated Green, G (s)	12.0	47.0	47.0	16.0	51.0	51.0	55.0	55.0	55.0	55.0	55.0	55.0
Effective Green, g (s)	12.0	47.0	47.0	16.0	51.0	51.0	55.0	55.0	55.0	55.0	55.0	55.0
Actuated g/C Ratio	0.09	0.36	0.36	0.12	0.39	0.39	0.42	0.42	0.42	0.42	0.42	0.42
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	163	674	572	218	731	621	194	788	670	137	788	670
v/s Ratio Prot	0.17	c0.65		c0.23	c0.41			0.32			0.28	
v/s Ratio Perm			0.16			0.17	0.34		0.39	c0.96		0.16
v/c Ratio	1.80	1.78	0.34	1.89	1.06	0.30	0.81	0.76	0.73	2.27	0.66	0.16
Uniform Delay, d1	59.0	41.5	30.2	57.0	39.5	27.2	33.0	31.8	31.2	37.5	30.0	23.2
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	382.3	358.5	0.4	419.3	49.1	0.3	22.4	4.2	3.9	594.1	2.0	0.1
Delay (s)	441.3	400.0	30.5	476.3	88.6	27.5	55.4	36.0	35.2	631.6	32.0	23.3
Level of Service	F	F	C	F	F	C	E	D	D	F	C	C
Approach Delay (s)		352.5			186.9			37.9			203.3	
Approach LOS		F			F			D			F	

Intersection Summary			
HCM Average Control Delay	205.1	HCM Level of Service	F
HCM Volume to Capacity ratio	2.07		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	137.3%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1770	1583	1770	1863	1863	1583
Flt Permitted	0.95	1.00	0.13	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	240	1863	1863	1583
Volume (vph)	796	551	442	739	578	611
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	865	599	480	803	628	664
RTOR Reduction (vph)	0	260	0	0	0	211
Lane Group Flow (vph)	865	339	480	803	628	453
Turn Type		Perm	pm+pt			Perm
Protected Phases	4		5	2	6	
Permitted Phases		4	2			6
Actuated Green, G (s)	36.0	36.0	46.0	46.0	27.0	27.0
Effective Green, g (s)	36.0	36.0	46.0	46.0	27.0	27.0
Actuated g/C Ratio	0.40	0.40	0.51	0.51	0.30	0.30
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	708	633	378	952	559	475
v/s Ratio Prot	c0.49		c0.21	0.43	0.34	
v/s Ratio Perm		0.38	0.44			0.42
v/c Ratio	1.22	0.54	1.27	0.84	1.12	0.95
Uniform Delay, d1	27.0	20.6	39.7	18.9	31.5	30.9
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	112.2	0.9	140.8	6.9	76.8	29.5
Delay (s)	139.2	21.5	180.5	25.8	108.3	60.4
Level of Service	F	C	F	C	F	E
Approach Delay (s)	91.1			83.7	83.6	
Approach LOS	F			F	F	

Intersection Summary			
HCM Average Control Delay	86.3	HCM Level of Service	F
HCM Volume to Capacity ratio	1.30		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	109.0%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor		1.00	1.00		1.00	1.00	1.00	0.95	1.00	1.00	0.95	
Frpb, ped/bikes		1.00	1.00		1.00	1.00	1.00	1.00	0.98	1.00	1.00	
Flpb, ped/bikes		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt		1.00	0.85		1.00	0.85	1.00	1.00	0.85	1.00	1.00	
Flt Protected		0.96	1.00		0.95	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1795	1583		1777	1583	1770	3539	1549	1770	3530	
Flt Permitted		0.13	1.00		0.66	1.00	0.05	1.00	1.00	0.05	1.00	
Satd. Flow (perm)		238	1583		1231	1583	92	3539	1549	92	3530	
Volume (vph)	59	19	71	634	20	123	60	2645	509	98	2896	44
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	64	21	77	689	22	134	65	2875	553	107	3148	48
RTOR Reduction (vph)	0	0	34	0	0	23	0	0	202	0	1	0
Lane Group Flow (vph)	0	85	43	0	711	111	65	2875	351	107	3195	0
Confl. Peds. (#/hr)							2		2	2		2
Turn Type	Perm		Perm	Perm		Perm	pm+pt		Perm	pm+pt		
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		
Actuated Green, G (s)		53.0	53.0		53.0	53.0	85.0	81.0	81.0	85.0	81.0	
Effective Green, g (s)		53.0	53.0		53.0	53.0	85.0	81.0	81.0	85.0	81.0	
Actuated g/C Ratio		0.35	0.35		0.35	0.35	0.57	0.54	0.54	0.57	0.54	
Clearance Time (s)		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)		84	559		435	559	97	1911	836	97	1906	
v/s Ratio Prot							0.02	0.81		c0.03	c0.91	
v/s Ratio Perm		0.36	0.05		c0.58	0.08	0.36		0.36	0.60		
v/c Ratio		1.01	0.08		1.63	0.20	0.67	1.50	0.42	1.10	1.68	
Uniform Delay, d1		48.5	32.2		48.5	33.7	73.8	34.5	20.5	75.2	34.5	
Progression Factor		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2		101.5	0.1		295.8	0.2	16.7	229.8	0.3	121.9	306.7	
Delay (s)		150.0	32.3		344.3	33.9	90.4	264.3	20.9	197.1	341.2	
Level of Service		F	C		F	C	F	F	C	F	F	
Approach Delay (s)		94.1			295.1			222.5			336.5	
Approach LOS		F			F			F			F	

Intersection Summary			
HCM Average Control Delay	276.0	HCM Level of Service	F
HCM Volume to Capacity ratio	1.64		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	132.0%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Appendix U – Intersection Operations Analysis Worksheets for 2045 With Project Phase 3 Conditions, with Mitigation Measures

HCM Signalized Intersection Capacity Analysis
1: Kaiminani Drive & Queen Kaahumanu Highway

2045 AM With Project+Mit
7/25/2012

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	1.00	0.91	1.00	0.97	0.91
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1583	5085	1583	3433	5085
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1583	5085	1583	3433	5085
Volume (vph)	480	588	1549	109	412	1232
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	522	639	1684	118	448	1339
RTOR Reduction (vph)	0	1	0	73	0	0
Lane Group Flow (vph)	522	638	1684	45	448	1339
Turn Type		pm+ov		Perm	Prot	
Protected Phases	8	1	2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	13.7	25.8	23.5	23.5	12.1	39.6
Effective Green, g (s)	13.7	25.8	23.5	23.5	12.1	39.6
Actuated g/C Ratio	0.22	0.42	0.38	0.38	0.20	0.65
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	767	770	1949	607	678	3285
v/s Ratio Prot	0.15	c0.16	c0.33		0.13	0.26
v/s Ratio Perm		0.24		0.07		
v/c Ratio	0.68	0.83	0.86	0.07	0.66	0.41
Uniform Delay, d1	21.8	15.8	17.4	12.0	22.7	5.2
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	2.5	7.3	4.3	0.1	2.4	0.1
Delay (s)	24.3	23.1	21.7	12.0	25.1	5.3
Level of Service	C	C	C	B	C	A
Approach Delay (s)	23.6		21.1			10.3
Approach LOS	C		C			B

Intersection Summary			
HCM Average Control Delay	17.6	HCM Level of Service	B
HCM Volume to Capacity ratio	0.85		
Actuated Cycle Length (s)	61.3	Sum of lost time (s)	8.0
Intersection Capacity Utilization	73.0%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Synchro 6 Report
Page 1

Katz, Okitsu & Associates


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AM (2045+P3)                Thu Jul 26, 2012 10:29:10                  Page 3-1
-------------------------------------------------------------------------------
                              JB23054 - Kaloko Makai
                                   Kona, Hawaii
                        2035 With Project Phase 3 Conditions
-------------------------------------------------------------------------------
                         Level Of Service Computation Report
             2000 HCM Unsignalized Method (Future Volume Alternative)
*******************************************************************************
Intersection #2 Queen Kaahumanu Hwy. @ Hulikoa Dr.
*******************************************************************************
Average Delay (sec/veh):      0.0       Worst Case Level Of Service: A[  7.2]
*******************************************************************************
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Uncontrolled     Uncontrolled     Yield Sign       Yield Sign
Rights:           Include          Include          Include          Ignore
Lanes:        0  0  2  0  1    0  1  2  0  0    0  0  0  0  0    0  0  1! 0  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:        0  590   218     0  835     0     0    0     0     0    0   182
Growth Adj:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Initial Bse:     0  590   218     0  835     0     0    0     0     0    0   182
Added Vol:       0  843   125    20  838     0     0    0     0    42    0   151
PasserByVol:     0    0    20   -20   62     0     0    0     0   -42    0    42
Initial Fut:     0 1433   363     0 1735     0     0    0     0     0    0   375
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
PHF Volume:      0 1433   363     0 1735     0     0    0     0     0    0     0
Reduct Vol:      0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:     0 1433   363     0 1735     0     0    0     0     0    0     0
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx   6.8  6.5   6.9
FollowUpTim:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx   3.5  4.0   3.3
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  2011 3168   717
Potent Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx    52   11   377
Move Cap.:   xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx    52   11   377
Volume/Cap:  xxxx xxxx  xxxx  xxxx xxxx  xxxx  xxxx xxxx  xxxx  0.00 0.00  0.00
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:   xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Control Del:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
LOS by Move:     *    *     *     *    *     *     *    *     *     *    *     *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx    0 xxxxx
SharedQueue:xxxxx xxxx xxxxx   0.0 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Shrd ConDel:xxxxx xxxx xxxxx   7.2 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Shared LOS:      *    *     *     A    *     *     *    *     *     *    *     *
ApproachDel:    xxxxxx            xxxxxx            xxxxxx            xxxxxx
ApproachLOS:         *                 *                 *                 *
*******************************************************************************
Note: Queue reported is the number of cars per lane.
*******************************************************************************

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Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	1348	363	29	1620	0	18
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	1465	395	32	1761	0	20
Pedestrians					2	
Lane Width (ft)					12.0	
Walking Speed (ft/s)					4.0	
Percent Blockage					0	
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			1862		2411	735
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1862		2411	735
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			90		100	95
cM capacity (veh/h)			320		25	362

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1
Volume Total	733	733	395	32	880	880	20
Volume Left	0	0	0	32	0	0	0
Volume Right	0	0	395	0	0	0	20
cSH	1700	1700	1700	320	1700	1700	362
Volume to Capacity	0.43	0.43	0.23	0.10	0.52	0.52	0.05
Queue Length (ft)	0	0	0	8	0	0	4
Control Delay (s)	0.0	0.0	0.0	17.5	0.0	0.0	15.5
Lane LOS				C			C
Approach Delay (s)	0.0			0.3			15.5
Approach LOS							C

Intersection Summary			
Average Delay	0.2		
Intersection Capacity Utilization	48.1%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0		4.0	4.0		4.0
Lane Util. Factor	0.97	0.95		1.00	0.95	1.00	0.97		1.00	1.00		1.00
Frt	1.00	0.98		1.00	1.00	0.85	1.00		0.85	1.00		0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95		1.00	0.95		1.00
Satd. Flow (prot)	3433	3461		1770	3539	1583	3433		1583	1770		1583
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95		1.00	0.95		1.00
Satd. Flow (perm)	3433	3461		1770	3539	1583	3433		1583	1770		1583
Volume (vph)	447	774	133	224	1072	138	346	0	81	113	0	466
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	486	841	145	243	1165	150	376	0	88	123	0	507
RTOR Reduction (vph)	0	14	0	0	0	81	0	0	76	0	0	0
Lane Group Flow (vph)	486	972	0	243	1165	69	376	0	12	123	0	507
Turn Type	Prot			Prot		Perm	Prot		Perm	Prot		Free
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases						8			2			Free
Actuated Green, G (s)	13.2	29.6		13.0	29.4	29.4	16.8		10.5	9.0		78.1
Effective Green, g (s)	13.2	29.6		13.0	29.4	29.4	16.8		10.5	9.0		78.1
Actuated g/C Ratio	0.17	0.38		0.17	0.38	0.38	0.22		0.13	0.12		1.00
Clearance Time (s)	4.0	4.0		4.0	4.0	4.0	4.0		4.0	4.0		
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0		3.0	3.0		
Lane Grp Cap (vph)	580	1312		295	1332	596	738		213	204		1583
v/s Ratio Prot	c0.14	0.28		0.14	c0.33		c0.11			c0.07		
v/s Ratio Perm						0.09			0.06			0.32
v/c Ratio	0.84	0.74		0.82	0.87	0.12	0.51		0.06	0.60		0.32
Uniform Delay, d1	31.4	20.9		31.4	22.6	15.9	27.0		29.5	32.9		0.0
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00		1.00
Incremental Delay, d2	10.2	2.3		16.8	6.7	0.1	0.6		0.1	5.0		0.5
Delay (s)	41.7	23.2		48.2	29.3	16.0	27.6		29.6	37.8		0.5
Level of Service	D	C		D	C	B	C		C	D		A
Approach Delay (s)		29.3			31.0			28.0			7.8	
Approach LOS		C			C			C			A	

Intersection Summary			
HCM Average Control Delay	26.5	HCM Level of Service	C
HCM Volume to Capacity ratio	0.72		
Actuated Cycle Length (s)	78.1	Sum of lost time (s)	12.0
Intersection Capacity Utilization	68.9%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	0.95	1.00	0.97	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frpb, ped/bikes	1.00	1.00	0.99	1.00	1.00	0.99	1.00	1.00	0.99	1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	3539	1565	3433	3539	1562	1770	1863	1562	1770	1863	1551
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	3539	1565	3433	3539	1562	1770	1863	1562	1770	1863	1551
Volume (vph)	186	543	127	604	919	248	220	374	235	216	611	243
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	186	543	127	604	919	248	220	374	235	216	611	243
RTOR Reduction (vph)	0	0	46	0	0	103	0	0	0	0	0	122
Lane Group Flow (vph)	186	543	81	604	919	145	220	374	235	216	611	121
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Turn Type	Prot		pm+ov	Prot		pm+ov	Prot		Free	Prot		Perm
Protected Phases	7	4	5	3	8	1	5	2		1	6	
Permitted Phases			4			8			Free			6
Actuated Green, G (s)	5.0	15.8	27.8	16.0	26.8	40.2	12.0	28.6	89.8	13.4	30.0	30.0
Effective Green, g (s)	5.0	15.8	27.8	16.0	26.8	40.2	12.0	28.6	89.8	13.4	30.0	30.0
Actuated g/C Ratio	0.06	0.18	0.31	0.18	0.30	0.45	0.13	0.32	1.00	0.15	0.33	0.33
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	191	623	554	612	1056	769	237	593	1562	264	622	518
v/s Ratio Prot	0.05	0.15	0.03	c0.18	c0.26	0.05	c0.12	0.20		0.12	c0.33	
v/s Ratio Perm			0.05			0.11			0.15			0.16
v/c Ratio	0.97	0.87	0.15	0.99	0.87	0.19	0.93	0.63	0.15	0.82	0.98	0.23
Uniform Delay, d1	42.3	36.0	22.4	36.8	29.9	15.0	38.5	26.1	0.0	37.0	29.6	21.6
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	57.1	12.7	0.1	32.7	8.0	0.1	38.9	2.2	0.2	17.6	31.4	0.2
Delay (s)	99.4	48.7	22.5	69.5	37.8	15.1	77.4	28.3	0.2	54.6	61.1	21.8
Level of Service	F	D	C	E	D	B	E	C	A	D	E	C
Approach Delay (s)		55.9			45.5			33.3			50.9	
Approach LOS		E			D			C			D	

Intersection Summary			
HCM Average Control Delay	46.5	HCM Level of Service	D
HCM Volume to Capacity ratio	0.89		
Actuated Cycle Length (s)	89.8	Sum of lost time (s)	8.0
Intersection Capacity Utilization	89.9%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	1.00	0.97	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	3433	1583	3433	1863	1863	1583
Flt Permitted	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (perm)	3433	1583	3433	1863	1863	1583
Volume (vph)	481	410	396	342	1269	769
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	481	410	396	342	1269	769
RTOR Reduction (vph)	0	62	0	0	0	0
Lane Group Flow (vph)	481	348	396	342	1269	769
Turn Type		pm+ov	Prot			Free
Protected Phases	4	5	5	2	6	
Permitted Phases		4				Free
Actuated Green, G (s)	18.0	33.0	15.0	104.0	85.0	130.0
Effective Green, g (s)	18.0	33.0	15.0	104.0	85.0	130.0
Actuated g/C Ratio	0.14	0.25	0.12	0.80	0.65	1.00
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	475	451	396	1490	1218	1583
v/s Ratio Prot	c0.14	c0.10	0.12	0.18	c0.68	
v/s Ratio Perm		0.15				0.49
v/c Ratio	1.01	0.77	1.00	0.23	1.04	0.49
Uniform Delay, d1	56.0	45.0	57.5	3.2	22.5	0.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	44.5	8.0	45.2	0.1	37.4	1.1
Delay (s)	100.5	53.0	102.7	3.3	59.9	1.1
Level of Service	F	D	F	A	E	A
Approach Delay (s)	78.6			56.6	37.7	
Approach LOS	E			E	D	

Intersection Summary			
HCM Average Control Delay	51.5	HCM Level of Service	D
HCM Volume to Capacity ratio	1.01		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	101.8%	ICU Level of Service	G
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	1.00		0.97	1.00		1.00	0.91	1.00	1.00	0.91	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	0.98	1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.89		1.00	0.87		1.00	1.00	0.85	1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	1649		3433	1614		1770	5085	1558	1770	5066	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1770	1649		3433	1614		1770	5085	1558	1770	5066	
Volume (vph)	17	7	24	492	18	152	68	2169	620	199	2081	48
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	18	8	26	535	20	165	74	2358	674	216	2262	52
RTOR Reduction (vph)	0	25	0	0	132	0	0	0	213	0	2	0
Lane Group Flow (vph)	18	9	0	535	53	0	74	2358	461	216	2312	0
Confl. Peds. (#/hr)							2		2	2		2
Turn Type	Prot			Prot			Prot		pm+ov	Prot		
Protected Phases	7	4		3	8		5	2	3	1	6	
Permitted Phases									2			
Actuated Green, G (s)	1.9	5.9		18.1	22.1		5.5	57.0	75.1	14.1	65.6	
Effective Green, g (s)	1.9	5.9		18.1	22.1		5.5	57.0	75.1	14.1	65.6	
Actuated g/C Ratio	0.02	0.05		0.16	0.20		0.05	0.51	0.68	0.13	0.59	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	30	88		559	321		88	2609	1109	225	2991	
v/s Ratio Prot	0.01	0.02		c0.16	c0.11		0.04	c0.46	c0.10	c0.12	0.46	
v/s Ratio Perm									0.33			
v/c Ratio	0.60	0.11		0.96	0.16		0.84	0.90	0.42	0.96	0.77	
Uniform Delay, d1	54.2	50.1		46.1	36.9		52.4	24.6	8.1	48.2	17.1	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	29.4	0.5		27.3	0.2		48.1	4.9	0.3	48.6	1.3	
Delay (s)	83.6	50.6		73.5	37.1		100.5	29.5	8.4	96.8	18.4	
Level of Service	F	D		E	D		F	C	A	F	B	
Approach Delay (s)		62.0			64.1			26.6			25.1	
Approach LOS		E			E			C			C	

Intersection Summary			
HCM Average Control Delay	30.5	HCM Level of Service	C
HCM Volume to Capacity ratio	0.85		
Actuated Cycle Length (s)	111.1	Sum of lost time (s)	8.0
Intersection Capacity Utilization	83.6%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	1.00	0.91	1.00	0.97	0.91
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1583	5085	1583	3433	5085
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1583	5085	1583	3433	5085
Volume (vph)	180	580	1626	387	669	1802
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	196	630	1767	421	727	1959
RTOR Reduction (vph)	0	1	0	242	0	0
Lane Group Flow (vph)	196	629	1767	179	727	1959
Turn Type		pm+ov		Perm	Prot	
Protected Phases	8	1	2		1	6
Permitted Phases		8		2		
Actuated Green, G (s)	9.1	26.7	28.7	28.7	17.6	50.3
Effective Green, g (s)	9.1	26.7	28.7	28.7	17.6	50.3
Actuated g/C Ratio	0.14	0.40	0.43	0.43	0.26	0.75
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	464	721	2165	674	896	3795
v/s Ratio Prot	0.06	c0.23	c0.35		0.21	0.39
v/s Ratio Perm		0.17		0.27		
v/c Ratio	0.42	0.87	0.82	0.27	0.81	0.52
Uniform Delay, d1	26.7	18.8	17.0	12.5	23.3	3.5
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.6	11.3	2.5	0.2	5.6	0.1
Delay (s)	27.4	30.0	19.5	12.7	29.0	3.6
Level of Service	C	C	B	B	C	A
Approach Delay (s)	29.4		18.2			10.5
Approach LOS	C		B			B

Intersection Summary			
HCM Average Control Delay	16.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.85		
Actuated Cycle Length (s)	67.4	Sum of lost time (s)	8.0
Intersection Capacity Utilization	74.0%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

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PM (2045+P3)                Thu Jul 26, 2012 10:30:04                  Page 3-1
-------------------------------------------------------------------------------
                              JB23054 - Kaloko Makai
                                   Kona, Hawaii
                        2035 With Project Phase 3 Conditions
-------------------------------------------------------------------------------
                        Level Of Service Computation Report
            2000 HCM Unsignalized Method (Future Volume Alternative)
*******************************************************************************
Intersection #2 Queen Kaahumanu Hwy. @ Hulikoa Dr.
*******************************************************************************
Average Delay (sec/veh):      0.0       Worst Case Level Of Service: A[  7.2]
*******************************************************************************
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:       Uncontrolled     Uncontrolled     Yield Sign       Yield Sign
Rights:           Include          Include          Include          Ignore
Lanes:        0  0  2  0  1    0  1  2  0  0    0  0  0  0  0    0  0  1! 0  0
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:        0  719   122     0 1068     0     0    0     0     0    0   205
Growth Adj:   1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Initial Bse:     0  719   122     0 1068     0     0    0     0     0    0   205
Added Vol:       0  982   134    13 1166     0     0    0     0    45    0   154
PasserByVol:     0    0    13   -13   58     0     0    0     0   -45    0    45
Initial Fut:     0 1701   269     0 2292     0     0    0     0     0    0   404
User Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
PHF Adj:      1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  0.00
PHF Volume:      0 1701   269     0 2292     0     0    0     0     0    0     0
Reduct Vol:      0    0     0     0    0     0     0    0     0     0    0     0
FinalVolume:     0 1701   269     0 2292     0     0    0     0     0    0     0
------------|---------------||---------------||---------------||---------------|
Critical Gap Module:
Critical Gp:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx   6.8  6.5   6.9
FollowUpTim:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx   3.5  4.0   3.3
------------|---------------||---------------||---------------||---------------|
Capacity Module:
Cnflict Vol: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  2465 3993   851
Potent Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx    26    3   308
Move Cap.:   xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx    26    3   308
Volume/Cap:  xxxx xxxx  xxxx  xxxx xxxx  xxxx  xxxx xxxx  xxxx  0.00 0.00  0.00
------------|---------------||---------------||---------------||---------------|
Level Of Service Module:
2Way95thQ:   xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx
Control Del:xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
LOS by Move:    *    *     *     *    *     *     *    *     *     *    *     *
Movement:     LT - LTR - RT    LT - LTR - RT    LT - LTR - RT    LT - LTR - RT
Shared Cap.: xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx xxxx xxxxx  xxxx    0 xxxxx
SharedQueue:xxxxx xxxx xxxxx   0.0 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Shrd ConDel:xxxxx xxxx xxxxx   7.2 xxxx xxxxx xxxxx xxxx xxxxx xxxxx xxxx xxxxx
Shared LOS:     *    *     *     A    *     *     *    *     *     *    *     *
ApproachDel:    xxxxxx            xxxxxx            xxxxxx            xxxxxx
ApproachLOS:         *                 *                 *                 *
*******************************************************************************
Note: Queue reported is the number of cars per lane.
*******************************************************************************

  Traffix 8.0.0715 (c) 2008 Dowling Assoc. Licensed to KOA CORP, MONTEREY PK
```


Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	1795	489	17	1900	0	74
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	1951	532	18	2065	0	80
Pedestrians					2	
Lane Width (ft)					12.0	
Walking Speed (ft/s)					4.0	
Percent Blockage					0	
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			2485		3023	978
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			2485		3023	978
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			90		100	68
cM capacity (veh/h)			182		9	250

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1
Volume Total	976	976	532	18	1033	1033	80
Volume Left	0	0	0	18	0	0	0
Volume Right	0	0	532	0	0	0	80
cSH	1700	1700	1700	182	1700	1700	250
Volume to Capacity	0.57	0.57	0.31	0.10	0.61	0.61	0.32
Queue Length (ft)	0	0	0	8	0	0	34
Control Delay (s)	0.0	0.0	0.0	27.0	0.0	0.0	26.1
Lane LOS				D			D
Approach Delay (s)	0.0			0.2			26.1
Approach LOS							D

Intersection Summary			
Average Delay	0.6		
Intersection Capacity Utilization	60.9%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0		4.0	4.0		4.0
Lane Util. Factor	0.97	0.95		1.00	0.95	1.00	0.97		1.00	1.00		1.00
Frt	1.00	0.99		1.00	1.00	0.85	1.00		0.85	1.00		0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95		1.00	0.95		1.00
Satd. Flow (prot)	3433	3496		1770	3539	1583	3433		1583	1770		1583
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95		1.00	0.95		1.00
Satd. Flow (perm)	3433	3496		1770	3539	1583	3433		1583	1770		1583
Volume (vph)	519	1197	105	133	944	127	615	0	347	153	0	534
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	564	1301	114	145	1026	138	668	0	377	166	0	580
RTOR Reduction (vph)	0	6	0	0	0	80	0	0	186	0	0	0
Lane Group Flow (vph)	564	1409	0	145	1026	58	668	0	191	166	0	580
Turn Type	Prot			Prot		Perm	Prot		Perm	Prot		Free
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases						8			2			Free
Actuated Green, G (s)	17.0	40.3		8.1	31.4	31.4	27.5		17.8	12.8		95.0
Effective Green, g (s)	17.0	40.3		8.1	31.4	31.4	27.5		17.8	12.8		95.0
Actuated g/C Ratio	0.18	0.42		0.09	0.33	0.33	0.29		0.19	0.13		1.00
Clearance Time (s)	4.0	4.0		4.0	4.0	4.0	4.0		4.0	4.0		
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0		3.0	3.0		
Lane Grp Cap (vph)	614	1483		151	1170	523	994		297	238		1583
v/s Ratio Prot	c0.16	c0.40		0.08	0.29		c0.19			0.09		
v/s Ratio Perm						0.09			0.24			0.37
v/c Ratio	0.92	0.95		0.96	0.88	0.11	0.67		0.64	0.70		0.37
Uniform Delay, d1	38.3	26.4		43.3	30.0	22.1	29.8		35.7	39.3		0.0
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00		1.00
Incremental Delay, d2	18.7	13.1		61.1	7.6	0.1	1.8		4.7	8.6		0.7
Delay (s)	57.1	39.5		104.4	37.6	22.2	31.6		40.4	47.8		0.7
Level of Service	E	D		F	D	C	C		D	D		A
Approach Delay (s)		44.5			43.4			34.7			11.2	
Approach LOS		D			D			C			B	

Intersection Summary			
HCM Average Control Delay	37.3	HCM Level of Service	D
HCM Volume to Capacity ratio	0.97		
Actuated Cycle Length (s)	95.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	78.0%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	0.95	1.00	0.97	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frpb, ped/bikes	1.00	1.00	0.98	1.00	1.00	0.99	1.00	1.00	0.99	1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	3539	1557	3433	3539	1560	1770	1863	1562	1770	1863	1548
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	3539	1557	3433	3539	1560	1770	1863	1562	1770	1863	1548
Volume (vph)	270	1106	237	380	710	252	145	549	570	286	477	227
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	270	1106	237	380	710	252	145	549	570	286	477	227
RTOR Reduction (vph)	0	0	73	0	0	44	0	0	0	0	0	150
Lane Group Flow (vph)	270	1106	164	380	710	208	145	549	570	286	477	77
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Turn Type	Prot		pm+ov	Prot		pm+ov	Prot		Free	Prot		Perm
Protected Phases	7	4	5	3	8	1	5	2		1	6	
Permitted Phases			4			8			Free			6
Actuated Green, G (s)	12.9	33.0	44.5	12.0	32.1	49.1	11.5	32.0	110.0	17.0	37.5	37.5
Effective Green, g (s)	12.9	33.0	44.5	12.0	32.1	49.1	11.5	32.0	110.0	17.0	37.5	37.5
Actuated g/C Ratio	0.12	0.30	0.40	0.11	0.29	0.45	0.10	0.29	1.00	0.15	0.34	0.34
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	403	1062	686	375	1033	753	185	542	1562	274	635	528
v/s Ratio Prot	0.08	c0.31	0.04	c0.11	0.20	0.05	0.08	c0.29		c0.16	0.26	
v/s Ratio Perm			0.12			0.11			0.36			0.15
v/c Ratio	0.67	1.04	0.24	1.01	0.69	0.28	0.78	1.01	0.36	1.04	0.75	0.15
Uniform Delay, d1	46.5	38.5	21.6	49.0	34.5	19.2	48.0	39.0	0.0	46.5	32.1	25.1
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	4.2	39.0	0.2	49.9	1.9	0.2	19.2	41.9	0.7	66.3	5.0	0.1
Delay (s)	50.7	77.5	21.8	98.9	36.4	19.4	67.2	80.9	0.7	112.8	37.1	25.3
Level of Service	D	E	C	F	D	B	E	F	A	F	D	C
Approach Delay (s)		64.8			50.9			43.2			56.3	
Approach LOS		E			D			D			E	

Intersection Summary			
HCM Average Control Delay	54.4	HCM Level of Service	D
HCM Volume to Capacity ratio	0.99		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	99.5%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

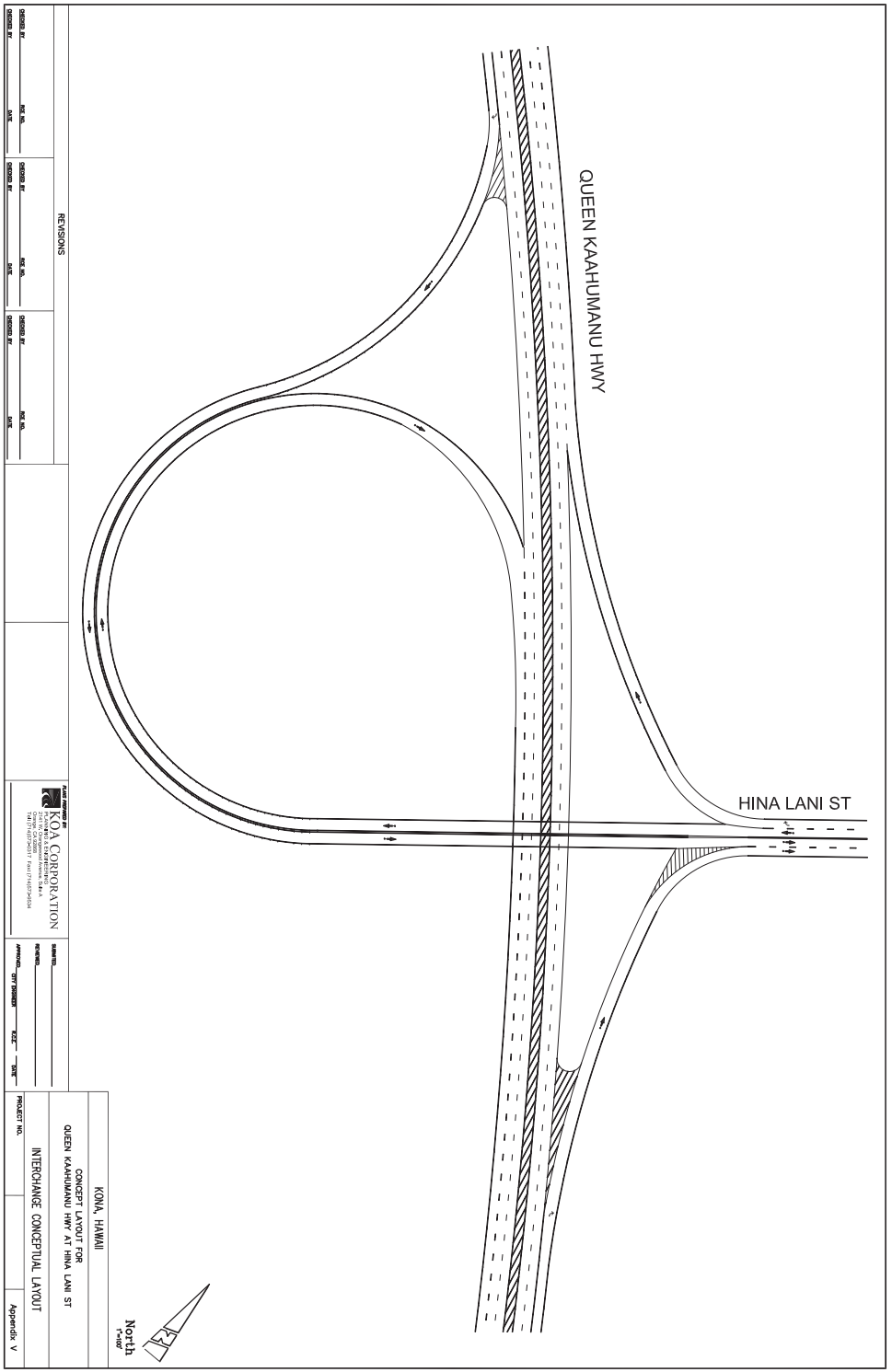
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	1.00	0.97	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	3433	1583	3433	1863	1863	1583
Flt Permitted	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (perm)	3433	1583	3433	1863	1863	1583
Volume (vph)	796	551	442	739	578	611
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	865	599	480	803	628	664
RTOR Reduction (vph)	0	63	0	0	0	0
Lane Group Flow (vph)	865	536	480	803	628	664
Turn Type		pm+ov	Prot			Free
Protected Phases	4	5	5	2	6	
Permitted Phases		4				Free
Actuated Green, G (s)	17.6	28.6	11.0	38.1	23.1	63.7
Effective Green, g (s)	17.6	28.6	11.0	38.1	23.1	63.7
Actuated g/C Ratio	0.28	0.45	0.17	0.60	0.36	1.00
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	949	810	593	1114	676	1583
v/s Ratio Prot	c0.25	c0.13	0.14	0.43	c0.34	
v/s Ratio Perm		0.25				0.42
v/c Ratio	0.91	0.66	0.81	0.72	0.93	0.42
Uniform Delay, d1	22.3	13.8	25.3	9.0	19.5	0.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	12.7	2.0	8.0	2.3	19.0	0.8
Delay (s)	35.0	15.8	33.4	11.4	38.5	0.8
Level of Service	C	B	C	B	D	A
Approach Delay (s)	27.1			19.6	19.2	
Approach LOS	C			B	B	

Intersection Summary			
HCM Average Control Delay	22.2	HCM Level of Service	C
HCM Volume to Capacity ratio	0.85		
Actuated Cycle Length (s)	63.7	Sum of lost time (s)	8.0
Intersection Capacity Utilization	75.7%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	1.00		0.97	1.00		1.00	0.91	1.00	1.00	0.91	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	0.98	1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.88		1.00	0.87		1.00	1.00	0.85	1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	1642		3433	1622		1770	5085	1547	1770	5072	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1770	1642		3433	1622		1770	5085	1547	1770	5072	
Volume (vph)	59	19	71	634	20	123	60	2645	509	98	2896	44
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	59	19	71	634	20	123	60	2645	509	98	2896	44
RTOR Reduction (vph)	0	48	0	0	99	0	0	0	124	0	1	0
Lane Group Flow (vph)	59	42	0	634	44	0	60	2645	385	98	2939	0
Confl. Peds. (#/hr)							2		2	2		2
Turn Type	Prot			Prot			Prot		pm+ov	Prot		
Protected Phases	7	4		3	8		5	2	3	1	6	
Permitted Phases									2			
Actuated Green, G (s)	8.9	10.1		27.0	28.2		5.0	82.0	109.0	9.0	86.0	
Effective Green, g (s)	8.9	10.1		27.0	28.2		5.0	82.0	109.0	9.0	86.0	
Actuated g/C Ratio	0.06	0.07		0.19	0.20		0.03	0.57	0.76	0.06	0.60	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	109	115		643	317		61	2894	1213	111	3027	
v/s Ratio Prot	0.03	c0.05		c0.18	0.09		0.03	0.52	0.08	c0.06	c0.58	
v/s Ratio Perm									0.25			
v/c Ratio	0.54	0.36		0.99	0.14		0.98	0.91	0.32	0.88	0.97	
Uniform Delay, d1	65.6	63.9		58.4	47.9		69.5	27.9	5.6	67.0	27.9	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	5.4	1.9		31.7	0.2		108.8	5.0	0.2	50.5	10.5	
Delay (s)	71.0	65.9		90.0	48.1		178.3	32.9	5.8	117.5	38.4	
Level of Service	E	E		F	D		F	C	A	F	D	
Approach Delay (s)		67.9			82.3			31.3			40.9	
Approach LOS		E			F			C			D	

Intersection Summary			
HCM Average Control Delay	41.7	HCM Level of Service	D
HCM Volume to Capacity ratio	0.97		
Actuated Cycle Length (s)	144.1	Sum of lost time (s)	16.0
Intersection Capacity Utilization	97.1%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Appendix V – Grade-Separated Interchange Conceptual Configuration



Appendix L

Acoustic Study for the Proposed Kaloko Makai Project

Y. Ebisu & Associates

August 2012

ACOUSTIC STUDY FOR THE PROPOSED KALOKO MAKAI PROJECT

NORTH KONA, HAWAII

Prepared for:

STANFORD CARR DEVELOPMENT

Prepared by:

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AUGUST 2012

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CHAPTER I. SUMMARY

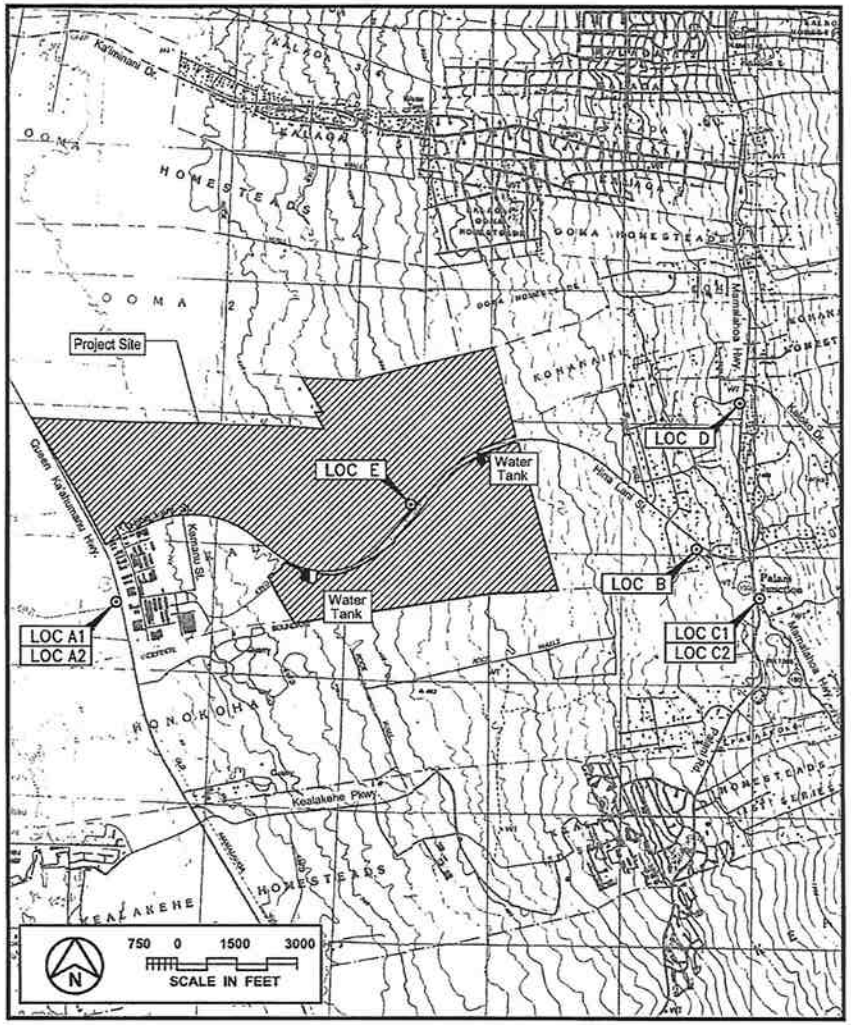
The existing and future traffic noise levels in the vicinity of the proposed Kaloko Makai Project in North Kona, Hawaii were evaluated for their potential impact on present and future noise sensitive areas. Figure 1 depicts the location of the project site. The future traffic noise levels along the primary access roadways to the project were calculated for the year 2045.

Along the existing Queen Kaahumanu Highway, traffic noise levels are expected to increase by 6.3 to 7.1 DNL between CY 2011 and CY 2045 as a result of both project and non-project traffic. Along Hina Lani Street, traffic noise levels are predicted to increase by 6.0 to 9.4 DNL. Traffic noise increases due to project traffic are predicted to range from 1.1 to 7.4 DNL, which are typically greater than the range of the noise increases caused by non-project traffic on these two roadways. These increases in traffic noise levels associated with project traffic range from the moderate to the moderately significant. The larger and more significant increases in traffic noise levels are expected to occur along Queen Kaahumanu Highway, where the lands along the highway Rights-of-Way are generally undeveloped or are developed with commercial uses. Adequate setback distances have been provided between the project's noise sensitive uses and Queen Kaahumanu Highway.

Along Mamalahoa Highway, noise impacts from project traffic should be difficult to measure or quantify, and should be much less than those associated with non-project traffic. Traffic noise mitigation measures in the form of increased setbacks, sound attenuation walls, and/or closure and air conditioning will probably be required at proposed residences and hospital facilities which front Hina Lani Street and Ane Keahokalole Highway.

Based on previously published 14 CFR Part 150 aircraft noise contours for Kona International Airport at Keahole (KOA), the project site is located outside of the existing and forecasted 60 and 55 DNL noise contours, and is considered to be acceptable for the development of noise sensitive uses as planned. Noise contours for CY 2008, CY 2013, and CY 2030, which were developed during the 2009 Master Plan and 14 CFR Part 150 Study updates for KOA, confirm that the project site is outside of the airport noise contours, and special aircraft noise attenuation measures are not required over the project area. The implementation of the airport noise disclosure provisions of Act 208 is not considered to be necessary over the entire project area because the existing and forecasted 55 DNL noise contours are not expected to encompass noise sensitive developments within the project area.

Unavoidable, but temporary, noise impacts may occur during the construction of the proposed project. Because construction activities are predicted to be audible at adjoining properties, the quality of the acoustic environment may be degraded to unacceptable levels during periods of construction. Mitigation measures to reduce



LOCATIONS OF PROJECT SITE AND NOISE MEASUREMENT LOCATIONS

FIGURE 1

construction noise to inaudible levels will not be practical in all cases. For this reason, the use of quiet equipment and construction curfew periods as required under the State Department of Health noise regulations are recommended to minimize construction noise impacts.

CHAPTER II. PURPOSE

The objectives of this study were to describe the existing and future noise environment in the environs of the proposed Kaloko Makai Project in North Kona on the island of Hawaii. Traffic noise level increases and impacts associated with the proposed development were to be determined within the project site as well as along the public roadways expected to service the project traffic. A specific objective was to determine the future traffic noise level increases associated with both project and non-project traffic, and the potential noise impacts associated with these increases. Assessments of possible impacts from noise resulting from fixed and rotary wing aircraft operations at nearby Kona International Airport at Keahole, and from short term construction noise at the project site were also included in the noise study objectives. Recommendations for minimizing these noise impacts were also to be provided as required.

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

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

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

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

Table 1, extracted from Reference 1, categorizes the various DNL levels of outdoor noise exposure with severity classifications. Table 2, also extracted from Reference 1, presents the general effects of noise on people in residential use situations. Figure 2, extracted from Reference 2, presents suggested land use compatibility guidelines for residential and nonresidential land uses. A general consensus among federal agencies has developed whereby residential housing development is considered acceptable in areas where exterior noise does not exceed 65 DNL. This value of 65 DNL is used as a federal regulatory threshold for determining the necessity for special noise abatement measures when applications for federal funding assistance are made.

As a general rule, noise levels of 55 DNL or less occur in rural areas, or in areas which are removed from high volume roadways. In urbanized areas which are shielded from high volume streets, DNL levels generally range from 55 to 65 DNL, and are usually controlled by motor vehicle traffic noise. Residences which front major roadways are generally exposed to levels of 65 DNL, and as high as 75 DNL when the

TABLE 1

EXTERIOR NOISE EXPOSURE CLASSIFICATION (RESIDENTIAL LAND USE)

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

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

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

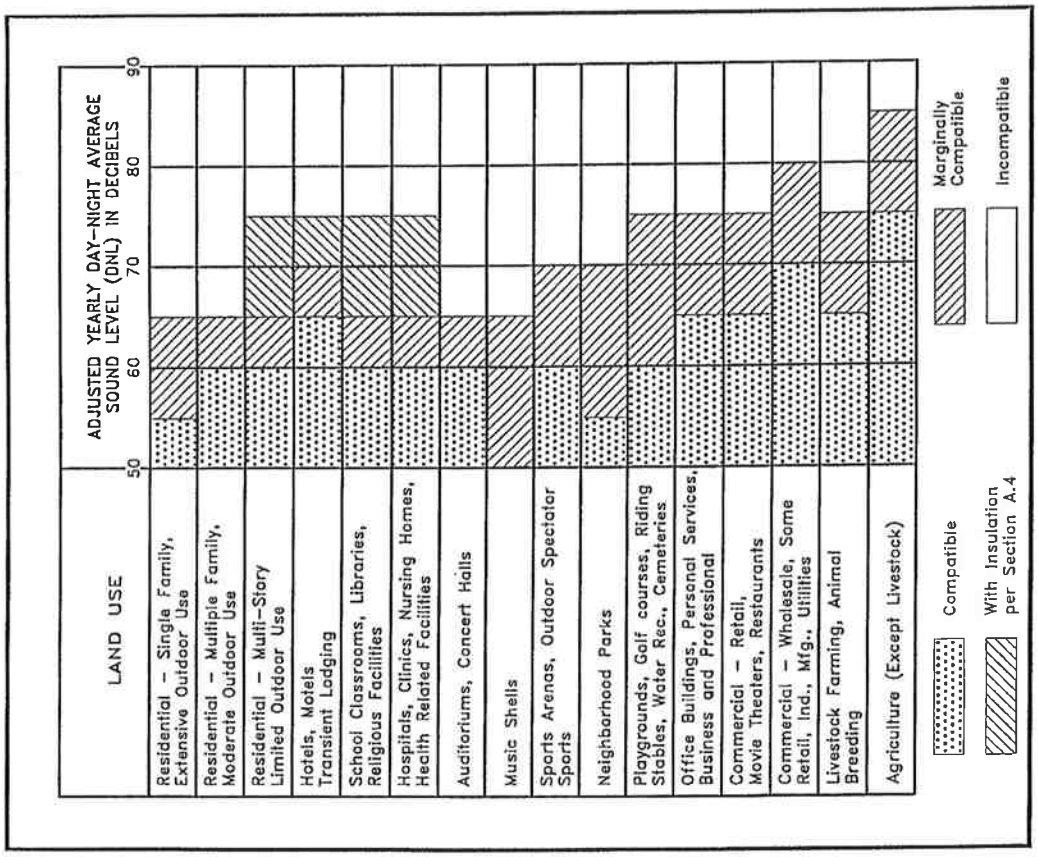


FIGURE 2

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

TABLE 2

EFFECTS OF NOISE ON PEOPLE
(Residential Land Uses Only)

EFFECTS[1] / DAY-NIGHT AVERAGE SOUND LEVEL IN DECIBELS	Hearing Loss	Speech Interference		Annoyance[2]	Average Community[4] Reaction	General Community Attitude Towards Area
		Indoor	Outdoor			
	Qualitative Description	%Sentence Intelligibility	Distance in Meters for 95% Sentence Intelligibility	% of Population Highly Annoyed[3]		
75 and above	May Begin to Occur	98%	0.5	37%	Very Severe	Noise is likely to be the most important of all adverse aspects of the community environment.
70	Will Not Likely Occur	99%	0.9	25%	Severe	Noise is one of the most important adverse aspects of the community environment.
65	Will Not Occur	100%	1.5	15%	Significant	Noise is one of the important adverse aspects of the community environment.
60	Will Not Occur	100%	2.0	9%	Moderate to Slight	Noise may be considered an adverse aspect of the community environment.
55 and below	Will Not Occur	100%	3.5	4%		Noise considered no more important than various other environmental factors.

1. "Speech Interference" data are drawn from the following tables in EPA's "Levels Document": Table 3, Fig. D-1, Fig. D-2, Fig. D-3. All other data from National Academy of Science 1977 report "Guidelines for Preparing Environmental Impact Statements on Noise, Report of Working Group 69 on Evaluation of Environmental Impact of Noise."

2. Depends on attitudes and other factors.

3. The percentages of people reporting annoyance to lesser extents are higher in each case. An unknown small percentage of people will report being "highly annoyed" even in the quietest surroundings. One reason is the difficulty all people have in integrating annoyance over a very long time.

4. Attitudes or other non-acoustic factors can modify this. Noise at low levels can still be an important problem, particularly when it intrudes into a quiet environment.

NOTE: Research implicates noise as a factor producing stress-related health effects such as heart disease, high-blood pressure and stroke, ulcers and other digestive disorders. The relationships between noise and these effects, however, have not as yet been quantified.

roadway is a high speed freeway. Due to noise shielding effects from intervening structures, interior lots are usually exposed to 3 to 10 DNL lower noise levels than the front lots which are not shielded from the traffic noise.

For the purposes of determining noise acceptability for funding assistance from federal agencies, an exterior noise level of 65 DNL or lower is considered acceptable. These federal agencies include the Federal Aviation Administration (FAA), Department of Defense (DOD); Federal Housing Administration, Housing and Urban Development (FHA/HUD), and Veterans Administration (VA). This standard is applied nationally (see Reference 3), including Hawaii.

Because of our open-living conditions, the predominant use of naturally ventilated dwellings, and the relatively low exterior-to-interior sound attenuation afforded by these naturally ventilated structures, an exterior noise level of 65 DNL does not eliminate all risks of noise impacts. Because of these factors, a lower level of 55 DNL is considered as the "Unconditionally Acceptable" (or "Near-Zero Risk") level of exterior noise (see Reference 4). For typical, naturally ventilated structures in Hawaii, an exterior noise level of 55 DNL results in an interior level of approximately 45 DNL, which is considered to be the "Unconditionally Acceptable" (or "Near-Zero Risk") level of interior noise. However, after considering the cost and feasibility of applying the lower level of 55 DNL, government agencies such as FHA/HUD and VA have selected 65 DNL as a more appropriate regulatory standard.

For aircraft noise, the Hawaii State Department of Transportation, Airports Division (HDOTA), has recommended that 60 DNL be used as the common level for determining land use compatibility in respect to noise sensitive uses near its airports. Table 3 summarizes the recommendations for compatible land uses at various levels of aircraft noise. For those noise sensitive land uses which are exposed to aircraft noise greater than 55 DNL, the division recommends that disclosure of the aircraft noise levels be provided prior to any real property transactions. Reference 5 requires that such disclosure be provided prior to real property transactions concerning properties located within Air Installation Compatibility Use Zones (AICUZ) or located within airport noise maps developed under Federal Aviation Regulation (FAR) Part 150 - Airport Noise Compatibility Planning (14 CFR Part 150). The most recent FAR Part 150 noise contours for Kona International Airport at Keahole were completed in 2009 and reflect conditions through 2013 (Reference 6). Additional airport noise contours for 2030 were developed by the HDOTA for information purposes only. These airport noise contours do not indicate that significant increases in aircraft noise will occur over the project site.

For commercial, industrial, and other non-noise sensitive land uses, exterior noise levels as high as 75 DNL are generally considered acceptable. Exceptions to this occur when naturally ventilated office and other commercial establishments are exposed to exterior levels which exceed 65 DNL.

TABLE 3

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

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

Numbers in parentheses refer to notes.

KEY TO TABLE 3:

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

TABLE 3 (CONTINUED)

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

NOTES FOR TABLE 3:

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

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

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

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

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

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

In the State of Hawaii, the State Department of Health (DOH) regulates noise from on-site activities. State DOH noise regulations are expressed in maximum allowable property line noise limits rather than DNL (see Reference 7). The noise limits apply on all islands of the State, including Hawaii. Although they are not directly comparable to noise criteria expressed in DNL, State DOH noise limits for preservation/residential, apartment/commercial, and agricultural/industrial lands equate to approximately 55, 60, and 76 DNL, respectively.

Because the proposed project site is located on lands designated for single family and multifamily residential, and commercial uses, various DOH noise limits would be applicable along the lot boundary lines or receptor locations for any stationary machinery, or equipment related to commercial or construction activities. These property line limits are 60 dBA and 50 dBA during the daytime and nighttime periods, respectively, for commercial lots or receptors. For multifamily or apartment use, the State DOH limits are also 60 dBA and 50 dBA during the daytime and nighttime periods, respectively. For single family residential and public facility uses, the State DOH limits are 55 dBA and 45 dBA during the daytime and nighttime periods, respectively. These noise limits cannot be exceeded for more than 2 minutes in any 20-minute time period under the State DOH noise regulations. The State DOH noise regulations do not apply to aircraft or motor vehicles.

TABLE 4
TRAFFIC AND BACKGROUND NOISE MEASUREMENT RESULTS

	LOCATION	Time of Day (HRS)	Ave. Speed (MPH)	Hourly Traffic Volume AUTO	M.TRUCK	H.TRUCK	Measured Leq (dB)	Predicted Leq (dB)
A1	50 FT from centerline of Q. Kaahumanu Hwy. (4/27/09)	0700 TO 0800	58	1,565	46	49	73.3	73.3
A2	100 FT from centerline of Q. Kaahumanu Hwy. (4/27/09)	0700 TO 0800	58	1,565	46	49	67.9	67.8
B	50 FT from centerline of Hina Lani Street (4/27/09)	0820 TO 0920	58	336	5	8	66.3	66.2
C1	50 FT from centerline of Mamalahoa Hwy. (4/27/09)	0935 TO 1035	50	682	3	6	66.0	66.6
C2	100 FT from centerline of Mamalahoa Hwy. (4/27/09)	0935 TO 1035	50	682	3	6	61.8	61.1
D	50 FT from centerline of Mamalahoa Hwy. (4/27/09)	1049 TO 1149	51	758	12	4	67.5	67.5

CHAPTER IV. GENERAL STUDY METHODOLOGY

Existing traffic and background ambient noise levels were measured at seven locations in the project environs to provide a basis for developing the traffic noise contours along the roadways which will service the proposed development: Queen Kaahumanu Highway, Hina Lani Street, and Mamalahoa Highway; and for determining the existing background ambient noise levels in the project area.

The locations of the measurement sites are shown in Figure 1. Noise measurements were performed during April 2009. The traffic noise measurement results, and their comparisons with computer model predictions of existing traffic noise levels are summarized in Table 4. The results of the traffic noise measurements were compared with calculations of existing traffic noise levels to validate the computer model used.

Traffic noise calculations for the existing conditions as well as noise predictions for the future conditions with and without the project were performed using the Federal Highway Administration (FHWA) Noise Prediction Model (Reference 8). Traffic data entered into the noise prediction model were: hourly traffic volumes, average vehicle speeds, estimates of traffic mix, and loose soil propagation loss factor. The traffic assignments for the project (Reference 9) and Hawaii State Department of Transportation counts on Queen Kaahumanu Highway (Reference 10) were the primary sources of data inputs to the model. For existing and future traffic, it was assumed that the average noise levels, or Leq(h), during the AM peak hour were equal to the 24-hour DNL along Queen Kaahumanu and Mamalahoa Highways. This assumption was based on computations of both the hourly Leq and the 24-hour DNL of traffic noise on Queen Kaahumanu Highway (see Figure 3). For the other roadways, it was assumed that the 24-hour DNL was equal to the average noise level during the PM peak hour.

Traffic noise calculations for both the existing and future conditions in the project environs were developed for ground level receptors without the benefit of shielding effects. Traffic assignments with and without the project were obtained from the project's traffic turning movements (Reference 9). The forecasted increases in traffic noise levels over existing levels were calculated for both scenarios, and noise impact risks evaluated. The relative contributions of non-project and project related traffic to the total noise levels were also calculated, and an evaluation was made of possible traffic noise impacts resulting from the project.

The relationships of the aircraft flight tracks and noise contours for Kona International Airport at Keahole to the project site and its proposed land uses were examined to determine if potential noise impacts were possible at the project site. The locations of the airport noise contours for 2008, 2013, and 2030 were compared with the location of the project site, and risks of noise impacts were evaluated. The need for special aircraft noise attenuation measures or disclosures of aircraft noise level at the project site was determined by comparing the locations of the most recently published

FIGURE 3

HOURLY VARIATIONS OF TRAFFIC NOISE AT 100 FT SETBACK DISTANCE FROM THE CENTERLINE OF QUEEN KAAHUMANU HWY. BETWEEN OTEC ACCESS RD. AND HULIKOA ST. AT 95 MILEPOST

(Sta. B7100190928O, 5/31/06)

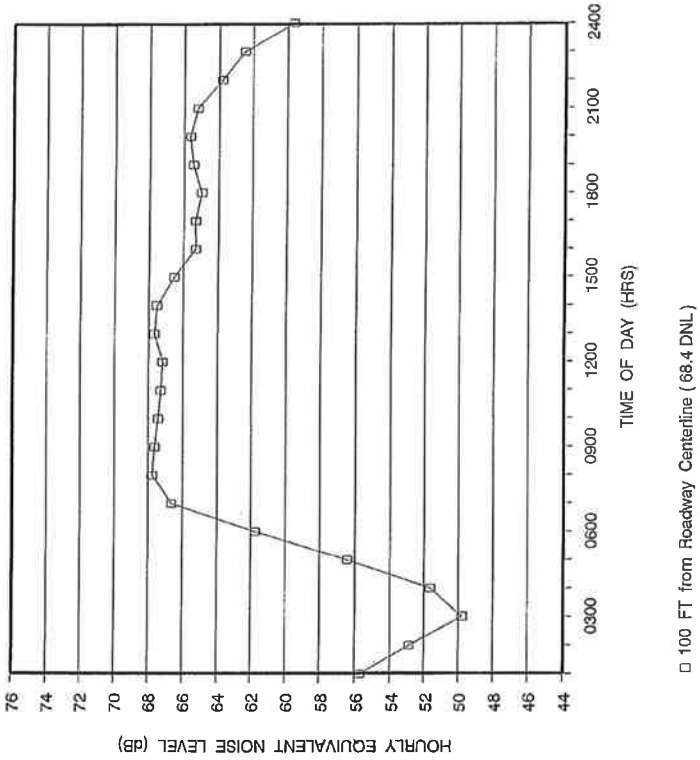


TABLE 4 (CONTINUED)
TRAFFIC AND BACKGROUND NOISE MEASUREMENT RESULTS

	LOCATION	Time of Day (HRS)	Ave. Speed (MPH)	------ Hourly Traffic Volume ------ AUTO	M.TRUCK	H.TRUCK	Measured Leq (dB)	Predicted Leq (dB)
E	50 FT from centerline of Hina Lani Street (4/27/09)	1436 TO 1536	55	547	9	12	67.5	67.6
A1	50 FT from centerline of Q. Kaahumanu Hwy. (4/27/09)	1555 TO 1655	49	1,931	27	5	71.4	70.8
A2	100 FT from centerline of Q. Kaahumanu Hwy. (4/27/09)	1555 TO 1655	49	1,931	27	5	63.2	65.3

Year 2013 14 CFR Part 150 airport noise contours with the location of the project site.

Traffic Noise. The existing traffic noise levels in the project environs vary from levels of approximately 62 DNL along the makai (west) property boundary, to less than 55 DNL at the mauka (east) property boundary and interior locations of the project site. Traffic noise levels along Queen Kaahumanu Highway are less than 65 DNL at 141 FT or greater setback distances from the highway centerline. Traffic noise levels along Mamalahoa Highway are less than 65 DNL at 95 FT or greater setback distances from the highway centerline. Along the east boundary of the project site which is removed from Hina Lani Street, existing background ambient noise levels are very low and less than 55 DNL.

Calculations of existing traffic noise levels during the AM and PM peak traffic hours are presented in Tables 5A and 5B. The hourly Leq (or Equivalent Sound Level) contribution from each roadway section in the project environs was calculated for comparison with forecasted traffic noise levels with and without the project. The existing setback distances from the roadways' centerlines to their associated 65 and 75 DNL contours were also calculated as shown in Table 6. The contour line setback distances do not take into account noise shielding effects or the additive contributions of traffic noise from intersecting street sections. Based on the results of Table 6, it was concluded that the existing 65 DNL traffic noise contour is located approximately 132 to 141 FT from the centerline of Queen Kaahumanu Highway, and approximately 93 to 95 FT from the centerline of Mamalahoa Highway in the immediate vicinity of the project site.

Existing traffic noise levels at the interior portions of the project site are controlled by the traffic along Hina Lani Street, and are approximately 65 to 69 DNL at 50 FT from the centerline of Hina Lani Street. At the interior locations on the project site which are removed from Hina Lani Street and Queen Kaahumanu Highway, existing background noise levels drop to 55 DNL or less, and aircraft noise and the natural sounds of birds and winds in foliage are the dominant noise sources. A discussion of existing aircraft noise levels on the project site is provided in the following section. Between intermittent noise events, background ambient noise levels drop to a range of 35 to 40 dB. During calm wind periods, background ambient noise levels decrease to levels less than 40 dB. The minimum background ambient noise levels at these interior locations are controlled by distant traffic and wind noise.

Aircraft Noise. Aircraft noise sources in the project environs are associated with fixed and rotary wing aircraft operations at Kona International Airport at Keahole. Figures 4 through 6 depict aircraft flight tracks in the project environs, which were similar to those reported in Reference 6. Occasionally, depending on weather, visibility, or air traffic conditions, helicopter and light, fixed wing aircraft may cross over the western boundary of project site as indicated by the average departure and arrival tracks shown in Figures 4 and 5, respectively. The noisier jet aircraft flight tracks

TABLE 5A

EXISTING (CY 2011) TRAFFIC VOLUMES AND NOISE LEVELS ALONG VARIOUS ROADWAY SECTIONS (AM PEAK HOUR)

LOCATION	SPEED (MPH)	TOTAL VPH	********* VOLUMES (VPH) ********** AUTOS	M TRUCKS	H TRUCKS	50' Leq	100' Leq	200' Leq
Mamalahoa Hwy. - N. of Hina Lani St.	51	1,418	1,390	14	14	70.2	64.6	58.5
Mamalahoa Hwy. - S. of Hina Lani St.	50	1,428	1,400	14	14	69.9	64.4	58.3
Hina Lani St. - W. of Mamalahoa Hwy.	58	386	372	5	9	66.7	61.1	55.1
Hina Lani St. - E. of Ane Keahokalole Hwy.	55	321	309	5	7	65.1	59.6	53.6
Ane Keahokalole Hwy. - N. of Hina Lani St.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Ane Keahokalole Hwy. - S. of Hina Lani St.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Hina Lani St. - W. of Ane Keahokalole Hwy.	55	321	309	5	7	65.1	59.6	53.6
Hina Lani St. - E. of Kamanu St.	55	321	309	5	7	65.1	59.6	53.6
Hina Lani St. - W. of Kamanu St.	45	369	355	6	8	63.2	57.8	52.1
Hina Lani St. - E. of Q. Kaahumanu Hwy.	45	947	912	15	20	67.3	61.9	56.1
Kamanu St. - N. of Hina Lani St.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Q. Kaahumanu Hwy. - N. of Hina Lani St.	58	1,509	1,422	42	45	72.9	67.4	61.4
Q. Kaahumanu Hwy. - S. of Hina Lani St.	58	1,742	1,641	49	52	73.5	68.0	62.0

TABLE 5B

EXISTING (CY 2011) TRAFFIC VOLUMES AND NOISE LEVELS ALONG VARIOUS ROADWAY SECTIONS (PM PEAK HOUR)

LOCATION	SPEED (MPH)	TOTAL VPH	********* VOLUMES (VPH) ********** AUTOS	M TRUCKS	H TRUCKS	50' Leq	100' Leq	200' Leq
Mamalahoa Hwy. - N. of Hina Lani St.	51	1,178	1,154	12	12	69.4	63.8	57.7
Mamalahoa Hwy. - S. of Hina Lani St.	50	1,189	1,165	12	12	69.1	63.6	57.5
Hina Lani St. - W. of Mamalahoa Hwy.	58	563	542	8	13	68.3	62.8	56.7
Hina Lani St. - E. of Ane Keahokalole Hwy.	55	499	481	8	10	67.0	61.5	55.5
Ane Keahokalole Hwy. - N. of Hina Lani St.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Ane Keahokalole Hwy. - S. of Hina Lani St.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Hina Lani St. - W. of Ane Keahokalole Hwy.	55	499	481	8	10	67.0	61.5	55.5
Hina Lani St. - E. of Kamanu St.	55	499	481	8	10	67.0	61.5	55.5
Hina Lani St. - W. of Kamanu St.	45	649	625	10	14	65.6	60.3	54.5
Hina Lani St. - E. of Q. Kaahumanu Hwy.	45	1,485	1,430	24	31	69.2	63.8	58.1
Kamanu St. - N. of Hina Lani St.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Q. Kaahumanu Hwy. - N. of Hina Lani St.	49	1,777	1,747	25	5	70.4	64.9	58.7
Q. Kaahumanu Hwy. - S. of Hina Lani St.	49	2,284	2,245	32	7	71.5	66.0	59.8

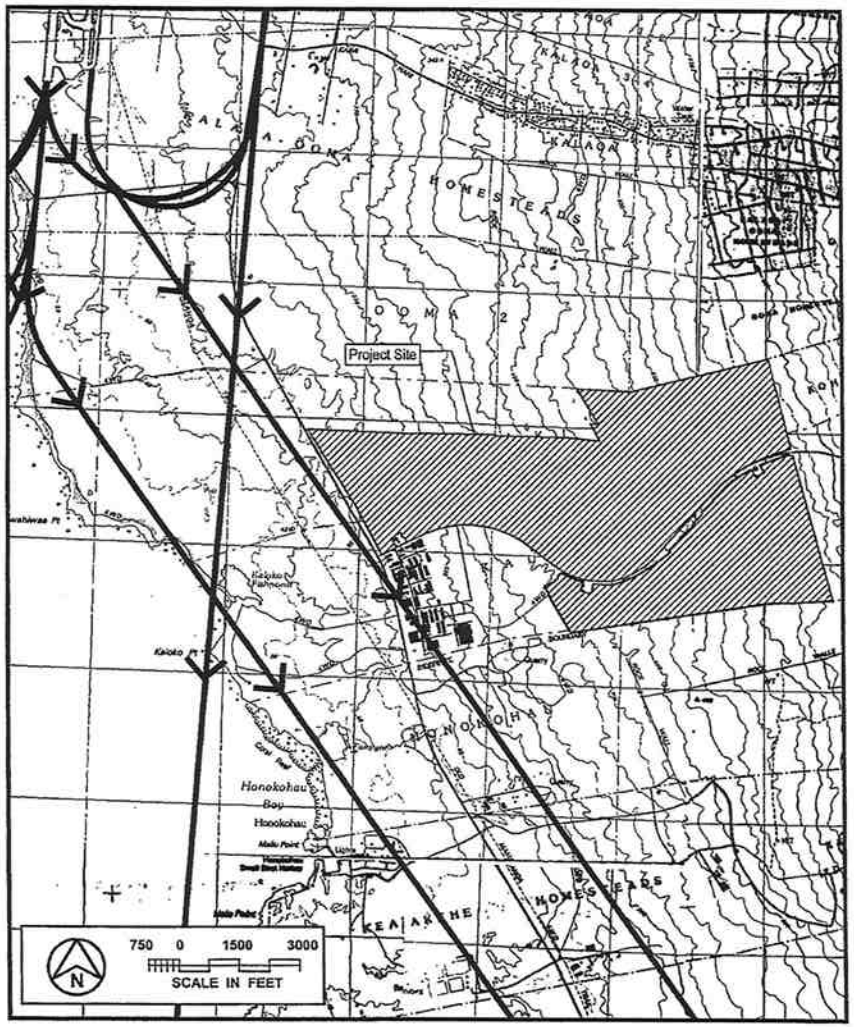
TABLE 6

YEAR 2011 AND 2045 DISTANCES TO 65 AND 75 DNL CONTOURS

STREET SECTION	65 DNL SETBACK (FT) CY 2011	65 DNL SETBACK (FT) CY 2045	75 DNL SETBACK (FT) CY 2011	75 DNL SETBACK (FT) CY 2045
Mamalahoa Hwy. - N. of Hina Lani St.	95	136	28	40
Mamalahoa Hwy. - S. of Hina Lani St.	93	121	26	35
Hina Lani St. - W. of Mamalahoa Hwy.	76	159	21	48
Hina Lani St. - E. of Ane Keahokalole Hwy.	64	223	18	57
Ane Keahokalole Hwy. - N. of Hina Lani St.	N/A	96	N/A	31
Ane Keahokalole Hwy. - S. of Hina Lani St.	N/A	103	N/A	33
Hina Lani St. - W. of Ane Keahokalole Hwy.	64	197	18	50
Hina Lani St. - E. of Kamanu St.	64	208	18	52
Hina Lani St. - W. of Kamanu St.	54	172	15	42
Hina Lani St. - E. of Q. Kaahumanu Hwy.	86	197	24	48
Kamanu St. - N. of Hina Lani St.	N/A	56	N/A	17
Q. Kaahumanu Hwy. - N. of Hina Lani St.	132	292	38	92
Q. Kaahumanu Hwy. - S. of Hina Lani St.	141	348	41	107

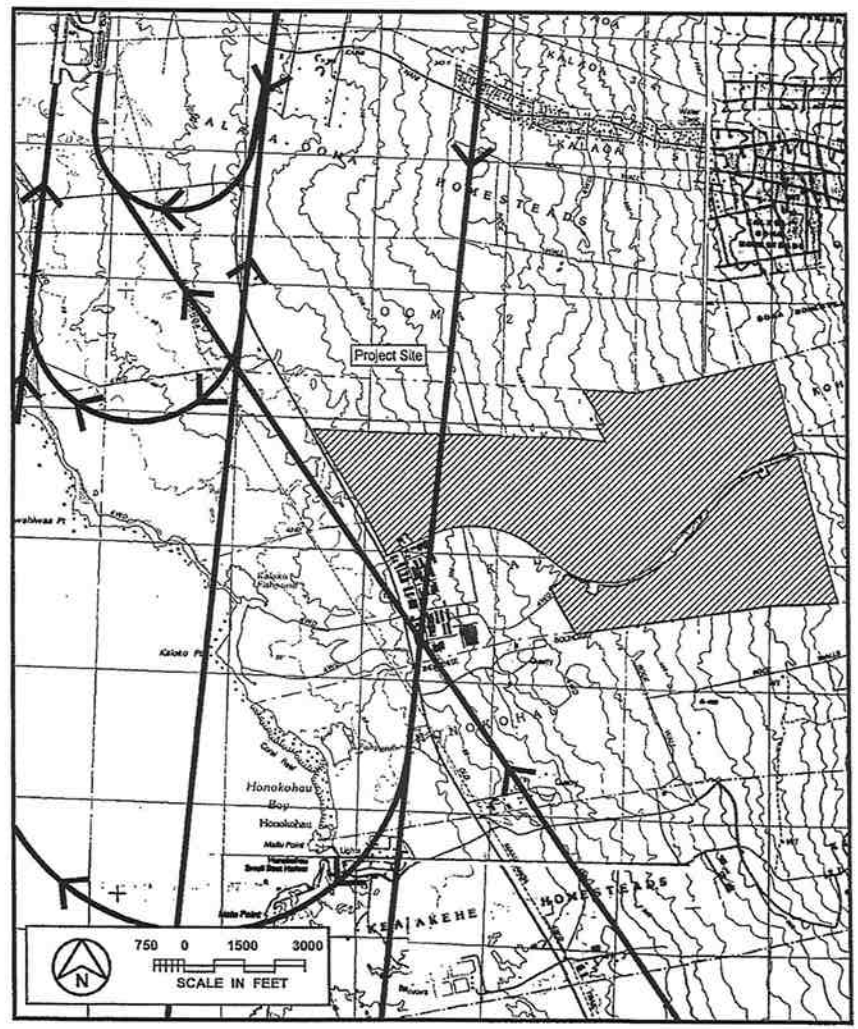
Notes:

(1) All setback distances are from the roadways' centerlines.
(2) See Tables 5A, 5B, 7A, and 7B for traffic volume, speed, and mix assumptions.
(3) Setback distances are for unobstructed line-of-sight conditions.



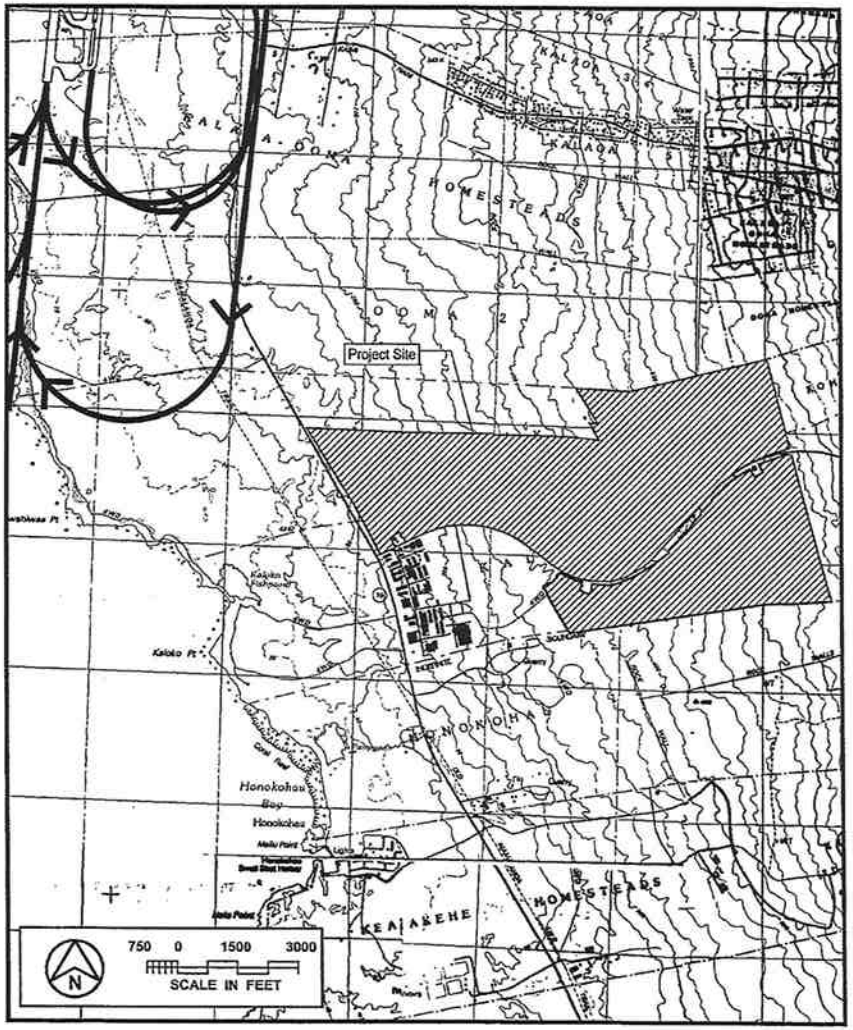
LOCATIONS OF EXISTING AVERAGE AIRCRAFT DEPARTURE FLIGHT TRACKS IN PROJECT ENVIRONS

FIGURE 4



LOCATIONS OF EXISTING AVERAGE AIRCRAFT ARRIVAL FLIGHT TRACKS IN PROJECT ENVIRONS

FIGURE 5



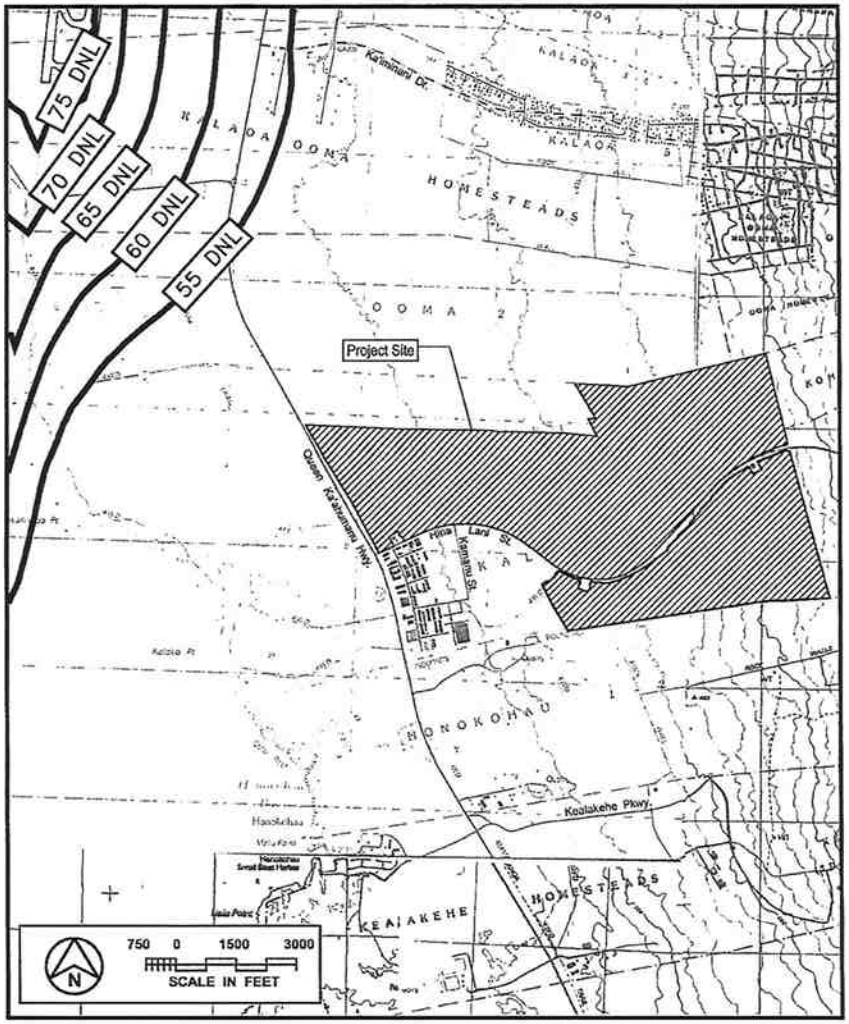
LOCATIONS OF EXISTING AVERAGE AIRCRAFT TRAINING FLIGHT TRACKS IN PROJECT ENVIRONS

FIGURE 6

typically remain offshore and west of the project site, and are aligned with Kona International Airport's single runway. However, large overseas jet aircraft may occasionally overfly the west end of the project site where shown in Figure 5 when landing while using a right hand turn during north flow pattern conditions (Runway 35 in use). This approach to the airport is used due to the presence of other aircraft traffic approaching the airport from the west.

Figure 7 depicts the locations of the 55 through 75 DNL aircraft noise contours during the CY 2008 period. These noise contours were obtained from the Kona International Airport At Keahole 14 CFR Part 150 report (Reference 6). From Figure 7, aircraft noise levels over the project site are below 55 DNL, and as such, are considered to be in the "Minimal Exposure, Unconditionally Acceptable" category for the planned land uses on the project site.

Based on the most current information on aircraft noise levels at Kona International Airport At Keahole, the location of the existing 55 DNL contour is estimated to be approximately 1 mile northwest of the project site as shown in Figure 7. The location of the existing 60 DNL contour is estimated to be approximately 1.3 miles northwest of the project site. Based on these 14 CFR Part 150 noise contours for Kona International Airport At Keahole, and their relationships to the project site, it was concluded that the 60 DNL aircraft noise contour is located outside the project site, with at least 10 DNL of margin for increased contour expansion. The 55 DNL aircraft noise contour also does not cross through the project site, and has a smaller 5 DNL of margin for increased contour expansion. Based on these airport noise contours in the project environs, it was concluded that special aircraft noise mitigation measures are not required, and existing aircraft noise levels do not place special development constraints on the project site.



2008 14 CFR PART 150 NOISE CONTOURS FOR KONA INTERNATIONAL AIRPORT AT KEAHOLE

FIGURE 7

CHAPTER VI. FUTURE NOISE ENVIRONMENT

Traffic Noise. Predictions of future traffic noise levels were made using the traffic volume assignments of Reference 9 for CY 2045 with and without the proposed project. The CY 2045 traffic turning movements with and without the project contained in Reference 9 were used. The future assignments of project plus non-project traffic on the roadway sections which would service the project are shown in Tables 7A and 7B for the AM and PM peak hours of traffic, respectively. As indicated in Table 8, by CY 2045 and following complete project build-out, traffic noise levels on Queen Kaahumanu Highway in the areas fronting the project are predicted to increase by approximately 6 to 7 DNL. Along Mamalahoa Highway, traffic noise levels are predicted to increase by 2 to 3 DNL. Along Hina Lani Street, traffic noise levels are predicted to increase by 6.0 to 9.4 DNL. The range of increases in traffic noise levels from 0 to 6 DNL is considered to be low to moderate, since it represents the growth in forecasted project and non-project traffic in the project environs over a 34 year period. The range of increases from 6 to 10 DNL over a 34 year period is considered to be moderate to large.

Table 6 summarizes the predicted increases in the future setback distances to the 65 and 75 DNL traffic noise contour lines along the roadways in the project environs and attributable to both project plus non-project traffic in CY 2045. The setback distances in Table 6 do not include the beneficial effects of noise shielding from terrain features and highway cuts, or the detrimental effects of additive contributions of noise from intersecting streets. As indicated in Table 6, the setback distances to the 65 DNL contour are predicted to range from 292 to 348 FT from the centerline of Queen Kaahumanu Highway following project build-out in CY 2045. Along Mamalahoa Highway, setback distances to the 65 DNL contour are predicted to range from 121 to 136 FT from the centerline of Mamalahoa Highway. Along Hina Lani Street, setback distances to the 65 DNL contour are expected to range from 159 to 223 FT.

Table 8 presents the predicted increases in traffic noise levels associated with non-project and project traffic by CY 2045, and as measured by the DNL descriptor system. As indicated in Table 8, the increases in traffic noise along Hina Lani Street west of Ane Keahokalole Highway due to project traffic are much greater than those resulting from non-project traffic. Along Mamalahoa Highway, project traffic noise contributions are expected to be much less than non-project traffic noise contributions by CY 2045. Along Hina Lani Street, project traffic is expected to increase traffic noise levels above those associated with non-project traffic by 2.2 to 7.4 DNL. The largest increases in traffic noise levels attributable to project traffic are expected to occur along Hina Lani Street near Kamanu Street. The relatively large increases in future traffic noise levels along Ane Keahokalole Highway are due to the relatively low non-project traffic volumes expected on that roadway prior to CY 2045.

By 2045 with the project, a highway interchange will probably be required on

TABLE 7A

FUTURE (CY 2045) TRAFFIC VOLUMES AND NOISE LEVELS ALONG VARIOUS ROADWAY SECTIONS (AM PEAK HOUR, WITH PROJECT)

LOCATION	SPEED (MPH)	TOTAL VPH	********* VOLUMES (VPH) ********** AUTOS	M TRUCKS	H TRUCKS	50' Leq	100' Leq	200' Leq
Mamalahoa Hwy. - N. of Hina Lani St.	51	2,861	2,803	29	29	73.2	67.7	61.6
Mamalahoa Hwy. - S. of Hina Lani St.	50	2,417	2,369	24	24	72.2	66.7	60.6
Hina Lani St. - W. of Mamalahoa Hwy.	58	2,056	1,980	29	47	73.9	68.4	62.3
Hina Lani St. - E. of Ane Keahokalole Hwy.	55	2,765	2,663	44	58	75.1	70.1	65.0
Ane Keahokalole Hwy. - N. of Hina Lani St.	45	1,878	1,809	30	39	70.3	64.2	59.3
Ane Keahokalole Hwy. - S. of Hina Lani St.	45	2,171	2,090	35	46	71.0	64.9	59.9
Hina Lani St. - W. of Ane Keahokalole Hwy.	55	2,238	2,155	36	47	74.2	69.2	64.1
Hina Lani St. - E. of Kamanu St.	55	2,402	2,314	38	50	74.5	69.5	64.4
Hina Lani St. - W. of Kamanu St.	45	3,013	2,902	48	63	72.9	68.0	63.0
Hina Lani St. - E. of Q. Kaahumanu Hwy.	45	3,665	3,529	59	77	73.7	68.9	63.9
Kamanu St. - N. of Hina Lani St.	35	1,164	1,121	19	24	65.4	59.5	54.8
						100' Leq	200' Leq	300' Leq
Q. Kaahumanu Hwy. - N. of Hina Lani St.	58	3,453	3,252	97	104	74.2	67.7	64.8
Q. Kaahumanu Hwy. - S. of Hina Lani St.	58	4,690	4,418	131	141	75.6	69.1	66.1

TABLE 7B

FUTURE (CY 2045) TRAFFIC VOLUMES AND NOISE LEVELS ALONG VARIOUS ROADWAY SECTIONS (PM PEAK HOUR, WITH PROJECT)

LOCATION	SPEED (MPH)	TOTAL VPH	********* VOLUMES (VPH) ********** AUTOS	M TRUCKS	H TRUCKS	50' Leq	100' Leq	200' Leq
Mamalahoa Hwy. - N. of Hina Lani St.	51	2,724	2,670	27	27	73.0	67.5	61.4
Mamalahoa Hwy. - S. of Hina Lani St.	50	2,310	2,264	23	23	72.0	66.5	60.4
Hina Lani St. - W. of Mamalahoa Hwy.	58	2,400	2,311	34	55	74.6	69.1	63.0
Hina Lani St. - E. of Ane Keahokalole Hwy.	55	3,304	3,182	53	69	75.9	70.9	65.8
Ane Keahokalole Hwy. - N. of Hina Lani St.	45	2,061	1,985	33	43	70.7	64.6	59.7
Ane Keahokalole Hwy. - S. of Hina Lani St.	45	2,358	2,270	38	50	71.4	65.2	60.3
Hina Lani St. - W. of Ane Keahokalole Hwy.	55	2,695	2,595	43	57	75.0	70.0	64.9
Hina Lani St. - E. of Kamanu St.	55	2,901	2,794	46	61	75.3	70.4	65.3
Hina Lani St. - W. of Kamanu St.	45	3,714	3,577	59	78	73.8	68.9	63.9
Hina Lani St. - E. of Q. Kaahumanu Hwy.	45	4,593	4,424	73	96	74.7	69.8	64.9
Kamanu St. - N. of Hina Lani St.	35	1,333	1,284	21	28	66.0	60.1	55.4
						100' Leq	200' Leq	300' Leq
Q. Kaahumanu Hwy. - N. of Hina Lani St.	49	4,174	4,103	58	13	71.9	65.5	62.5
Q. Kaahumanu Hwy. - S. of Hina Lani St.	49	5,869	5,769	82	18	73.4	66.9	64.0

TABLE 8

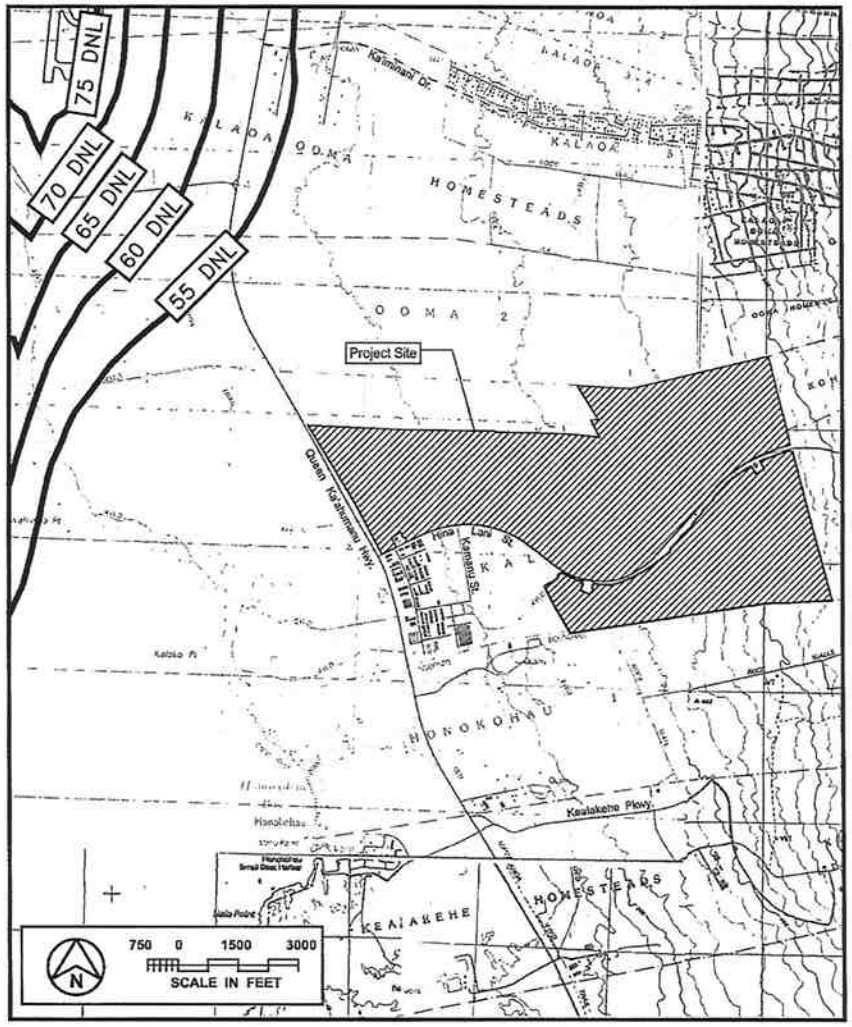
CALCULATIONS OF PROJECT AND NON-PROJECT TRAFFIC NOISE CONTRIBUTIONS (CY 2045)

STREET SECTION	NOISE LEVEL (DNL) INCREASE DUE TO: NON-PROJECT TRAFFIC	PROJECT TRAFFIC
Mamalahoa Hwy. - N. of Hina Lani St.	2.2	0.9
Mamalahoa Hwy. - S. of Hina Lani St.	1.2	1.1
Hina Lani St. - W. of Mamalahoa Hwy.	4.1	2.2
Hina Lani St. - E. of Ane Keahokalole Hwy.	4.9	4.5
Ane Keahokalole Hwy. - N. of Hina Lani St.	59.5	5.1
Ane Keahokalole Hwy. - S. of Hina Lani St.	62.8	2.4
Hina Lani St. - W. of Ane Keahokalole Hwy.	3.2	5.3
Hina Lani St. - E. of Kamanu St.	2.2	6.7
Hina Lani St. - W. of Kamanu St.	1.2	7.4
Hina Lani St. - E. of Q. Kaahumanu Hwy.	0.6	5.4
Kamanu St. - N. of Hina Lani St.	N/A	60.1
Q. Kaahumanu Hwy. - N. of Hina Lani St.	5.2	1.1
Q. Kaahumanu Hwy. - S. of Hina Lani St.	4.9	2.2

Queen Kaahumanu Highway at Hina Lani Street. An overpass ramp structure will be required to go southbound on the highway from Hina Lani Street and to go eastbound on Hina Lani Street from the highway's southbound approach. A northbound on-ramp from Hina Lani Street and a northbound off-ramp to Hina Lani Street will also be required. The proposed Park at the west end of the project site is the closest land use to the future interchange which may be considered noise sensitive. In order that the CY 2045 traffic noise levels not exceed 65 DNL at the west park boundary, the centerline of the northbound on-ramp should be located at least 85 FT west of the Park's west boundary.

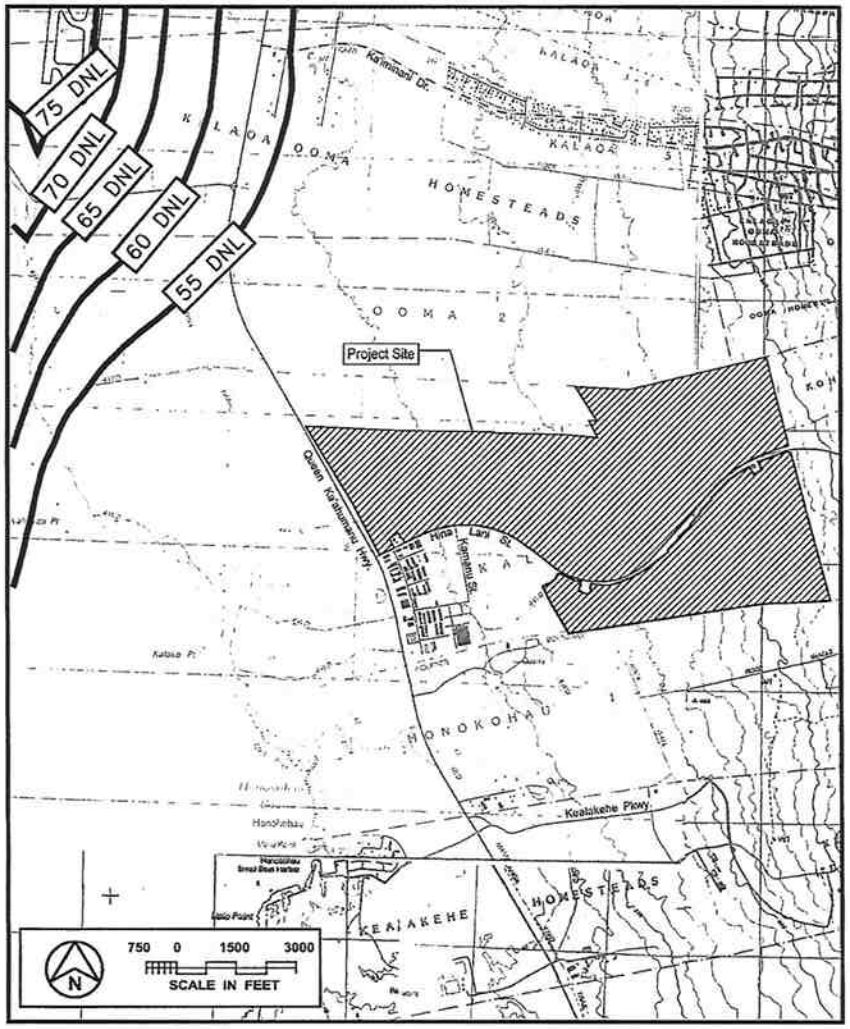
The predicted noise level from the overpass ramp structure in CY 2045 was 65 DNL at 116 FT from the centerline of the ramp structure. Because the overpass ramp structure will probably be located on the northwest quadrant of the interchange, the 65 DNL contour from Queen Kaahumanu Highway through traffic will extend between 110 to 130 FT beyond the westernmost edge of the overpass ramp structure. Beyond the future interchange at Hina Lani Street, the CY 2045 setback distances to the highway's 65 DNL contours north and south of Hina Lani Street should be similar to those shown in Table 6.

Aircraft Noise. The aircraft noise contours in the project environs for the CY 2013 and 2030 periods were developed during the most recent 14 CFR Part 150 Noise Study Update for Kona International Airport at Keahole. These airport noise contours are shown in Figures 8 and 9 and were obtained from Reference 6. These noise contours and their relationships to the project site are very similar to the existing (2008) airport noise contours shown in Figure 7. The forecasted 2013 and long range airport noise contours are expected to remain outside the project area. Based on the relationships of the project site to the forecasted airport noise contours shown in Figures 8 and 9, it was concluded that risks of adverse noise impacts from aircraft noise should be minimal at the project site, and that the proposed noise sensitive developments on the project site conforms to the land use compatibility recommendations of the State Department of Transportation, Airports Division.



2013 14 CFR PART 150 NOISE CONTOURS FOR KONA INTERNATIONAL AIRPORT AT KEAHOLE

FIGURE 8



LONG RANGE 14 CFR PART 150 NOISE CONTOURS FOR KONA INTERNATIONAL AIRPORT AT KEAHOLE

FIGURE 9

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

Traffic Noise. The increases in traffic noise levels attributable to the project from the present to CY 2045 are predicted to range from 1.1 to 2.2 DNL along Queen Kaahumanu Highway, where traffic noise levels are expected to be above 65 DNL at relatively large distances from the highway Right-of-Way. These increases in traffic noise levels along Queen Kaahumanu Highway which are attributable to the project are much lower than the traffic noise increases expected as a result of non-project traffic. The project's development plan has allowed for adequate setback distances of the project's noise sensitive parcels from Queen Kaahumanu Highway, with the light industrial properties providing both a buffer and sound attenuating structures between the highway and the noise sensitive parcels planned to the east. The lands along the highway Right-of-Way are generally vacant in the project environs except for existing commercial developments south of the Hina Lani Street intersection. For these reasons, traffic noise impacts along Queen Kaahumanu Highway and resulting from project traffic are not considered to be serious. However, setback distances to the 65 and 75 DNL contours are expected to increase as a result of both project and non-project traffic.

Relatively small increases (1.0 DNL or less) in traffic noise levels along the north and south sections of Mamalahoa Highway at the Hina Lani Street intersection are expected to occur as a result of the proposed project. Non-project traffic is expected to cause increases of 1.2 to 2.2 DNL during this same period. By CY 2045, project traffic is expected to increase traffic noise levels along the north and south sections of Mamalahoa Highway by approximately 0.9 DNL and 1.1 DNL, respectively. This level of increase is not considered significant, and traffic noise impacts resulting from project traffic along these sections of the highway will be difficult to quantify over this 34 year period.

Along Hina Lani Street, potential noise impacts from project and non-project traffic are possible, both in respect to existing and planned noise sensitive receptors along this roadway. Existing and future residences which are located along the sections of Hina Lani Street between Mamalahoa Highway and Queen Kaahumanu Highway may be impacted by the future traffic noise along the roadway if their setback distances from the highway centerline are less than 223 FT. Because traffic noise along public roadways such as Hina Lani Street are generated by non-project as well as project traffic, mitigation of offsite traffic noise impacts are generally performed by individual property owners along the roadways' Rights-of-Way or by public agencies during roadway improvement projects. These mitigation measures generally take the form of increased setbacks, sound attenuating walls, total closure and air conditioning, or the use of sound attenuating windows. Where adequate setbacks beyond the 65 DNL noise contour are not available, the construction of 6 FT high sound walls is generally effective for attenuating traffic noise at single story structures, or at the ground floors of multistory structures. Whenever mitigation of traffic noise at the upper

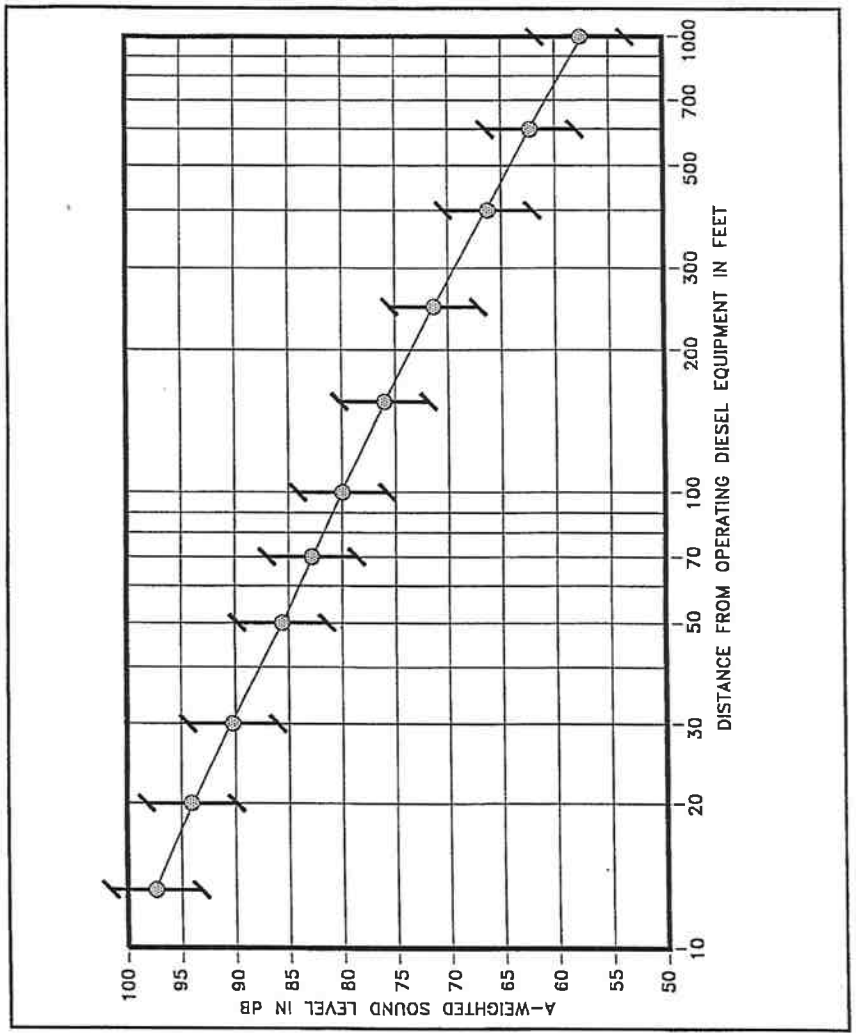
floors are required, the use of closure and air conditioning, or the use of sound attenuating windows are the more appropriate sound attenuation measures. Along the future Ane Keahokalole Highway, project residences will require setback distances in the order of 96 to 103 FT from the centerline of the highway, or sound attenuation walls constructed along the Rights-of-Way may be required for traffic noise mitigation.

Aircraft Noise. Based on currently available existing and forecasted aircraft noise contours over the project site, special aircraft noise attenuation measures are not considered mandatory on the project site. The implementation of the airport noise disclosure provisions of Act 208 is not required because the existing and forecasted 55 DNL noise contours do not enter into the project area.

Combined Traffic and Aircraft Noise. When applying for FHA/HUD financial assistance on residential developments, sound attenuation measures are normally required if total exterior noise levels exceed 65 DNL. Traffic noise levels may exceed 65 DNL along the highway corridors and major thoroughfares which service the project. If the traffic noise level equals 65 DNL and the aircraft noise level is less than 55 DNL at a project dwelling, the total noise level will also be 65 DNL, which does not exceed the FHA/HUD standard of 65 DNL. Because existing and forecasted aircraft noise levels over the project site should not exceed 55 DNL, combined traffic and aircraft noise levels should not exceed 65 DNL when traffic noise levels are equal to or less than 65 DNL. Where traffic noise levels exceed 65 DNL, the combined noise levels will be identical to the traffic noise levels over the entire project site, and will not be dependent upon the levels of aircraft noise.

Construction Noise. Audible construction noise will probably be unavoidable during the entire project construction period. The total time period for construction is unknown, but it is anticipated that the actual work will be moving from one location on the project site to another during that period. Actual length of exposure to construction noise at any receptor location will probably be less than the total construction period for the entire project. Typical levels of noise from construction activity (excluding pile driving activity) are shown in Figure 10. The noise sensitive properties which are predicted to experience the highest noise levels during construction activities on the project site are the future residences who first occupy the project site following the initial phases of project completion. Existing residences to the east along Hina Lani Street may also experience audible construction noise of approximately 55 dBA or less. Adverse impacts from construction noise are not expected to be in the "public health and welfare" category due to the temporary nature of the work and due to the administrative controls available for its regulation. Instead, these impacts will probably be limited to the temporary degradation of the quality of the acoustic environment in the immediate vicinity of the project site.

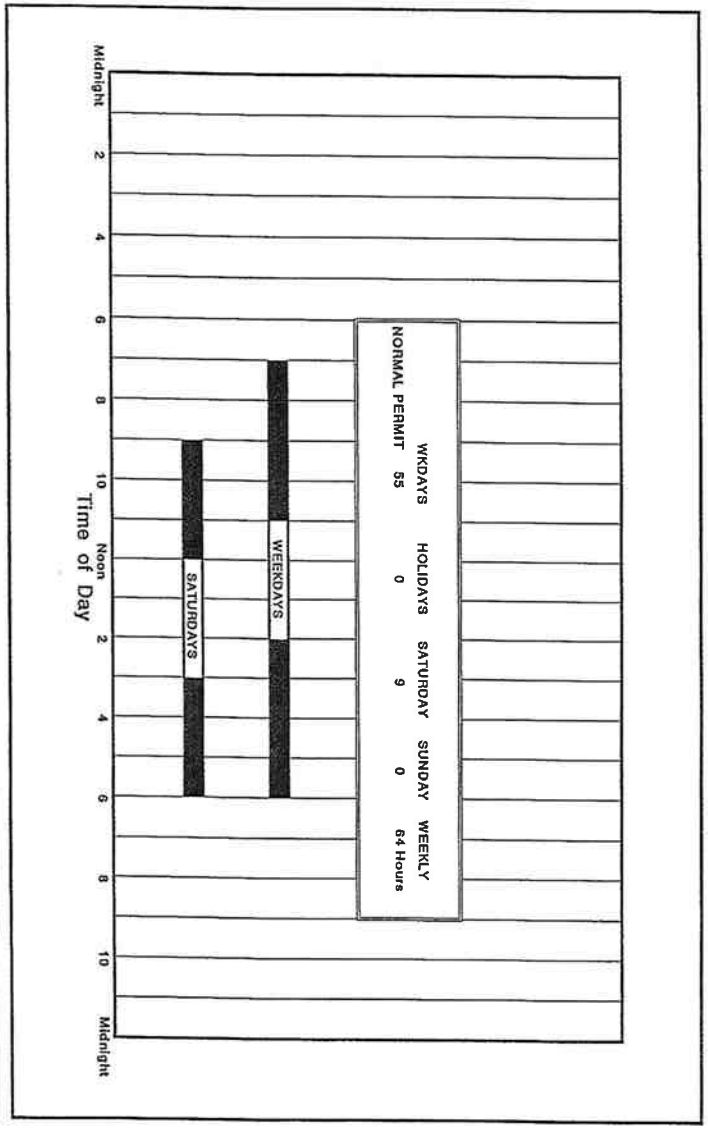
Mitigation of construction noise to inaudible levels will not be practical in all cases due to the intensity of construction noise sources (80 to 90+ dB at 50 FT distance), and due to the exterior nature of the work (grading and earth moving,



ANTICIPATED RANGE OF CONSTRUCTION NOISE LEVELS VS. DISTANCE

FIGURE 10

trenching, concrete pouring, hammering, etc.). The use of properly muffled construction equipment should be required on the job site. The incorporation of State Department of Health construction noise limits and curfew times, which are applicable on the island of Hawaii (Reference 7), is another noise mitigation measure which can be applied to this project. Figure 11 depicts the normally permitted hours of construction for normal construction noise as well as the curfew periods for construction noise. Noisy construction activities are not allowed on Sundays and holidays under the DOH permit procedures.



AVAILABLE WORK HOURS UNDER DOH PERMIT PROCEDURES FOR CONSTRUCTION NOISE

FIGURE 11

APPENDIX A. REFERENCES

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

(2) American National Standard, "Sound Level Descriptors for Determination of Compatible Land Use," ANSI S12.9-1998/ Part 5; Acoustical Society of America.

(3) "Environmental Criteria and Standards, Noise Abatement and Control, 24 CFR, Part 51, Subpart B;" U.S. Department of Housing and Urban Development; July 12, 1979.

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

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

(6) "Kona International Airport At Keahole, 14 CFR Part 150 Noise Compatibility Study, Noise Exposure Maps Update;" State Department of Transportation, Airports Division; April 2009.

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

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

(9) "Traffic Impact Study for Kaloko Makai in Kona, Hawaii;" KOA Corporation; August 8, 2012.

(10) 24-Hour Traffic Counts, Station B71001909280, Queen Kaahumanu Highway Between OTEC Access Road and Hulikoa Street; State Department of Transportation; May 31, 2006.

APPENDIX B

EXCERPTS FROM EPA'S ACOUSTIC TERMINOLOGY GUIDE

Descriptor Symbol Usage

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

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

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

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

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

Descriptor Nomenclature

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

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

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

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

Noise Impact

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

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

APPENDIX B (CONTINUED)

TABLE I

A-WEIGHTED RECOMMENDED DESCRIPTOR LIST

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

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

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

APPENDIX B (CONTINUED)

TABLE II

RECOMMENDED DESCRIPTOR LIST

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

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

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

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

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

APPENDIX C

SUMMARY OF BASE YEAR AND FUTURE YEAR (2045) TRAFFIC VOLUMES

ROADWAY LANES	**** CY 2010 *****		CY 2045 (NO BUILD)		CY 2045 (BUILD)	
	AM VPH	PM VPH	AM VPH	PM VPH	AM VPH	PM VPH
Mamalahoa Hwy. - North of Hina Lani St. (NB)	331	701	544	1,258	823	1,535
Mamalahoa Hwy. - North of Hina Lani St. (SB)	1,087	477	1,814	883	2,038	1,189
Two-Way	1,418	1,178	2,358	2,141	2,861	2,724
Mamalahoa Hwy. - South of Hina Lani St. (NB)	393	588	492	843	738	1,181
Mamalahoa Hwy. - South of Hina Lani St. (SB)	1,035	601	1,372	824	1,679	1,129
Two-Way	1,428	1,189	1,864	1,667	2,417	2,310
Hina Lani St. - West of Mamalahoa Hwy. (EB)	136	400	305	765	891	1,347
Hina Lani St. - West of Mamalahoa Hwy. (WB)	250	163	695	409	1,165	1,053
Two-Way	386	563	1,000	1,174	2,056	2,400
Hina Lani St. - East of Ane Keahokalole Hwy. (EB)	101	339	320	980	994	1,962
Hina Lani St. - East of Ane Keahokalole Hwy. (WB)	220	160	900	541	1,771	1,342
Two-Way	321	499	1,220	1,521	2,765	3,304
Ane Keahokalole Hwy. - North of Hina Lani St. (NB)	N/A	N/A	182	375	808	1,071
Ane Keahokalole Hwy. - North of Hina Lani St. (SB)	N/A	N/A	462	253	1,070	990
Two-Way	N/A	N/A	644	628	1,878	2,061
Ane Keahokalole Hwy. - South of Hina Lani St. (NB)	N/A	N/A	429	747	829	1,264
Ane Keahokalole Hwy. - South of Hina Lani St. (SB)	N/A	N/A	878	606	1,342	1,094
Two-Way	N/A	N/A	1,307	1,353	2,171	2,358
Hina Lani St. - West of Ane Keahokalole Hwy. (EB)	101	339	194	723	856	1,613
Hina Lani St. - West of Ane Keahokalole Hwy. (WB)	220	160	605	303	1,382	1,082
Two-Way	321	499	799	1,026	2,238	2,695
Hina Lani St. - East of Kamanu St. (EB)	101	339	202	565	968	1,697
Hina Lani St. - East of Kamanu St. (WB)	220	160	442	300	1,434	1,204
Two-Way	321	499	644	865	2,402	2,901
Hina Lani St. - West of Kamanu St. (EB)	137	210	254	323	1,354	1,821
Hina Lani St. - West of Kamanu St. (WB)	232	439	339	582	1,659	1,893
Two-Way	369	649	593	905	3,013	3,714

APPENDIX C (CONTINUED)

SUMMARY OF BASE YEAR AND FUTURE YEAR TRAFFIC VOLUMES

ROADWAY LANES	**** CY 2010 *****		CY 2045 (NO BUILD)		CY 2045 (BUILD)	
	AM VPH	PM VPH	AM VPH	PM VPH	AM VPH	PM VPH
Hina Lani St. - East of Q. Kaahumanu Hwy. (EB)	532	741	741	906	1,840	2,404
Hina Lani St. - East of Q. Kaahumanu Hwy. (WB)	415	744	506	877	1,825	2,189
Two-Way	947	1,485	1,247	1,783	3,665	4,593
Kamanu St. - North of Hina Lani St. (NB)	N/A	N/A	N/A	N/A	585	646
Kamanu St. - North of Hina Lani St. (SB)	N/A	N/A	N/A	N/A	579	687
Two-Way	N/A	N/A	N/A	N/A	1,164	1,333
Q. Kaahumanu Hwy. North of Hina Lani St. (NB)	670	859	1,256	1,566	1,637	1,975
Q. Kaahumanu Hwy. North of Hina Lani St. (SB)	839	918	1,458	1,709	1,816	2,199
Two-Way	1,509	1,777	2,714	3,275	3,453	4,174
Q. Kaahumanu Hwy. South of Hina Lani St. (NB)	845	1,111	1,458	1,827	2,263	2,930
Q. Kaahumanu Hwy. South of Hina Lani St. (SB)	897	1,173	1,425	1,941	2,427	2,939
Two-Way	1,742	2,284	2,883	3,768	4,690	5,869

Appendix M

Air Quality Study for the Proposed Kaloko Makai Project
B.D. Neal & Associates
October 31, 2012

Draft

AIR QUALITY STUDY

FOR THE PROPOSED

KALOKO MAKAI VILLAGE PROJECT

NORTH KONA, HAWAII

Prepared for:

Stanford Carr Development

October 31, 2012

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1.0 SUMMARY

Sanford Carr Development is proposing to develop the Kaloko Makai Village Project in the North Kona District on the island of Hawaii. The proposed 1,139-acre project will include single and multi-family housing, a hotel, commercial space, two schools, parks and other associated amenities and facilities. Development of the project is expected to occur in three phases and be completed and fully occupied by 2045. 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, although in some cases the Hawaii standards are more stringent than the national standards, such as for carbon monoxide. For some other parameters, such as for particulate matter and sulfur dioxide, the national standards are more restrictive.

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 near coastal situation and by nearby mountains. Winds are predominantly light and variable, although kona storms generate occasional strong winds from the south or southwest during winter. Temperatures in the project area are generally very consistent and moderate with average daily temperatures ranging from about 65°F to 85°F. The extreme minimum temperature recorded at the nearby Old Kona Airport is 47°F, while the extreme maximum temperature is 93°F. Average annual rainfall in the area amounts to about 25 inches with each month typically contributing about 2 inches.

Except for periodic impacts from volcanic emissions (vog) and possibly occasional localized impacts from traffic congestion, the present air quality of the project area is believed to be relatively good. The limited air quality data that are available for the area from the Department of Health indicate that fine particulate concentrations, which are due to the vog, exceed the national air quality standards.

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 phases. 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 construction periods. 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 periods 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, a computerized air quality modeling study was undertaken to estimate current ambient concentrations of carbon monoxide* at roadway intersections in the project vicinity and to predict future levels 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. Without the project, carbon monoxide concentrations can be expected to gradually increase through the year 2045 but remain within standards. With the project in the year 2025, after the first phase of the

project is completed, carbon monoxide concentrations were estimated to increase moderately in the project area compared to without it, but concentrations would continue to comply with air quality standards. Increases were predicted to continue in the second and third phases of the project, but concentrations should remain within state and federal standards through the year 2045. 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 significant impacts are unlikely. Nevertheless, incorporating energy conservation design features and promoting conservation and recycling programs within the proposed development could serve to further reduce any associated impacts and conserve the island's resources.

2.0 INTRODUCTION

Sanford Carr Development is proposing to develop the Kaloko Makai Village Project on approximately 1,139 acres of undeveloped lands in the North Kona District on the island of Hawaii (see Figure 1 for project location). The project site straddles Hina Lani Street between Queen Kaahumanu Highway and Mamalahoa Highway. The proposed mixed-use development includes multi- and single-family housing, a hotel, parks, an elementary school, a middle school,

hospital/medical facilities, commercial space for stores and services, office space, fire/police facilities, a wastewater treatment plant, light industrial space and other associated facilities and infrastructure. Development is planned for three phases which are expected to be completed in approximately 10-year increments (2025, 2035 and 2045).

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 project impacts 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 national AAQS are reviewed periodically, and multiple revisions have occurred over the past 30 years. In general, the national AAQS have become more stringent with the passage of time and as more information and evidence become available concerning the detrimental effects of air pollution. Changes to the Hawaii AAQS over the past several years have tended to follow revisions to the national AAQS, making several of the Hawaii AAQS the same as the national AAQS.

4.0 REGIONAL AND LOCAL CLIMATOLOGY

Regional and local climatology significantly affect 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.

The site of the proposed project is located near the midpoint of the western coast of the island of Hawaii. The topography of Hawaii Island is dominated by the great volcanic masses of Mauna Loa (13,653 feet), Mauna Kea (13,796 feet), and of Hualalai, the Kohala Mountains and Kilauea. The island consists entirely of the slopes of these mountains and of the broad saddles between

them. Mauna Loa and Kilauea, located on the southern half of the island, are still active volcanoes.

Hawaii lies well within the belt of northeasterly trade winds generated by the semi-permanent Pacific high pressure cell to the north and east. Nearly the entire western coast of the island of Hawaii, however, is sheltered from the trade winds by high mountains, except when unusually strong trade winds sweep through the saddle between the Kohala Mountains and Mauna Kea and reach some areas to the lee. Due to wind shadow effects caused by the terrain, winds in the project area are predominantly light and variable. Local winds such as land/sea breezes and/or upslope/downslope winds dominate the wind pattern for the area. During the daytime, winds typically move onshore because of seabreeze and/or upslope effects. At night, winds generally are land breezes and/or drainage winds that move downslope and out to sea. During winter, occasional strong winds from the south or southwest occur in association with the passage of winter storm systems.

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 depends 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 site's leeward location results in a larger temperature profile compared to windward locations at the same elevation. At the Old Kona Airport, located a few miles south of the project site, average daily minimum and maximum temperatures are 67°F and 83°F, respectively [1]. The extreme minimum temperature on record at this location is 47°F, and the extreme maximum is 93°F. Temperatures at the project site are similar.

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 often measured and described in terms of Pasquill-Gifford stability class. Stability class 1 is the most turbulent and class 6 is the least. Thus, air pollution dissipates the best during stability class 1 conditions and the worst when stability class 6 prevails. In the Kona area, stability classes 5 or 6 typically occur during the nighttime or early morning hours when temperature inversions form due to radiational cooling or to drainage flow from the mountainous interior of the island. 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 climate of the project area is wetter than might be expected for a leeward location. This is due to the persistent onshore and upslope movement of marine air caused by both eddie and seabreeze or mountain slope effects. Some of the rainfall occurs during summer afternoons and evenings as a result of this onshore and upslope movement of moisture-laden marine air, and some occurs in conjunction with winter storms. At the Old Kona Airport, average annual rainfall amounts to about 25 inches with each month registering about 2 inches [1]. Rainfall at the project site is probably about the same.

5.0 PRESENT AIR QUALITY

Present air quality in the project area is mostly affected by air pollutants from vehicular, industrial, natural and/or agricultural sources. Table 2 presents an air pollutant emission summary for the island of Hawaii for calendar year 1993. This has become somewhat dated but is the latest information available. 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 manmade particulate emissions on Hawaii originate from area sources, such as the mineral products industry and agriculture. Manmade sulfur oxides are emitted almost exclusively by point sources, such as power plants and other fuel-burning industries. Nitrogen oxides emissions emanate predominantly from area sources (mostly motor vehicle traffic), although industrial point sources 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 Hawaii, emissions of particulate and nitrogen oxides may have increased during the past several years, while emissions of sulfur oxides, carbon monoxide and hydrocarbons probably have declined.

It should be noted that Hawaii Island is unique from the other islands in the state in terms of the natural volcanic air pollution emissions that occur. Volcanic emissions periodically plague the project area. This is especially so since the latest

eruption phase of the Kilauea Volcano began in 1983. Air pollution emissions from the Hawaiian volcanoes consist primarily of sulfur dioxide. After entering the atmosphere, these sulfur dioxide emissions are carried away by the wind and either washed out as acid rain or gradually transformed into particulate sulfates or acid aerosols. Although emissions from Kilauea are vented on the other side of a mountain barrier more than 50 miles east of the project site, the prevailing wind patterns eventually carry some of the emissions into the Kona area. These emissions can be seen in the form of the volcanic haze (vog) which persistently hangs over the area.

The major industrial source of air pollution in the project vicinity is Hawaii Electric Light Company's Keahole Power Plant, which is located about 2 miles to the north. Air pollution emissions from Keahole Power Plant consist mostly of sulfur dioxide and oxides of nitrogen.

The project site is situated between Queen Kaahumanu Highway on the makai side and Mamalahoa Highway on the mauka side. Both of these highways are regional arterial roadways that often carry substantial volumes of traffic. Winds may sometimes carry emissions from motor vehicles traversing these roadways toward the project site.

The State Department of Health operates a network of air quality monitoring stations at various locations around the state. Unfortunately, very limited data are available for Hawaii Island,

and even less data are available for the Kona area specifically. During the most recent 5-year period for which data have been reported (2006-2010), the Department of Health operated an air quality monitoring site in the Kealakekua area for measuring sulfur dioxide. Particulate (PM 2.5) was also monitored at this site, but monitoring for this parameter was only initiated during 2008. As indicated in Table 3, measurements of sulfur dioxide concentrations at this location during the 2006-2010 monitoring period were consistently low with annual average concentrations of 0.004 to 0.009 ppm, which represents about 30 percent of the state and national standard. The highest annual second-highest 3-hour and 24-hour concentrations (which are most relevant to the standards) for these five years were 0.112 and 0.042 ppm, respectively; these are about 22 to 30 percent of the applicable standards. No exceedances of the state/national 3-hour and 24-hour AAQS for sulfur dioxide were recorded.

The annual average particulate (PM 2.5) concentrations for the years 2008 through 2010 ranged from 16 to 21 $\mu g/m^3$. These values exceed the national annual standard which is set at 15 $\mu g/m^3$. The 98th percentile 24-hour concentration (which is most relevant to the national 24-hour standard) was reported at 37 $\mu g/m^3$ for 2008 and 2009 and at 35 $\mu g/m^3$ for 2010. These values are slightly above or equal to the national standard of 35 $\mu g/m^3$. These higher concentrations of fine particulate are primarily due to volcanic emissions.

At this time, there are no reported measurements of lead, ozone, nitrogen dioxide or carbon monoxide in the project vicinity. These are primarily motor vehicle related air pollutants. Lead, ozone and nitrogen dioxide typically are regional scale problems. Concentrations of lead and nitrogen dioxide generally have not been found to exceed AAQS elsewhere in the state. Ozone concentrations, on the other hand, have been found to exceed the state standard at times at Sand Island on Oahu. Carbon monoxide air pollution typically is a microscale problem caused by congested motor vehicular traffic. In traffic congested areas such as urban Honolulu, carbon monoxide concentrations have been found to occasionally exceed the state AAQS. Present concentrations of carbon monoxide in the project area are estimated later in this study based on computer modeling of motor vehicle emissions.

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 annual standard for nitrogen dioxide is not likely to be violated by short-term construction equipment emissions. Also, the new short-term (1-hour) standard for nitrogen dioxide is based on a three-year average; thus it is unlikely that relatively short-term construction emissions would exceed the standard. Carbon monoxide emissions from diesel engines 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 20

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, seven scenarios were evaluated for the carbon monoxide modeling study: year 2011 with present conditions; years 2025, 2035 and 2045 without the project; and years 2025, 2035 and 2045 with the project. The years evaluated correspond to the three project phases that are planned. To begin the modeling study of the seven study 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, the same key intersections identified in the traffic study were also selected for air quality analysis. These included the following intersections:

- Queen Kaahumanu Highway at Kaiminani Drive
- Queen Kaahumanu Highway at Hulikoa Drive
- Queen Kaahumanu Highway at Hina Lani Street
- Queen Kaahumanu Highway at Kealakehe Parkway
- Hina Lani Street at Kanalani Street
- Hina Lani Street at Kamanu Street
- Hina Lani Street at Ane Keohokalole Highway
- Hina Lani Street at Mamalahoa Highway

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 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 MOBILE6.2 [5] was used to calculate vehicular carbon monoxide emissions for each year studied. One of the key inputs to MOBILE6.2 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 34.2% light-duty gasoline-powered automobiles, 52.8% light-duty gasoline-powered trucks and vans, 3.6% heavy-duty gasoline-powered vehicles, 0.2% light-duty diesel-powered vehicles, 8.6% 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 MOBILE6.2 generally have an inverse relationship to the ambient temperature.

After computing vehicular carbon monoxide emissions through the use of MOBILE6.2, 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.

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. All emission factors that were input to CAL3QHC for free-flow traffic on roadways were obtained from MOBILE6.2 based on assumed free-flow vehicle speeds corresponding to the posted speed limits.

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 0.5 ppm to all predicted concentrations for 2011. 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 0.5 ppm was assumed to persist for the future scenario studied.

Predicted Worst-Case 1-Hour Concentrations

Table 4 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 seven scenarios: year 2011 with existing traffic; years 2025, 2035 and 2045 without the project; and years 2025, 2035 and 2045 with the project. 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 (2011) case was 3.6 ppm. This was projected to occur during the morning peak traffic hour near the intersection of Queen Kaahumanu Highway and Kealakehe Parkway. Concentrations at other locations

and times studied were 2.9 ppm or lower. All predicted worst-case 1-hour concentrations for the 2011 scenario were within both the national AAQS of 35 ppm and the state standard of 9 ppm.

In the year 2025 without the project, the predicted highest worst-case 1-hour concentration continued to occur during the morning at the intersection of Queen Kaahumanu Highway and Kealakehe Parkway with a value of 3.9 ppm. Other concentrations for this scenario ranged between 1.4 and 3.2 ppm. The predicted concentrations for 2025 without the project are slightly higher at most of the locations studied compared to the existing case, but the predicted worst-case concentrations remained within standards. As indicated by the other results shown in Table 4, this trend would continue in 2035 and 2045 without the project with worst-case concentrations tending to increase slightly, but the concentrations are projected to remain within standards.

In the year 2025 with the proposed project, the predicted highest worst-case 1-hour concentration occurred during the morning at the intersection of Queen Kaahumanu Highway and Hina Lani Street with a value of 5.4 ppm. Other concentrations for this scenario ranged between 2.1 and 5.1 ppm. With the project and assuming the roadway improvements identified in the project traffic study are implemented, carbon monoxide concentrations in the year 2025 were predicted to increase compared to the without-project case at all locations studied. However, the predicted worst case carbon monoxide concentrations remained within the state and federal standards. In 2035 with the project, this trend would tend to continue, although the location with the highest

concentration, a value of 5.8 ppm, was predicted to occur during the morning at the intersection of Queen Kaahumanu Highway and Kealakehe Parkway. In the 2045 with project scenario, worst-case concentrations generally decreased (improved) slightly or remained unchanged. For all three phases of the project, worst-case concentrations were predicted to remain 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 0.6 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 5. For the 2011 scenario, the estimated worst-case 8-hour carbon monoxide concentrations for the seven locations studied ranged from 0.7 ppm at the Hina Lani Street at Kamanu Street intersection to 1.8 ppm at the Queen Kaahumanu Highway/Kealakehe Parkway intersection. The estimated worst-case concentrations for the existing case were well within the national limit of 9 ppm and the state standard of 4.4 ppm.

In 2025 without the project, worst-case 8-hour carbon monoxide concentrations in the project area were predicted to increase slightly or remain nearly unchanged compared to the existing case. As shown by the results given in the table, the analysis suggests this trend would continue through 2035 and 2045 without the project, and worst-case 8-hour carbon monoxide concentrations should remain within the standards through 2045.

For the 2025 with project scenario, worst-case concentrations increased at all locations studied compared to the without project case. The worst-case concentrations ranged from 1.4 to 2.7 ppm. Although concentrations were predicted to increase compared to the without project case, all predicted 8-hour concentrations for the 2025 with project scenario were within both the national and the state AAQS. In the years 2035 and 2045 with the project, worst-case 8-hour concentrations were predicted to continue to increase only slightly or remain nearly unchanged, and compliance with standards would be maintained.

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. The annual electrical demand of the project when fully developed is expected to reach a maximum of approximately 87 million kilowatt-hours [12]. The estimated annual electrical demand for each project phase is: 35 million kilowatt-hours for Phase 1, 35 million kilowatt-hours for Phase 2, and 17 million kilowatt-hours for Phase 3. Electrical power for the project will most probably be provided mainly by oil-fired generating facilities, but some of the project power may also be derived from geothermal energy, wind power or other sources. In order to meet the electrical power needs of the

proposed project, power generating facilities will likely be required to burn more fuel and hence more air pollution will be emitted at these facilities. Given in Table 6 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 local power plants. These values can be compared to the island-wide emission estimates for 1993 given in Table 2. The estimated indirect emissions from the full project electrical demand amount to about 2 percent or less of the present (manmade) air pollution emissions occurring on Hawaii Island if all power is assumed to be derived from oil.

7.3 Solid Waste Disposal

Solid waste generated by the proposed development when fully completed and occupied is not expected to exceed about 4,672 tons per year for Phase 1; 4,253 tons per year for Phase 2; and 2,515 tons per year for Phase 3, for a project total of about 11,440 tons per year [13]. Currently, all solid waste on the island is buried at solid waste landfills. Thus, assuming this continues to be the method for solid waste disposal, the only associated air pollution emissions that will occur will be from trucking the waste to the landfill and burying it. These emissions should be relatively minor.

8.0 CONCLUSIONS AND RECOMMENDATIONS

Existing air quality in the project area is impacted by emissions from Kilauea Volcano. Fine particulate measurements from the

Department of Health monitoring station at Kealakekua indicate that the national standards for both the 24-hour and the annual averaging periods may be exceeded. While this phase of Kilauea's eruption has been occurring for more than 25 years and it is unknown when it will end, fine particulate concentrations will go down significantly when it does.

The major potential short-term air quality impact of the project will occur from the emission of fugitive dust during construction phases. 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 phases are completed and fully occupied, carbon monoxide concentrations in the project area due to motor vehicle emissions will likely increase slightly with each phase, but worst-case concentrations should remain within both the state and the national ambient air quality standards through the year 2045. 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 solid waste materials generated by the project will likely be small based on the relatively small magnitudes of these emissions. Nevertheless, 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; 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; providing movable, controlled openings for ventilation at opportune times; and possibly installing 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.

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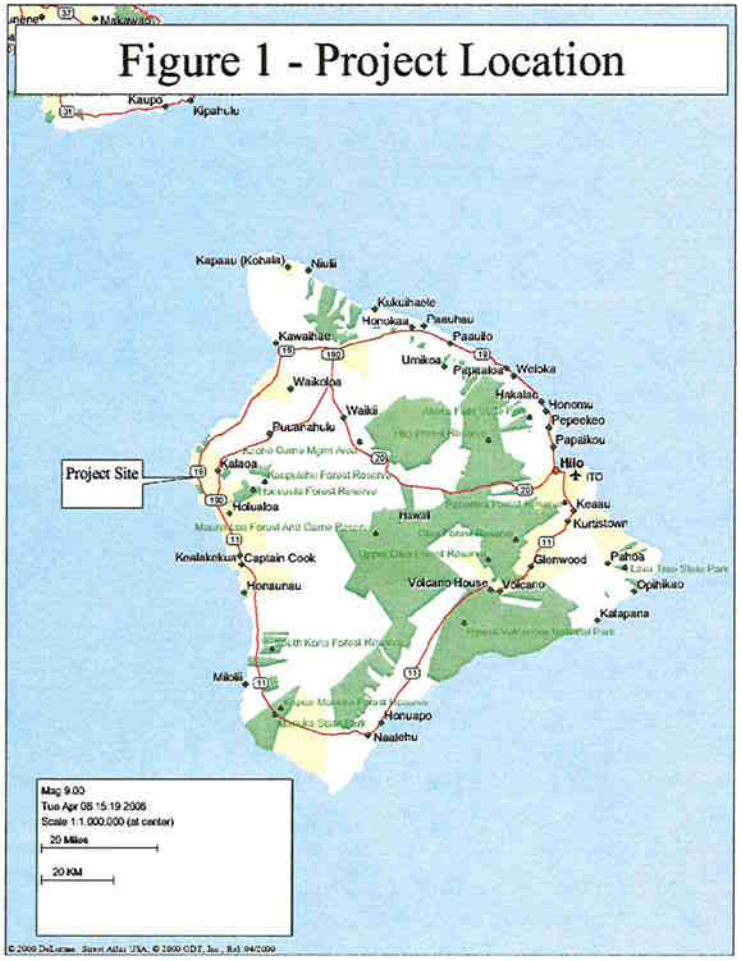

Table 1

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	- 150[a]	- 150[a]	50 150[b]
Particulate Matter (<2.5 microns)	µg/m³	Annual 24 Hours	15[c] 35[d]	15[c] 35[d]	- -
Sulfur Dioxide	ppm	Annual 24 Hours 3 Hours 1 Hour	- - - 0.075[e]	- - 0.5[b] -	0.03 0.14[b] 0.5[b] -
Nitrogen Dioxide	ppm	Annual 1 Hour	0.053 0.100[f]	0.053 -	0.04 -
Carbon Monoxide	ppm	8 Hours 1 Hour	9[b] 35[b]	- -	4.4[b] 9[b]
Ozone	ppm	8 Hours	0.075[g]	0.075[g]	0.08[g]
Lead	µg/m³	3 Months Quarter	0.15[h] 1.5[i]	0.15[h] 1.5[i]	- 1.5[i]
Hydrogen Sulfide	ppm	1 Hour	-	-	0.035[b]

[a] Not to be exceeded more than once per year on average over three years.
[b] Not to be exceeded more than once per year.
[c] Three-year average of the weighted annual arithmetic mean.
[d] 98th percentile value of the 24-hour concentrations averaged over three years.
[e] Three-year average of annual fourth-highest daily 1-hour maximum.
[f] 98th percentile value of the daily 1-hour maximum averaged over three years.
[g] Three-year average of annual fourth-highest daily 8-hour maximum.
[h] Rolling 3-month average.
[i] Quarterly average.

Table 2

AIR POLLUTION EMISSIONS INVENTORY FOR ISLAND OF HAWAII, 1993

Air Pollutant	Point Sources (tons/year)	Area Sources (tons/year)	Total (tons/year)
Particulate	30,311	9,157	39,468
Sulfur Oxides	9,345	nil	9,345
Nitrogen Oxides	4,054	8,858	12,912
Carbon Monoxide	3,357	23,934	27,291
Hydrocarbons	1,477	203	1,680

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 3

ANNUAL SUMMARIES OF AIR QUALITY MEASUREMENTS FOR MONITORING STATIONS NEAREST KALOKO MAKAI VILLAGE PROJECT

Parameter / Location	2006	2007	2008	2009	2010
Sulfur Dioxide / Kealakekua, Kona					
3-Hour Averaging Period:					
No. of Samples	2697	2756	2445	2560	2625
Highest Concentration (ppm)	0.046	0.034	0.124	0.130	0.150
2nd Highest Concentration (ppm)	0.035	0.025	0.112	0.111	0.095
No. of State AAQS Exceedances	0	0	0	0	0
24-Hour Averaging Period:					
No. of Samples	341	343	353	365	344
Highest Concentration (ppm)	0.012	0.011	0.054	0.045	0.039
2nd Highest Concentration (ppm)	0.011	0.011	0.038	0.042	0.034
No. of State AAQS Exceedances	0	0	0	0	0
Annual Average Concentration (ppm)	0.004	0.004	0.009	0.004	0.006
Particulate (PM-2.5) / Kealakekua, Kona					
24-Hour Averaging Period:					
No. of Samples	-	-	292	352	359
Highest Concentration (μg/m³)	-	-	44	61	63
98th Percentile Concentration (μg/m³)	-	-	37	37	35
No. Occurrences Greater than 35 μg/m³	-	-	10	8	6
Annual Average Concentration (μg/m³)	-	-	21	16	18

Source: State of Hawaii Department of Health, "Annual Summaries, Hawaii Air Quality Data, 2006 - 2010"

Table 4 (continued)

ESTIMATED WORST-CASE 1-HOUR CARBON MONOXIDE CONCENTRATIONS ALONG ROADWAYS NEAR KALOKO MAKAI VILLAGE PROJECT (parts per million)

Roadway Intersection	Year/Scenario					
	2025/With Project		2035/With Project		2045/With Project	
	AM	PM	AM	PM	AM	PM
Queen Kaahumanu Highway at Kaiminani Drive	2.9	2.1	4.0	3.0	4.6	2.8
Queen Kaahumanu Highway at Hulikoa Drive	3.6	2.2	3.9	2.5	3.4	2.2
Queen Kaahumanu Highway at Hina Lani Street	5.4	3.6	5.6	4.4	-	-
Queen Kaahumanu Highway at Kealakehe Parkway	5.1	3.6	5.8	3.9	5.5	3.6
Hina Lani Street at Kanalani Street	3.1	2.0	3.4	2.2	3.4	2.3
Hina Lani Street at Kamanu Street	3.3	3.0	3.7	2.9	3.6	2.9
Hina Lani Street at Ane Keohokalole Highway	2.7	2.1	4.2	2.8	4.3	3.0
Hina Lani Street at Mamalahoa Highway	3.8	2.4	4.1	2.6	4.2	2.5

Hawaii State AAQS: 9
National AAQS: 35

Table 4

ESTIMATED WORST-CASE 1-HOUR CARBON MONOXIDE CONCENTRATIONS ALONG ROADWAYS NEAR KALOKO MAKAI VILLAGE PROJECT (parts per million)

Roadway Intersection	Year/Scenario							
	2011/Present		2025/Without Project		2035/Without Project		2045/Without Project	
	AM	PM	AM	PM	AM	PM	AM	PM
Queen Kaahumanu Highway at Kaiminani Drive	2.7	1.9	2.5	1.8	3.0	2.2	2.9	2.0
Queen Kaahumanu Highway at Hulikoa Drive	2.9	1.9	3.0	1.9	3.3	2.1	3.2	2.0
Queen Kaahumanu Highway at Hina Lani Street	2.9	2.6	3.2	2.7	3.4	2.7	3.4	2.4
Queen Kaahumanu Highway at Kealakehe Parkway	3.6	2.3	3.9	2.7	4.3	2.9	4.3	2.8
Hina Lani Street at Kanalani Street	2.3	1.7	2.3	1.6	2.2	1.6	1.9	1.4
Hina Lani Street at Kamanu Street	1.4	1.5	1.7	1.6	1.5	1.5	1.3	1.5
Hina Lani Street at Ane Keohokalole Highway	-	-	1.5	1.4	2.5	2.0	2.3	1.8
Hina Lani Street at Mamalahoa Highway	2.2	1.5	2.8	1.8	2.8	1.8	2.7	1.8

Hawaii State AAQS: 9
National AAQS: 35

(continued)

Table 5 (continued)

ESTIMATED WORST-CASE 8-HOUR CARBON MONOXIDE CONCENTRATIONS ALONG ROADWAYS NEAR KALOKO MAKAI VILLAGE PROJECT (parts per million)

Roadway Intersection	Year/Scenario		
	2025/With Project	2035/With Project	2045/With Project
Queen Kaahumanu Highway at Kaiminani Drive	1.4	2.0	2.3
Queen Kaahumanu Highway at Hulikoa Drive	1.8	2.0	1.7
Queen Kaahumanu Highway at Hina Lani Street	2.7	2.8	-
Queen Kaahumanu Highway at Kealakehe Parkway	2.6	2.9	2.8
Hina Lani Street at Kanalani Street	1.6	1.7	1.7
Hina Lani Street at Kamanu Street	1.6	1.8	1.8
Hina Lani Street at Ane Keohokalole Highway	1.4	2.1	2.2
Hina Lani Street at Mamalahoa Highway	1.9	2.0	2.1

Hawaii State AAQS: 4.4
National AAQS: 9

Table 5

ESTIMATED WORST-CASE 8-HOUR CARBON MONOXIDE CONCENTRATIONS ALONG ROADWAYS NEAR KALOKO MAKAI VILLAGE PROJECT (parts per million)

Roadway Intersection	Year/Scenario			
	2011/Present	2025/Without Project	2035/Without Project	2045/Without Project
Queen Kaahumanu Highway at Kaiminani Drive	1.4	1.2	1.5	1.4
Queen Kaahumanu Highway at Hulikoa Drive	1.4	1.5	1.6	1.6
Queen Kaahumanu Highway at Hina Lani Street	1.4	1.6	1.7	1.7
Queen Kaahumanu Highway at Kealakehe Parkway	1.8	2.0	2.2	2.2
Hina Lani Street at Kanalani Street	1.2	1.2	1.1	1.0
Hina Lani Street at Kamanu Street	0.7	0.8	0.8	0.8
Hina Lani Street at Ane Keohokalole Highway	-	0.8	1.2	1.2
Hina Lani Street at Mamalahoa Highway	1.1	1.4	1.4	1.4

Hawaii State AAQS: 4.4
National AAQS: 9

(continued)

Table 6

ESTIMATED INDIRECT AIR POLLUTION EMISSIONS FROM KALOKO MAKAI VILLAGE PROJECT ELECTRICAL DEMAND[a]

Air Pollutant	Emission Rate (tons/year)			
	Phase 1	Phase 2	Phase 3	Total
Particulate	9	9	4	22
Sulfur Dioxide	91	91	44	226
Carbon Monoxide	9	9	4	22
Volatile Organics	<1	<1	<1	1
Nitrogen Oxides	39	39	19	97

[a]Based on U.S. EPA emission factors for utility boilers [2]. Assumes annual electrical demand of 35 million kw-hrs for Phase 1, 35 million kw-hrs for Phase 2 and 17 million kw-hrs for Phase 3, for a total of 87 million kw-hrs per year of electrical power use [12]. Estimated emission rates assume low-sulfur oil used to generate power.

Appendix N

Economic and Fiscal Impact Assessment for Kaloko Makai
Mikiko Corporation
January 2013

MIKIKO
CORPORATION

ECONOMIC AND FISCAL IMPACT ASSESSMENT FOR KALOKO MAKAI

North Kona, Island of Hawaii

Prepared for:
SCD-TSA Kaloko Makai, LLC

FINAL REPORT

January 2013

Economic and Fiscal Impact Assessment for Kaloko Makai

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Economic and Fiscal Impact Assessment for Kaloko Makai

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ECONOMIC AND FISCAL IMPACT ASSESSMENT FOR KALOKO MAKAI

Report Text

1 – Introduction and Study Overview

Report Organization

This report is organized as follows:

- **Report Text -**
  - **Introduction and Study Overview** (Chapter 1) - Study background, objectives and approach of this economic and fiscal impact assessment.
  - **Executive Summary** (Chapter 2) – Tabular and narrative presentation of key study findings.
    - ♦ Projected Development Phasing
    - ♦ Projected Impacts
  - **Study Conditions and Terminology** (Chapter 3) **-** Explanation of factors that underlie the above conclusions, presented in narrative form, including:
    - ♦ Special Considerations
    - ♦ Definition of Key Terms
    - ♦ Report Conditions
- **Exhibits** - Detailed study findings, noting input assumptions and explanations in exhibit format.

Project and Study Background

SCD-TSA Kaloko Makai, LLC (SCD-TSA) proposes to develop a 1,142-acre site in North Kona, Hawaii as a master-planned community called Kaloko Makai (the Project.) The site is well-situated in a rapidly developing area, south of Kona International Airport at Keahole (Kona Airport) and adjacent to and north of the well-established commercial and light industrial-service centers of North Kona and Kailua-Kona.

Kaloko Makai is planned as a Transit-Oriented Development (TOD), as identified in the Kona Community Development Plan (Kona CDP.) It would be one of 10 TOD areas identified by the County and community groups as a higher density area in which most of the future population growth of the Kona area is intended to be accommodated. The Project master plan includes the key elements shown on the following table.

Key Developments Proposed at Kaloko Makai

	Units	Notes
Residential units	5,000 homes	Affordable & market-priced, single- and multifamily. Some developed as senior housing, including senior care residences.
Commercial retail & office	600,000 sq. ft. GLA	May include medical office buildings to support hospital.
Light industrial/ business park	75 (50 after taking) gross acres 40 net acres at completion	75 gross acres (60 net) developed in total, but 25 gross acres (20 net) are anticipated to be taken for a highway interchange in the 2026 to 2035 timeframe. This would result in 50 gross (40 net) acres in use at Project completion.
Lodge and business center	120 rooms plus business center	Kama`aina and business traveler orientation.
Outpatient care center	30,000 building sq. ft.	Includes pharmacy imaging, lab, ambulatory surgery & urgent care facilities, developed in two phases.
Hospital	150 beds 286,000 sq. ft	Main hospital and service building; developed in two phases.
Schools*	(To be developed by State of Hawaii and/or third parties)	One middle and two elementary school sites to be provided within the community.

* Planned or proposed for development, but assessment of economic and fiscal impacts is limited; see Chapter 2.

Source: SCD-TSA Kaloko Makai, LLC, 2012 and 2013

The Project land use plan is presented in the Exhibits section as Exhibit 1-1.

Together, the proposed developments would create a substantial residential, civic and employment center, generating myriad opportunities for community lifestyles as well as employment in professional, business, service and retail fields for island residents.

Assuming that necessary entitlements are obtained in a timely fashion, SCD-TSA estimates the first real estate products could be available for sale or use by 2015 and that all development could be completed by 2045.

Study Objectives

SCD-TSA seeks State of Hawaii (State) and County of Hawaii (County) entitlements for Kaloko Makai, including a State Land Use District Boundary Amendment (SLUDBA), and County zoning. In this respect, SCD-TSA engaged Mikiko Corporation (Mikiko) to prepare two reports:

1) **Market assessment** – Mikiko prepared an assessment of the market support for the residential, commercial, industrial and lodge/business center uses proposed. Market assessments for the medical facilities were prepared by Cattaneo & Stroud, Inc.

2) **Economic and fiscal impact assessment** – Mikiko prepared this assessment of the economic and fiscal impacts of the Project, including its medical-related uses.

Mikiko's market assessment (herein "the Market Study") is contained in a separate document entitled "Market Assessment for Kaloko Makai," dated April 2012. The economic and fiscal impact assessment reported in this document uses findings from the Mikiko and the Cattaneo & Stroud market studies as input assumptions.

Factors that are Assessed

This economic and fiscal assessment assesses the Project's impacts within the State of Hawaii and the County of Hawaii. Factors evaluated include:

- Economic impacts:
  - Expenditures by persons attracted to reside on the Island of Hawaii;
  - Development-related employment;
  - Operations-related employment; and
  - Personal income deriving from development and operations.
- Population impacts:
  - Residential utilization patterns;
  - Average daily visitor population; and
  - In-migrant resident population.
- Fiscal impacts:
  - Property tax and other County government revenues;
  - General excise tax, income tax, transient accommodations tax and other State government revenues;
  - County and State government operating expenditures; and
  - County and State net fiscal operating impacts.

Dollar Denomination

Unless otherwise stated, all dollar amounts in this report are stated in 2010 dollars.

Reporting Periods

This analysis extends from 2013 to 2045, a 33-year period that would span from preconstruction planning through Project buildout. The reporting periods in which impacts are assessed are:

- **Phase 1, 2013-2025 –** A 13-year period, during which the first two years would be dominated by entitlement, design, planning and pre-marketing; the subsequent 11 years would include real estate sales and lease closings;
- **Phase 2, 2026-2035** - A 10-year period, during which it is assumed the State Department of Transportation (DOT) exercises its right to take some 25 gross acres of industrial lands within the Project;
- **Phase 3, 2036-2045** – The final 10 years of Project buildout and sell-out/lease-up of its real estate products; and
- **After 2045** – An indefinite time beginning after complete buildout and market absorption of the Project. This final reporting "period" depicts the long-term impacts of the Project after its initial development and marketing impacts have been realized.

2 – Executive Summary

Development Phasing

Kaloko Makai's first properties could be expected to be available for sale or lease in 2015. The Project is expected to be built out and fully sold or leased-up by 2045.

In accordance with current County policies, up to 1,000 residential units are expected to be marketed according to County standards for affordable housing. Affordable housing would be developed for sale or rent at prices to be determined in agreements with governing agencies.[1]

Kaloko Makai is estimated to support some $1.58 billion in development-related expenditures statewide between 2013 and 2045. In an average year, this would represent about $48 million in new expenditures.

This estimate includes infrastructure, vertical construction, commercial tenant improvements, landscaping and soft costs such as professional services, administration of operating subsidiaries and the like.

The cost estimate does not cover construction of the planned schools, since such State projects are anticipated to be developed somewhere on the island, whether or not Kaloko Makai proceeds. Also excluded from this estimate are substantial sums that will be spent for furniture, fixtures and equipment within the various facilities; development and equipping of the desalinization plant, fire station, future water tank, parks and the dryland forest; County and State permits and fees; financing expenditures; contingency allowances; and other off-site infrastructure or potential public contributions thereof.

Portions of these substantial additional expenditures that are not estimated herein would also circulate through the local economies.

[1] Estimated affordable unit count is based on 5,000 total units generating 1,000 affordable housing credits, and County rules regarding assignment of credits on for-sale units by income range of buyers. See Hawaii County Code, Chapter 11, Section 11-5 (amended 2011.) If additional housing credits are required to address nonresidential units at Kaloko Makai, the developer will comply with such requirements.

For illustrative purposes, Hawaii County guidelines in effect as of September 1, 2010 would specify for-sale housing offered to households of two to four persons earning incomes ranging from less than 80% and up to 120% of the County median income be priced from $202,500 to $366,200; figure shown is based on a mix of market orientations that would satisfy the 1,000 credits expected to be required of the developer.

Alternatively, some of SCD-TSA's affordable housing commitment at the Project could be met with rental housing.

Kaloko Makai Proposed Development Phasing and Costs

	Comment	**Phase 1: 2013 - 2025**	**Phase 2: 2026 - 2035**	**Phase 3: 2036 - 2045**	**Total**
Homes*:	***Overall mix:***				
Market units	*80%*	1,395	1,567	1,038	4,000
Affordable units	*20%*	357	383	260	1,000
Total	***100%***	**1,752**	**1,950**	**1,298**	**5,000**
Average home sales price:					
Market units	*In 2010 dollars*	$396,000	$396,000	$396,000	
Affordable units		$284,500	$284,500	$284,500	
Weighted average		**$374,000**	**$374,000**	**$374,000**	
Commercial uses:					
Light industrial land**	*Net acres*	20	20	20	60**
Light industrial buildings**	*Same area, but in building sq. ft.*	40,000	130,000	130,000	300,000**
Retail & office centers	*Gross leasable area, in sq. ft.*	430,000	130,000	40,000	600,000
Lodge & Business Center	Guest rooms	120	0	0	120
Medical facilities -	Building square feet				
Outpatient care center		24,000	0	6,000	30,000
Hospital		191,000	95,000	0	286,000
Community support:					
Schools	*To be developed by State and/or third parties (timing may vary)*	Middle	Elemen-tary	Elemen-tary	3
Total development costs* **	*Hard and soft costs (mils)*	**$692**	**$555**	**$337**	**$1,584**
Average annual	*In 2010 dollars*	$53	$56	$34	$48

* Includes senior housing and senior care residences.

** A 20-net acre (25-gross acre) area alongside Queen Kaahumanu Highway is assumed to be taken by the State Department of Transportation for use as a highway interchange between 2026 and 2035. This would result in there being 40 net acres (50 gross) available for use at Project completion, despite 60 net (75 gross) having been developed and marketed over the Project's development. Likewise, there could be some 260,000 square feet of light industrial building area upon Project completion, despite some 300,000 square feet having been developed over the Project's development period.

*** Includes professional services post-entitlement; vertical, horizontal and infrastructure construction costs; and various off-site costs such as home office overhead. Excludes expected off-site and many other expenditures, as explained in preceding text.

Projected Impacts

The Project would generate significant, on-going economic and fiscal benefits for residents of Hawaii, as well as for the County and State governments. Development of facilities would generate employment and consequent income and taxes. In addition, by attracting new residents to the Island of Hawaii and generating additional real estate sales and leasing activity, the Project is expected to support long-term impacts, including additional consumer expenditures, employment opportunities, personal income and government revenue enhancement.

Highlights of the Project impacts are summarized in the table on the next page. Study methodology and definition of key terms such as "direct," "indirect" and "induced" are provided in Chapter 3.

Development Employment

- **FTE employment** – During its buildout, Kaloko Makai is estimated to generate some 300 to 400 full-time equivalent (FTE) jobs annually, including positions created directly and indirectly by its development activities. These jobs would be located throughout the state, with greatest concentration on the Big Island.

- **Personal earnings** - The new development-related positions are expected to be associated with total personal earnings[2] of some $1.09 billion over the projection period, or $23 to $38 million per year. The earnings represent an average of $83,000 to $87,000 per FTE job, including direct construction-related jobs as well as indirect and induced opportunities created throughout the economy. The direct job positions are expected to enjoy higher salaries than the averages reported here.

Operational Employment

- **On-site jobs** - By the time of its expected completion in 2045, the Project could have generated some 3,100 direct FTE jobs on-site at its retail, office, industrial, lodge, and medical-related facilities. Because these on-site jobs would be supported at Project components, they are all considered direct impacts; there are assumed to be no indirect or induced employment impacts on-site.

  This estimate includes employees of the three planned schools, but it excludes Realtors and commercial brokers that may locate on-site, as well as private household workers and employees of community associations or facilities.

[2] Earnings are defined as wage, salary and proprietary income, plus director's fees and employer contributions to health insurance, less employee contributions to social insurance.

Summary of Projected Economic and Fiscal Impacts
2010 dollars

	Comment	2025	2035	2045	After 2045
FTE employment:*	***Direct, indirect and induced except as noted***				
Development-related	*Average annual since prior date*	400	400	300	0
Operations-related -	*Annual, on-going*				
On-site	*Generated at Project facilities (direct impacts only)*	1,900	2,700	3,100	3,100
Net new jobs on Island	*New to County*	1,000	1,500	1,700	1,700
Total personal earnings:**	***Direct, indirect and induced***				
Development-related	*Average annual since prior date*	$37	$38	$23	$0
Operations-related	*Annual, on-going, on net new jobs only*	$59	$88	$94	$90
Average earnings per FTE job:**	***Direct, indirect and induced (not in millions)***				
Development-related	*Average annual since prior date*	$87,000	$87,000	$83,000	NA
Operations-related	*On net new jobs only*	$58,000	$59,000	$55,000	$53,000
In-migrant resident population:	***Average daily employees, dependents, and new island residents***				
To the County		330	650	840	840
To the State	*Subset of County in-migrants*	230	480	630	630
Net additional government revenues:	***Projected revenues less projected expenditures***				
For the County		$3.9	$6.9	$8.8	$8.8
For the State		$5.4	$6.2	$4.9	$2.8
Revenue/expenditure ratio:					
For the County		6.0	6.0	6.1	6.1
For the State		5.2	3.4	2.4	1.8

Note: Other than for on-site jobs, estimates shown do not consider impacts of the planned schools, since equivalent facilities would be assumed to be developed elsewhere on the island even if the Project was not developed.

* FTE = Full-time equivalent, defined as 40 hours per week or 2,080 hours per year.

** Earnings defined to include wage, salary and proprietary incomes, plus directors' fees and employer contributions to health insurance, less employee contributions to social insurance.

Sources: SCD-TSA Kaloko Makai, LLC, 2012 and 2013; Cattaneo & Stroud, 2011; Mikiko Corporation, 2012.

- **Net new jobs –**

  - **FTE employment** - Considering the Project's direct, indirect and induced impacts statewide, Kaloko Makai could alternatively be seen to generate some 1,700 permanent, on-going FTE jobs. These are positions that might not have existed had the Project not been developed. These "net new" jobs could include shares of the professional, technical, managerial and other staff positions at the new hospital, other medical facilities, office and retail areas; sales and marketing positions supported by the on-going resales and releasing of property at the Project; positions generated at the business and kama`aina-oriented lodge; and myriad other positions generated throughout the economy.[3]

    The net new job estimate is lower than the on-site job estimate because some of the jobs shown at Project facilities could be expected to be created elsewhere on the island even if the Project were not developed.

  - **Personal earnings** - Personal earnings from the new operational positions will increase over time as more facilities and establishments are opened. New personal earnings are projected to total about:

    - $59 million in 2025,
    - $88 million in 2035,
    - $94 million in 2045, and
    - $90 million per year after 2045, on an ongoing basis.

    The difference between the last, "ongoing" time frame and the Phase 3 (2045) earnings is the expiration of the initial residential and commercial brokerage opportunities.

    On average, these net new FTE positions are expected to earn about $55,000 to $59,000 per year during Project buildout, and $53,000 per year after 2045. Considering the 2009-2010 observed ratio of total family earnings of 1.8 times the average County wage, these earnings could be expected to be associated with average family incomes of about $97,000, or 145% of the County median reported for fiscal year 2010, on an ongoing basis.

[3] The share of new positions within each employment category reflects judgments about the ability of Project facilities to support activity that might not have otherwise existed, such as offering substantially expanded medical services in the heart of Kona, or attracting kama`aina or business travelers to stay overnight on Hawaii island rather than returning home (making a day trip only) or staying with friends.

Population Movements

Opportunities created by Kaloko Makai, particularly its professional, technical and managerial career opportunities, will create incentives for some neighbor islanders or former Hawaii residents to move back to the State and/or to the Island of Hawaii.

In addition, some of Kaloko Makai's homes may attract householders that previously lived off-island or out-of-state. These could include retirees as well as younger household heads.

- **County –** The influences described above are estimated to result in perhaps 330 persons living on the Island of Hawaii who might not otherwise have lived on the island (in-migration to the County) by 2025, or up to 840 after Project completion in 2045.

- **State** - Within the above total, some 230 and 630 persons, respectively, are expected to be persons who had previously lived out-of-state.

Fiscal Impacts

- **County** - The Project could be expected to contribute some $8.8 million per year in net additional County revenues at its completion and annually thereafter.

  By 2045, new County government revenues are estimated to represent about 6.1 times the new County government operating expenditures required to support the additional population that could be attracted to the Island of Hawaii by the Project.

  The Project's real property taxes are the major contributor to the County net fiscal benefits.

- **State** - For the State, net additional operating revenues generated by the Project are estimated at $4.9 to $6.2 million per year during buildout, when development activity would generate high gross excise and income taxes. The Project is projected to continue to contribute to State budget gains in the long-run, with net additional revenues of some $2.8 million per year after 2045.

  These fiscal impacts represent a revenue/expenditure ratio for the State of some 2.4 to 5.2 during buildout, and 1.8 by 2045 and thereafter.

- **Other** - These public sector contributions do not consider the value of the school sites, dryland forest, public parks or potential off-site infrastructural improvements that may be contributed by SCD-TSA. Neither do they consider the various impacts and permit fees expected to be paid to the County and State governments during the development of the Project.

3. Study Conditions and Terminology

Special considerations and terminology for the analyses on which the preceding results rely are presented in this chapter. For a more complete understanding of the study analyses, one should refer to the exhibits in the next section of this report, and the notes that accompany each exhibit.

Special Considerations

- **Use and classification of residential units –** Although not considered a major market segment, the Project could attract some buyers that previously lived on a neighbor island or out-of-state. These new island residents may be expected to include households at many stages of life, including retirees. This group is distinguished from buyers who are already established island residents in terms of their economic and fiscal impacts.

  - New island residents who buy homes at the Project bring new investments, earnings and expenditures to the State and County. Conversely, they also require additional government resources and services. In short, they generate economic and fiscal impacts for the County and State.

  - Previously established island residents who buy homes at the Project are assumed to be able to live elsewhere on the Island of Hawaii even if the Project is not developed. Thus, while they may increase population at the Kaloko Makai site itself, from the County and State's standpoint, their presence is not a new impact.

- **Commercial facilities** - The proposed commercial facilities are expected to attract spending from Kaloko Makai and other island residents, as well as Hawaii Island visitors.

  It is likely that Hawaii Island residents and visitors would have spent an equivalent amount on dining out and/or personal services whether or not the Project's commercial facilities were developed. Thus, given a competitive retail and office market on the island, the planned facilities could lead to a geographic reallocation of spending within the region, but would not in themselves be expected to significantly increase expenditures made in the County or State.

  On the other hand, commercial facilities would contribute to the Project's ability to attract residential buyers to Kaloko Makai.

  In other words, Kaloko Makai's on-site commercial facilities will employ workers, pay taxes and generate other economic and fiscal benefits. These are considered

direct Project impacts and most of these jobs would be located on-site. However, the net benefits of the Project's commercial facilities are best measured in terms of the new spending that Kaloko Makai attracts to the island, and the taxes and other benefits these persons will generate throughout the County and State. Many of these impacts are likely to be felt off-site, benefitting establishments throughout the island.

- **Other uses/considerations not modeled –** Kaloko Makai is planned to include one middle and two elementary school sites, with facilities to be built by the State and/or private developer(s). Other than as a generator of on-site employment, this assessment does not consider the economic and fiscal impacts of the State's planned schools. These facilities are noted but are not evaluated in terms of their other economic and fiscal impacts. It is assumed that comparable schools would be built somewhere in West Hawaii whether or not the Project is developed, and thus Kaloko Makai itself would not generate their impacts.

  Although the developer proposes to contribute land for public facilities, the value of such contributions is not included in this assessment and should be considered an additional benefit to the public and to State and/or County governments.

- **Entitlement spending not considered** – SCD-TSA's current entitlement process for Kaloko Makai is already generating significant economic activity and fiscal benefits by employing professionals and supporting vendors around the state. However, since such benefits are not dependent on the outcome of the entitlement process, they are not enumerated in this analysis.

- **Government expenditures –** State and County revenues and expenses estimated herein are based largely on the structure of tax collections and services for the fiscal years ending June 30, 2010 (FY2010) for the County and June 30, 2009 (FY2009) for the State, with adjustments to 2010 dollars. Information is obtained from the Comprehensive Annual Financial Reports of the respective jurisdictions. The impacts estimated would differ if governmental taxing and spending policies were to be materially altered.

- **Government revenues –** Government revenues are largely derived from the same sources noted above for expenditures. County real property tax revenues are based on rates that were in effect during the fiscal year ending June 30, 2010, although rates have increased subsequently. State income tax revenues, are based on 2010 rates, which were unchanged in 2011 in the income brackets considered.

Definition of Key Terms

Within this report, the following definitions apply:

- **Direct impacts** - Those economic, population or other impacts attributable to persons or activities that are a direct result of the proposed development. For instance, direct

employment impacts are expected to include those involved in building the proposed facilities, such as construction workers, and those who would later work at them in their operations.

Many, but not all of direct impacts can be expected to occur on-site. For instance, a portion of the construction budget is for architects and engineers. While such persons' employment might be temporarily dependent on contracts regarding Kaloko Makai, some of these professionals may do the majority of their work from offices in Hilo, Honolulu or elsewhere. Likewise, administrative and managerial staff located off-site would support construction professionals working on-site.

- **Indirect impacts -** Indirect impacts occur when the businesses or persons who are directly affected make expenditures for additional supplies or services. For instance, some of the additional retail spending by those newly attracted to Hawaii by the Project could be spent on eating out. These elevated dining out expenditures could indirectly increase demand for produce, seafood and meats from Hawaii farms, fishermen and/or ranching enterprises. Kaloko Makai would thus have indirectly supported new business opportunities for area providers of such goods and services.

- **Induced impacts -** Induced impacts occur throughout the community when those persons or companies that have benefited from the direct or indirect impacts of the Project spend their associated earnings on consumer goods and services. For instance, a construction worker may spend her earned wages to buy a new pair of shoes, or to pay for her child's day care. The farmer who sells produce to a restaurant at Kaloko Makai may use some of his profit to take his family out to the movies. The businesses and individuals impacted by such re-spending are said to enjoy induced economic impacts from the Project.

- **Total impacts -** Total impacts are defined as the sum of direct, indirect and induced impacts for any given variable.

- **Resident population -** Resident population refers to all those persons who habitually reside in a given area, whether or not they may have temporarily traveled away.

- **Full-time equivalent** - This study measures employment opportunities in full-time equivalent (FTE) units. One full-time equivalent position is defined herein as 2,080 hours of employment (including paid vacation and sick leave) per year. This is equivalent to 40 hours per week, and may also be referred to as a "person-year" of employment. Two half-time jobs would be considered to together represent one FTE job.

- **Other** – Other special terms used in this analysis are generally defined within the respective exhibit where the term is used.

Report Conditions

Assumptions regarding the scale, nature and timing of the Project are made in order to assess its impacts. This assessment is based on findings of the market study prepared by Mikiko, as well as the assessment of medical-related facilities prepared by Cattaneo & Stroud, as provided to Mikiko by SCD-TSA. This study relies on physical parameters, layouts, timelines, budgets, development programs and other inputs provided by SCD-TSA, Wilson Okamoto Corporation (Wilson Okamoto), and other sources as noted.

In addition, this assessment also incorporates information provided by government agencies, developers, brokers, landowners, and other sources as cited in the exhibits. While attempts have been made to verify such information via multiple sources, it is not always possible to do so.

Mikiko cannot guarantee the accuracy or appropriateness of all information upon which its assessments may be based.

Although Project data were updated in 2012 and 2013 to reflect current plans for development, Mikiko has no responsibility to update this report or any of the underlying data for events and circumstances occurring after July 15, 2011, the date of substantial completion of other primary data collection.

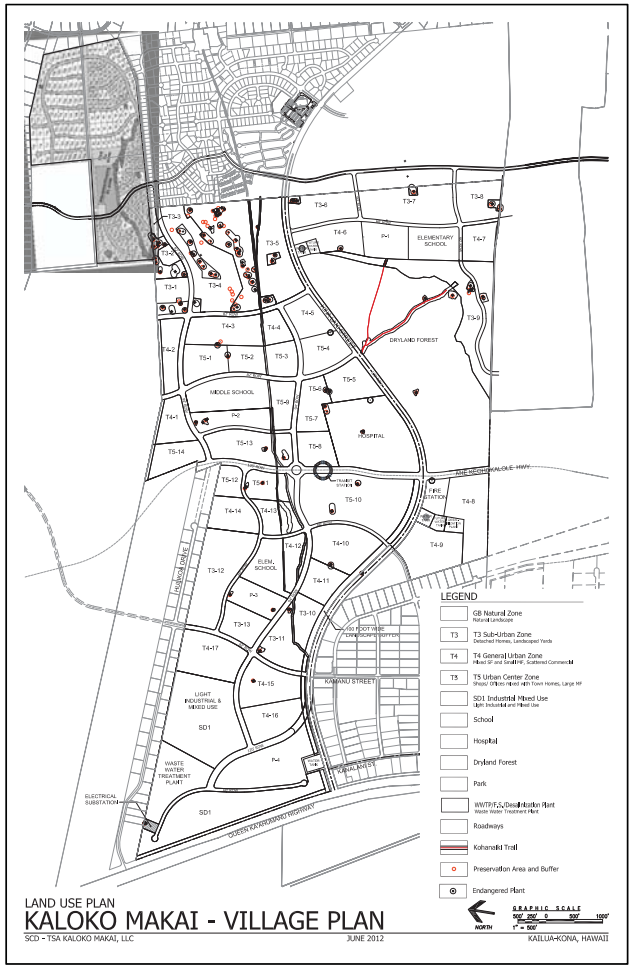
This report is for the planning purposes of SCD-TSA, Wilson Okamoto and their consultants, as well as for public disclosure of the nature of the Project pursuant to seeking State and County land entitlements. It is not intended to be used for solicitation of investment.

This report does not offer an appraisal of the Subject, nor should it be construed as an opinion of value for the Project.

ECONOMIC AND FISCAL IMPACT ASSESSMENT FOR KALOKO MAKAI

Exhibits

Exhibit 1-1
Kaloko Makai – Conceptual Land Use Plan



Source: SCD-TSA Kaloko Makai, LLC2012.

Exhibit 2-1
Project Concept and Potential Development Timing
2013 to 2045

	Unit	Notes		2013-25	2026-35	2036-45	Total
				Phase 1	*Phase 2*	*Phase 3*	
Highlights of period:		*2013-14: entitlement, design & planning* *2015: First building completions* *Parks, schools, open spaces opening throughout*		■ *First homes in 2015* ■ *Urgent care & hospital* ■ *First retail, office & industrial* ■ *Lodge/ bus. center*	■ *Ongoing residential & commercial* ■ *Hospital expands* ■ *DOT takes 25 acres of industrial land*	■ *Full Project buildout* ■ *Urgent care facility expands*	
Development in period:			*Average sales/year (rounded)*				
Residential units completions/sales[1]		*Av. price:*					
Market units (single & multifamily)	*Sold homes*	*$396,000*	*130*	1,395	1,567	1,038	4,000
Affordable units (multifamily)[2]	*Sold homes*	*$284,500*	*30*	357	383	260	1,000
Total, residential units/weighted average price		*$374,000*	*160*	1,752	1,950	1,298	5,000
Light industrial land[3]							
Land put in service	*Gross acres*			*25*	*25*	*25*	75
Land removed from service	*Gross acres*	*Assumed taking by DOT*[3]		-	*(25)*	-	(25)
Land in use at end of period	*Gross acres*			*25*	*25*	*50*	
Net acres put in service	*Net acres*	*0.8*	*of gross acres put in service*	20	20	20	
Light industrial buildings[4]	*Built sq. ft., on net ac.*	*0.15*	*floor area ratio; see note 4*	40,000	130,000	130,000	300,000
Commercial centers	*GLA sq. ft.*			430,000	130,000	40,000	600,000
Lodge and Business Center	*Rooms*			120	0	0	120
Medical facilities:		*Cattaneo & Stroud, June 2011*					
Outpatient care center	*Building GSF*	*Imaging, lab, urgent care, etc.*		24,000	0	6,000	30,000
Hospital	*Building GSF*	*Includes service building*		191,000	95,000	0	286,000
Schools[5]	*Schools*	*To be developed by State and/or its private partner (timing may vary)*		Middle	Elementary	Elementary	3

1 Includes senior housing and senior care residences.

2 Affordable unit count based on 5,000 total units generating 1,000 affordable housing credits, and County rules regarding assignment of credits on for-sale units by income range of buyers. See Hawaii County Code, Chapter 11, Section 11-5 (amended 2011.) If additional housing credits are required to address nonresidential units at Kaloko Makai, developer will comply with such requirements.

For illustrative purposes, Hawaii County guidelines in effect as of September 1, 2010 would specify for-sale housing offered to households of two to four persons earning incomes ranging from less than 80% and up to 120% of the County median income be priced from $202,500 to $366,200; figure shown is based on a mix of market orientations that would satisfy the 1,0000 credits that could be required of the developer.

3 A 25-gross acre area alongside Queen Kaahumanu Highway is assumed to be taken by the State Department of Transportation (DOT) for use as a highway interchange during Phase 2. Exhibit figures reflect total acreages to be developed. However, due to taking, acreage remaining in service at Project completion in 2045 is expected to be less than the total developed.

4 Relatively less building improvement anticipated on first increment of land development due to the expected taking of those lands in second period. Development on lands added into service in second and third periods is projected to reflect the average floor area ratio shown. Note that buildings constructed on lands to be taken by DOT likely to be subsequently demolished, so that net buildings remaining at completion of Project likely to be less than total of development activity shown in exhibit.

5 Assumed to include one, 1,000-student middle school and two, 750-student elementary schools, based on information provided to SCD-TSA by Department of Education, 2013.

Exhibit 2-1, Continued
Project Concept and Potential Development Timing

	Notes	2025	2035	2045
Cumulative development by end of phase:		*Phase 1*	*Phase 2*	*Phase 3*
Residential units completions/sales[1]				
Market units (single & multifamily)	*Sold homes*	1,395	2,962	4,000
Affordable units (multifamily)[2]	*Sold homes*	357	740	1,000
Total		1,752	3,702	5,000
Light industrial land[3]	*Net acres in service*	20	20	40
Light industrial buildings[4]	*Built sq. ft., on net ac.*	40,000	130,000	260,000
Commercial centers	*Gross leasable square feet (GLA)*	430,000	560,000	600,000
Lodge and Business Center	*Rooms*	120	120	120
Medical Facilities:	*Building gross square feet (GSF)*			
Outpatient care center		24,000	24,000	30,000
Hospital		191,000	286,000	286,000
Elementary and middle schools[5]	*Number of schools (to be developed by State and/or its private partner)*	1	2	3

1 Includes senior housing and senior care residences.

2 Affordable unit count based on 5,000 total units generating 1,000 affordable housing credits, and County rules regarding assignment of credits on for-sale units by income range of buyers. See Hawaii County Code, Chapter 11, Section 11-5 (amended 2011.) If additional housing credits are required to address nonresidential units at Kaloko Makai, developer will comply with such requirements.

For illustrative purposes, Hawaii County guidelines in effect as of September 1, 2010 would specify for-sale housing offered to households of two to four persons earning incomes ranging from less than 80% and up to 120% of the County median income be priced from $202,500 to $366,200; figure shown is based on a mix of market orientations that would satisfy the 1,0000 credits that could be required of the developer.

3 A 25-gross acre area alongside Queen Kaahumanu Highway is assumed to be taken by the State Department of Transportation (DOT) for use as a highway interchange during Phase 2. Exhibit figures reflect total acreages to be developed. However, due to taking, acreage remaining in service at Project completion in 2045 is expected to be less than the total developed.

4 Relatively less building improvement anticipated on first increment of land development due to the expected taking of those lands in second period. Development on lands added into service in second and third periods is projected to reflect the average floor area ratio shown. Note that buildings constructed on lands to be taken by DOT likely to be subsequently demolished, so that net buildings remaining at completion of Project likely to be less than total of development activity shown in exhibit.

5 Assumed to include one, 1,000-student middle school and two, 750-student elementary schools, based on information provided to SCD-TSA by Department of Education, 2013.

Sources: SCD-TSA Kaloko Makai, LLC, 2012; Cattaneo & Stroud, 2011; Mikiko Corporation, 2012.

Exhibit 2-2
Buyer Origins and Residential Utilization Patterns

	Basis/reference	2025	2035	2045	After 2045
Usage assumptions: [1]					
Market units-resident housing units (RHU)	*81% of sold market units*	1,133	2,407	3,250	3,250
Market units-non-RHU's	*19% of sold market units*	262	555	750	750
Affordable units	*100% of sold affordable units*	357	740	1,000	1,000
Total	*85% share of all units that are RHU (see Market Study)*	1,752	3,702	5,000	5,000
Unit occupancy assumptions: [1]					
Market units-resident housing units (RHU)	*Allowance for vacancy/transitions*	*95%*	*95%*	*95%*	*95%*
Market units-non-primary	*Share of time spent on-island*	*45%*	*45%*	*45%*	*45%*
Affordable units	*Allowance for vacancy/transitions*	*95%*	*95%*	*95%*	*95%*
Utilization pattern:					
Average daily occupied units -	*Exhibit 2-1 + usage assumption*				
Market units-resident housing units (RHU)[1]		1,077	2,286	3,088	3,088
Market units-non-primary[1]		118	250	338	338
Affordable units	*All primary homes*	339	703	950	950
Total, rounded		**1,530**	**3,240**	**4,380**	**4,380**
Average daily persons in residence -	*Ref market study, Ex. 2-6 (midpoint)*				
Market units-resident housing units (RHU)[1]	*2.8 persons per occupied unit*	3,015	6,402	8,645	8,645
Market units-non-primary[1]	*2.2 persons per occupied unit*	259	550	743	743
Affordable units	*2.9 persons per occupied unit*	984	2,039	2,755	2,755
Total, rounded		**4,260**	**8,990**	**12,140**	**12,140**

1 Based on projected market mix for the Project and average household sizes for North Kona-North as shown in Market Study, Exhibit 2-6 and Appendix 1. Includes senior housing and senior care residences.

Exhibit 2-3
Lodge and Business Center Operations and Utilization Patterns

	Basis/reference	2025	2035	2045	After 2045
Number of rooms	*Exhibit 2-1*	120	120	120	120
Unit occupancy assumptions:					
Average occupancy		60%	65%	65%	65%
Average party size	*Number of persons per occupied room*	1.8	1.8	1.8	1.8
Average daily guests	*Rounded*	**130**	**140**	**140**	**140**
Projected guest mix:					
Island residents -		5%	5%	5%	5%
Neighbor island residents -					
Business		30%	30%	30%	30%
Visiting friends & family		15%	15%	15%	15%
Sports or other event/group travel		10%	10%	10%	10%
Subtotal		55%	55%	55%	55%
Out-of-state residents -					
Business		20%	20%	20%	20%
Visiting friends & family		15%	15%	15%	15%
Sports or other event/group travel		5%	5%	5%	5%
Subtotal		40%	40%	40%	40%
Total		100%	100%	100%	100%
Average daily room rate	*Mid-point of projected low and high ranges in Market Study*	$120	$125	$130	$130
Projected revenues	*In millions*				
Rooms		$3.2	$3.6	$3.7	$3.7
Other (sundries, parking, business services, etc.)	*$10.00 per occupied room*	$0.3	$0.3	$0.3	$0.3
		$3.4	$3.8	$4.0	$4.0

Sources: SCD-TSA Kaloko Makai, LLC, 2012; Mikiko Corporation, Market Study, 2012.

Exhibit 3-1
Visitor and Non-Primary Resident Expenditures in Hawaii, Average Annual
2010 dollars, in millions, except as noted

	Basis/reference (not in millions)		2025	2035	2045	After 2045
Non-primary residents:						
Bases for projection:						
Average household income[1]	*Approximate 90th percentile, 2010 North Kona-North resident incomes*	*$200,000*				
Percent of income spent on island[2]	*50% times % of year on-island (Ex. 2-2), =*	*23%*				
Persons per household	*Exhibit 2-2*	*2.2*				
Projections:						
Direct expenditures	*Expenditure per FTE person:*	*$20,500*	$5.3	$11.3	$15.2	$15.2
Indirect & induced	*0.93 multiplier*[3]		$4.9	$10.5	$14.2	$14.2
Total			**$10.2**	**$21.8**	**$29.4**	**$29.4**
Visitors to Hawaii Island:						
From neighbor islands:						
Number of visitors	*Based on share of visitors shown in Exhibit 2-3*		*72*	*77*	*77*	*77*
Direct expenditures	*Based on share of revenues shown in Exhibit 2-3*		$1.9	$2.1	$2.2	$2.2
Indirect & induced	*0.93 multiplier*[3]		$1.8	$2.0	$2.0	$2.0
Total			**$3.6**	**$4.1**	**$4.2**	**$4.2**
From out-of-State:						
Number of visitors	*Based on share of visitors shown in Exhibit 2-3*		*52*	*56*	*56*	*56*
Direct expenditures	*Based on share of revenues shown in Exhibit 2-3*		$1.4	$1.5	$1.6	$1.6
Indirect & induced	*0.93 multiplier*[3]		$1.3	$1.4	$1.5	$1.5
Total			**$2.6**	**$3.0**	**$3.1**	**$3.1**

1 See Market Study, Exhibit 2-7.

2 Corroborates with benchmark estimate of average spending on local consumption items of 53% of pre-tax income, considering that recent in-migrants may have more on-going obligations or interests outside of the state than do previously established residents. Estimates derived from figures shown in Department of Business, Economic Development and Tourism, State of Hawaii Data Book 2006, "Table 13.25, Average Annual Expenditures and Other Characteristics of Consumer Units, for Honolulu: 2000-2001 to 2004-2005," 2004-2005 figures, excluding shelter and personal insurance and pensions expenditures. DBEDT source references U.S. Bureau of Labor Statistics, Selected Western Metropolitan Statistical Areas: Average annual Expenditures and Characteristics, Consumer Expenditure Survey (annual.)

3 Based on State weighted average of Type II final demand multipliers for output among 20 condensed industry groups (less 1.0) as shown in State of Hawaii, Department of Business, Economic Development and Tourism, "The Hawaii State Input-Output Study: 2007 Benchmark Report," July 2011, Table 2.4.

Exhibit 3-2
Input-Output Multipliers Applied to Development Activities

DIRECT REQUIREMENT COEFFICIENTS

	DBEDT industrial categories applied	Direct requirement coefficients per $1 million (2007$) project cost: Jobs[1]	FTE factor[2]	Productivity factor[3]	$ Earnings[4]
Professional services	*#46-Architectural and engineering services*	6.69	0.81	0.66	0.57
Construction:					
Residential & commercial units	*#13-SF housing construction (10%), #14-Construction of other buildings (90%)*	4.52	0.90	0.63	0.30
Light industrial	*#14-Construction of other buildings*	4.64	0.90	0.63	0.30
Commercial facilities	*#14-Construction of other buildings*	4.64	0.90	0.63	0.30
Tenant improvements	*#14-Construction of other buildings*	4.64	0.90	0.63	0.30
Lodge and Business Center	*#14-Construction of other buildings*	4.64	0.90	0.63	0.30
Medical facilities	*#14-Construction of other buildings*	4.64	0.90	0.63	0.30
Wastewater treatment plan	*#14-Construction of other buildings*	4.64	0.90	0.63	0.30
Infrastructure	*#15-Heavy & civil engineering construction*	10.38	0.90	0.62	0.30
Other costs	*#41-Other finance & insurance, #43-Real estate, #45-Legal services, #49-Other professional services, #52-Administrative & support services*	14.67	0.81	0.67	0.43

DIRECT EFFECT INDUSTRY MULTIPLIERS[5]

	DBEDT industrial categories applied	Indirect & induced multiplier per direct: FTE job	$ Earnings
Professional services	*Same as above*	1.39	0.56
Construction:			
Residential & commercial units	*Same as above*	2.04	1.12
Light industrial	*Same as above*	1.99	1.13
Commercial facilities	*Same as above*	1.99	1.13
Tenant improvements	*Same as above*	1.99	1.13
Lodge and Business Center	*Same as above*	1.99	1.13
Medical facilities	*Same as above*	1.99	1.13
Wastewater treatment plan		1.99	1.13
Infrastructure	*Same as above*	0.89	1.14
Other	*Same as above*	0.79	0.94

1 Coefficients calculated from total (wage, salaried and proprietary) jobs per $1 million total output, as shown in Hawaii State Department of Business, Economic Development & Tourism, "The Hawaii State Input-Output Study: 2007 Benchmark Report," July 2011. Figures derived from 68-industry detailed tables provided separately in excel workbook accompanying the report.

2 Adjustment factor applied to the jobs coefficients to estimate full-time equivalent jobs at 40 hours per week, since DBEDT input data reflects all jobs, including full- and part-time. Factor derived from statewide annual data for 2007 to 2010 on average weekly hours reported worked in the private sector professional and business services, and the mining and construction industries, as reported by State of Hawaii, Department of Labor & Industrial Relations, at http://www.hiwi.org/gsipub/index.asp?docid=419, as accessed July 10, 2011.

3 Adjustment factor applied to the jobs coefficients to reflect inflation and anticipated gains in labor productivity. Factors derived from 2007 vs. projected 2017 Type II final demand multipliers for total jobs by detailed industry, as presented in DBED excel workbook, ibid.

4 Earnings defined to include wage, salary and proprietary incomes, plus directors' fees and employer contributions to health insurance, less employee contributions to social insurance. Calculated from total earnings reported per $1 million total output, DBEDT, ibid.

5 For indirect and induced impacts of respective direct impacts. Multipliers derived from Type II direct effect total job/total job and earnings/earnings multipliers as shown in DBEDT, ibid; published multipliers reduced by 1.0 to eliminate direct jobs previously calculated.

Exhibit 3-3
Estimated Current Development Costs: Total for Each Period
2010 and 2007 dollars, in millions unless stated

	Basis/reference (not in mils unless stated)	2013 2025	2026 2035	2036 2045	Total
In 2010 dollars:[1]					
Professional services[2]	*Design, planning, engineering, legal, etc.*	$33.72	$21.45	$13.10	$68.3
Construction -	*Net of contingencies & residential options*				
Residential & commercial units	*Includes SNF and senior units*	$301.8	$335.9	$223.58	$861.3
Light industrial	*$75 PSF in place (Ex. 2-1)*	$3.0	$9.8	$9.8	$22.5
Tenant improvements[3]	*$140 Per square foot industrial & commercial space (Ex. 2-1)*	$65.8	$36.4	$23.8	$126.0
Lodge and Business Center	*SCD, 2012*	$67.2	$0.0	$0.0	$67.2
Medical facilities	Urgent care & hospital facilities	$94.1	$44.6	$0.9	$139.6
Waste water treatment plant	Buildings only	$3.9	$1.7	$1.7	$7.2
Infrastructure[4]	*Site preparation, utilities, roads, on-site*	$95.0	$74.3	$43.7	$213.0
Subtotal		$630.7	$502.5	$303.4	$1,436.6
Other	*On & off-site soft costs such as home office overhead*	$27.8	$30.9	$20.6	$79.3
Total, rounded		**$692.2**	**$554.9**	**$337.1**	**$1,584.2**
In 2007 dollars:[5]	*93% of 2010 values*				
Professional services		$31.5	$20.0	$12.2	$63.8
Construction -					
Residential units		$281.9	$313.8	$208.9	$804.5
Light industrial		$2.8	$9.1	$9.1	$21.0
Commercial facilities		$0.0	$0.0	$0.0	$0.0
Tenant improvements		$61.5	$34.0	$22.2	$117.7
Lodge and Business Center		$62.8	$0.0	$0.0	$62.8
Medical facilities		$87.9	$41.6	$0.8	$130.4
Waste water treatment plant		$3.6	$1.5	$1.5	$6.7
Infrastructure		$88.7	$69.4	$40.8	$198.9
Other		$26.0	$28.9	$19.2	$74.1
Total, rounded		**$646.6**	**$518.3**	**$314.9**	**$1,479.8**

1 Provided by SCD-TSA Kaloko Makai, LLC, 2012, unless otherwise noted.

2 Excludes consultant services related to entitlement efforts.

3 Includes developer- and tenant-provided construction budgets. Comparison examples for first generation buildouts include office space at $150-170 per square foot, and retail at $150-$250 per square foot, as provided by Colliers Monroe Friedlander, 2007; restaurants minimum $300 per square foot per SL Sofos & Co., Ltd.; industrial at $50 PSF. Weighted average figure based by product mix by type is inflated to 2010 dollars.

4 Covers grading and other preparation of on-site development pads with utility installation; subdivision and collector roads. Excludes parks, schools, dryland forest, desalinization plant, fire station, future water tank, off-site infrastructure and other potential expenditures or public contributions.

5 Based on Honolulu single-family home and high rise building construction cost indices (averaged) for 2007-2010 as reported by UHERO, Data Portal, as accessed July 7, 2011 and September 25, 2012.

Exhibit 3-4
Estimated Current Development Costs: Average Annual
2010 dollars, in millions

	Basis/reference	2013 2025	2026 2035	2036 2045	Overall average
Costs by type:	*Exhibit 3-3, annualized*				
Professional services		$2.6	$2.1	$1.3	$2.1
Construction -					
Residential & commercial units		$23.2	$33.6	$22.4	$26.1
Light industrial		$0.2	$1.0	$1.0	$0.7
Tenant improvements[1]		$5.1	$3.6	$2.4	$3.8
Lodge and Business Center		$5.2	$0.0	$0.0	$2.0
Medical facilities		$7.2	$4.5	$0.1	$4.2
Waste water treatment plant		$0.3	$0.2	$0.2	$0.2
Infrastructure[2]		$7.3	$7.4	$4.4	$6.5
Other		$2.1	$3.1	$2.1	$2.4
Total, rounded		**$53.2**	**$55.5**	**$33.7**	**$48.0**

1 Includes developer- and tenant-provided construction budgets.

2 Covers grading and other preparation of on-site development pads with utility installation; subdivision and collector roads. Excludes parks, schools, dryland forest, desalinization plant, fire station, future water tank, off-site infrastructure and other potential expenditures or public contributions.

Exhibit 3-5
Development Employment, FTE Jobs[1]
2013 to 2045 (Total in each period)

	Basis/reference	2013 2025	2026 2035	2036 2045	Total/ average
Total:					
Direct jobs -	*Exhibits 3-2 and 3-3*				
Professional services		113	72	44	228
Construction -					
Residential & commercial units		722	804	535	2,061
Light industrial		7	24	24	55
Commercial facilities		0	0	0	0
Tenant improvements[2]		162	89	58	310
Lodge and Business Center		165	0	0	165
Medical facilities		231	109	2	343
Wastewater treatment plant		9	4	4	18
Infrastructure[3]		514	402	236	1,152
Other		207	230	153	590
Subtotal direct jobs (rounded)		2,100	1,700	1,100	4,900
Indirect and induced jobs (rounded) [4]	*Exhibit 3-2*	3,400	2,700	1,700	7,800
Total jobs		**5,500**	**4,400**	**2,800**	**12,700**
Average annual:					
Direct jobs -					
Professional services		9	7	4	7
Construction[2,3]		139	143	86	124
Other		16	23	15	18
Subtotal direct jobs (rounded)		**160**	**170**	**110**	**150**
Indirect and induced jobs[4]		262	270	170	236
Total jobs (rounded)		**400**	**400**	**300**	**390**

1 FTE = Full time equivalent, defined as 40 hours per week or 2,080 hours per year.

2 Includes employees supported by developer- and tenant-provided construction activities.

3 Covers grading and other preparation of on-site development pads with utility installation; subdivision and collector roads. Excludes parks, schools, dryland forest, desalinization plant, fire station, future water tank, off-site infrastructure and other potential expenditures or public contributions.

4 Based on weighted average of Direct-Effect jobs multipliers for each job category, as shown on Exhibit 3-2.

Exhibit 3-6
Personal Earnings from Development - Total in Period
2010 dollars, in millions

	Basis/reference	2013 2025	2026 2035	2036 2045	Total
Direct earnings[1]:	*Exhibits 3-2 & 3-3*				
Professional services		$20.1	$12.8	$7.8	$40.7
Construction -					
Residential & commercial units		$94.7	$105.4	$70.2	$270.3
Light industrial		$0.9	$3.1	$3.1	$7.1
Tenant improvements[2]		$20.7	$11.4	$7.5	$39.5
Lodge and Business Center		$21.1	$0.0	$0.0	$21.1
Medical facilities		$29.5	$14.0	$0.3	$43.8
Wastewater treatment plan		$1.2	$0.5	$0.5	$2.2
Infrastructure[3]		$29.8	$23.3	$13.7	$66.8
Other		$12.5	$13.9	$9.3	$35.7
Subtotal, direct		**$230.6**	**$184.4**	**$112.3**	**$527.3**
Indirect and induced earnings[4]		$245.6	$197.2	$119.8	$562.5
Total earnings		**$476.2**	**$381.6**	**$232.1**	**$1,089.8**

Notes: Earnings defined to include wage, salary and proprietary incomes, plus directors' fees and employer contributions to health insurance, less employee contributions to social insurance.

1 Based on industry coefficients as shown in Exhibit 3-2 and estimated construction costs in 2007 dollars, as shown in Exhibit 3-2. Figures inflated 12.0% based on average annual hourly wage data for statewide mining and construction industry from 2007 to 2010: Current Employment Statistics (CES) data, not seasonally adjusted, as provided by Hawaii Workforce Infonet at www.hiwi.org/, accessed September 25, 2012.

2 Includes earnings supported by developer- and tenant-provided construction activities.

3 Covers grading and other preparation of on-site development pads with utility installation; subdivision and collector roads. Excludes parks, schools, dryland forest, desalinization plant, fire station, future water tank, off-site infrastructure and other potential expenditures or public contributions.

4 Weighted average of estimated direct earnings by industry as shown above, and direct effect industry multipliers shown in Exhibit 3-2.

Exhibit 3-7
Personal Earnings from Development - Average Annual
2010 dollars, in millions except average earnings

	Basis/reference	2013 2025	2026 2035	2036 2045	Average
Average annual in period (rounded):	*Exhibit 3-6, refers to all jobs*				
Direct earnings		$18	$18	$11	$16
Indirect & induced earnings		$19	$20	$12	$17
Total earnings		**$37**	**$38**	**$23**	**$33**
Average per new FTE job:	*Exhibits 3-5 and 3-6, rounded*				
Direct jobs		$110,000	$108,000	$102,000	$108,000
Indirect and induced jobs		$72,000	$73,000	$70,000	$72,000
Average per job		**$87,000**	**$87,000**	**$83,000**	**$86,000**
Estimated average family income[1]:	*1.8 times average wage*				
For direct job-holders		$201,000	$197,000	$187,000	$197,000
For indirect and induced job-holders		$132,000	$133,000	$128,000	$132,000
All Project-related job-holders		**$159,000**	**$159,000**	**$152,000**	**$157,000**
Percent of median income[2]:	*$66,700 median family income, FY2010, Hawaii County*				
For direct job-holders		301%	295%	280%	295%
For indirect and induced job-holders		198%	199%	192%	198%
All Project-related job-holders		**238%**	**238%**	**228%**	**235%**

Notes: Earnings defined to include wage, salary and proprietary incomes, plus directors' fees and employer contributions to health insurance, less employee contributions to social insurance.

1 Ratio estimated from 2009/2010 average annual wage in Hawaii County, all occupations, as provided by State of Hawaii, Department of Labor & Industrial Relations (www.hiwi.org, Census of Employment and Wages), and FY 2010 median family income in the County, as provided by U.S. Department of Housing & Urban Development, HUD USER. Reflects multiple job-holders within each family as well as multiple job-holding by individuals.

2 U.S. Department of Housing & Urban Development, HUD USER (www.huduser.org), as accessed July 10, 2011.

Exhibit 3-8
Direct On-Site Operational Employment, FTE Jobs

	Basis/reference	2025	2035	2045	After 2045
Commercial facilities -					
Light industrial	*600 building square feet per FTE job*	67	217	433	433
Commercial retail/office	*425 square feet general commercial area per FTE job*	1,012	1,318	1,412	1,412
Other facilities -					
Lodge and Business Center	*0.3 FTE jobs per room*	36	36	36	36
Medical facilities	*Cattaneo & Stroud, Inc., 2011*				
Outpatient/urgent care center		47	47	59	59
Hospital		550	825	825	825
Senior care residences:	*Subset of residential units in T-5 zones*				
Number of units	*SCD*	*262*	*262*	*262*	262
Number of jobs	*See note 1*	57	57	57	57
Schools[2]	*72 FTE positions per elementary school* *113 FTE positions per middle school*	113	185	257	257
Total on-site jobs, rounded		**1,900**	**2,700**	**3,100**	**3,100**

Note: Excludes Realtors and brokers that may locate on-site, private household maintenance and other assistance, potential employees of community association(s) and employees of the wastewater treatment plant.

1 Based on 300 beds at 95% occupancy and 1 FTE employee per 5 residents.

2 Assumes one, 1,000-student middle school and two, 750-student elementary schools, based on information provided to SCD-TSA by Department of Education, 2013. These positions are not counted on the "net" impacts shown on the next exhibit because it is assumed that they would be developed elsewhere in West Hawaii even if the Project did not proceed.

Exhibit 3-9
Net Additional Operational Employment, FTE Jobs[1]
2010 dollars, in millions, except as noted

	Basis/reference		2025	2035	2045	After 2045
Bases for projection:						
Av. annual spending by non-primary residents	*Direct, indirect & induced (new to island):*	*Exhibit 3-1*	*$10.2*	*$21.8*	*$29.4*	*$29.4*
Av. annual residential selling costs		*See Exhibit 3-1*				
Sell-out of developer inventory	*2.0%*	*of gross sales, preceding years*[2]	*$1.2*	*$1.5*	*$1.0*	*$0.0*
Resales	*3.0%* *6.0%*	*Turnover per year*[3] *of gross sales, same av. price*	*$0.1*	*$0.2*	*$0.3*	*$0.3*
Projected net additional jobs:						
Direct -						
Attributable to non-primary residents[4, 5]	*7.7*	*/$mil output, selected industries*	73	156	210	210
Real estate leasing & sales[5]	*3.1*	*/$mil selling costs, new and resales*	4	5	4	1
Light industrial	*10%*	*assumed net new jobs, see Ex. 3-8*	7	22	43	43
Lodge and Business Center	*25%*	*assumed net new jobs, see Ex. 3-8*	9	9	9	9
Medical facilities	*60%*	*assumed net new jobs, see Ex. 3-8*	392	557	565	565
Subtotal, direct jobs, rounded			**490**	**750**	**830**	**830**
Indirect and induced -	*Multiplier and industry category applied*[6]*:*					
Attributable to non-primary residents[4]	*0.97*	*Weighted average, selected industries*	71	151	203	203
Real estate leasing & sales	*1.68*	*Real estate & rentals industries*	6	8	6	2
Light industrial	*1.62*	*Average of select industries*	11	35	70	70
Lodge and Business Center	*1.23*	*Accommodations industry*	11	11	11	11
Medical facilities	*0.96*	*Health services industry*	377	535	542	542
Subtotal, indirect & induced jobs, rounded			480	740	830	830
Total net additional jobs , rounded			**1,000**	**1,500**	**1,700**	**1,700**

1 FTE = Full time equivalent, defined as 40 hours per week or 2,080 hours per year.

2 Represents 2% inside commissions; no outside commissions.

3 Resales activity assumed 3.0% of completed and sold residential inventory shown in Exhibit 2-1. Resales factor considers 2010 Hawaii Island recorded sales of 2,022 resales vs. 69,100 housing units (2.9%): see Mikiko Market Study, Exhibits 2-6 and 3-2. Commissions and other selling costs estimated at rate shown and average prices shown in Exhibit 2-1.

4 Category addresses commercial and other impacts of non-primary resident spending in categories such as retail, wholesale, eating & drinking, ground transportation, accommodations, telecommunications, arts & entertainment, etc. Net additional employment is considered a function of direct new spending on-island, not leasable area to be developed at the Project. Spending by existing island residents, such as at the commercial centers to be developed, is assumed to have occurred elsewhere on-island even if the Project were not developed.

Retail trade margins already factored into transactions table accounting and thus are not applied here.

5 Coefficients are calculated based on total (wage, salary and proprietors') jobs per million output in representative industries as shown in DBEDT 2007 detailed industry input-output transactions table, adjusted to reflect DBEDT's estimate of future inflation and 2017 vs. 2007 productivity. See DBEDT, ibid.

Sales and expenditure data adjusted to 2007 dollars based on Honolulu CPI-U factor of: 93% from U.S. Bureau of Labor Statistics data.

6 For indirect and induced impacts of respective direct impacts. Multipliers derived from Type II direct effect total job/total job multipliers as shown in DBEDT, ibid; published multipliers reduced by 1.0 to eliminate direct jobs previously calculated.

Exhibit 3-10
Personal Earnings from Net New Operational Activity - Total Annual
2010 dollars, in millions, except as noted

	Basis/reference (not in millions)		2025	2035	2045	After 2045
Direct earnings -	*Estimated average FTE salary or other basis*[1]*:*					
Attributable to non-primary residents[2]	*$37,300*	*Estimated average Hawaii County wage, 2010*[1]	$2.7	$5.8	$7.8	$7.8
Real estate sales & marketing -	*Residential & commercial properties, Ex. 3-9*					
Sell out of developed inventory			$1.2	$1.5	$1.0	$0.0
On-going resales after 2012			$0.1	$0.2	$0.3	$0.3
Light industrial	*$47,600*	*average wage, select industries*	$0.3	$1.0	$2.1	$2.1
Lodge and Business Center	*$36,700*	*average wage, accommodation and food service industries*	$0.3	$0.3	$0.3	$0.3
Medical facilities	*$66,200*	*Cattaneo & Stroud*	$26.0	$36.9	$37.4	$37.4
Subtotal, direct earnings			**$30.7**	**$45.8**	**$48.9**	**$47.9**
Indirect and induced earnings -	*Multiplier and industry category*[2]*:*					
Attributable to non-primary resider	*1.14*	*Weighted average, selected industries*	$3.1	$6.6	$8.9	$8.9
Real estate leasing and sales	*2.89*	*Real estate & rentals industries*	$3.8	$4.9	$3.8	$1.0
Light industrial	*1.30*	*Average of select industries*	$0.4	$1.3	$2.7	$2.7
Lodge and Business Center	*0.89*	*Accommodations industry*	$0.3	$0.3	$0.3	$0.3
Medical facilities	*0.78*	*Health services industry*	$20.3	$28.8	$29.2	$29.2
Subtotal, indirect & induced			$27.8	$42.0	$44.9	$42.0
Total earnings, rounded			**$58.5**	**$87.8**	**$93.8**	**$90.0**

Notes: Earnings defined to include wage, salary and proprietary incomes, plus directors' fees and employer contributions to health insurance, less employee contributions to social insurance. They exclude tips. The figures shown are considered conservative in that only wage data is available for the "non-primary resident," light industrial and hotel employment categories.

1 Average Honolulu salary based on $36,556 reported for 2009 by Department of Labor and Industrial Relations, "Quarterly Census of Employment and Wages" as accessed July 10, 2011; inflation to 2010 dollars based on Honolulu CPI-U for 2010 vs. 2009. Considered conservative because it incorporates no adjustment to FTE work.

2 For indirect and induced impacts of respective direct impacts. Multipliers derived from Type II direct effect total job/total job multipliers as shown in DBEDT, ibid; published multipliers reduced by 1.0 to eliminate direct jobs previously calculated.

Exhibit 3-11
Personal Earnings from Net New Operational Activity - Average Per Job and Family
2010 dollars, in millions, except as noted

	Basis/reference	2025	2035	2045	After 2045
Average earnings per new FTE job:	*Not in millions*				
Direct jobs		$63,000	$61,000	$59,000	$58,000
Indirect and induced jobs		$58,000	$57,000	$54,000	$51,000
Average per job		**$58,000**	**$59,000**	**$55,000**	**$53,000**
Estimated average family income[1]:	*1.8 times average wage; not in millions*				
For direct job-holders		$115,000	$112,000	$108,000	$106,000
For indirect and induced job-holders		$106,000	$104,000	$99,000	$93,000
All Project-related job-holders		**$106,000**	**$108,000**	**$101,000**	**$97,000**
Percent of median income[2]:	*$66,700 median family income, FY2010, Hawaii County*				
For direct job-holders		172%	168%	162%	159%
For indirect and induced job-holders		159%	156%	148%	139%
All Project-related job-holders		**159%**	**162%**	**151%**	**145%**

Notes: Exhibit portrays only those earnings from positions that would be new to the community; not on all employment associated with the Project.

Earnings defined to include wage, salary and proprietary incomes, plus directors' fees and employer contributions to health insurance, less employee contributions to social insurance.

1 Ratio estimated from 2009 average annual wage in Hawaii County, all occupations, as provided by State of Hawaii, Department of Labor & Industrial Relations, and FY 2010 median family income in the County, as provided by U.S. Department of Housing & Urban Development, HUD USER. Reflects multiple job-holders within each family as well as multiple job-holding by individuals.

2 U.S. Department of Housing & Urban Development, HUD USER (www.huduser.org), as accessed July 10, 2011.

Exhibit 4-1
Average Daily In-Migrant Population

	Basis/reference	2025	2035	2045	After 2045
Non-primary residents at Project:					
Average FTE persons in residence	*At non-primary resident units: Exhibit 2-2*	259	550	743	743
In-migrants to State (rounded)	*80% of FTE persons in residence*	210	440	590	590
In-migrants to Co. (rounded)[1]	*100% of FTE persons in residence*	260	550	740	740
Employees:					
In-migrants to the State[1] -	*Subset of in-migrants to County*				
Development employees	*2% of direct av. annual jobs (Ex. 3-5)*	3	3	2	0
Direct operational employees	*2% of net jobs generated (Exhibit 3-9)*	10	15	17	17
Dependents[2]	*Ratio of in-migrant employees*	10	20	20	20
In-migrants to State (rounded)[3]		20	40	40	40
In-migrants to County[3] -	*Includes in-migrants to State*				
Development employees	*4% of direct av. annual jobs (Ex. 3-5)*	6	7	4	0
Operational employees	*6% of net jobs generated (Exhibit 3-9)*	29	45	50	50
Dependents[2]	*Ratio of in-migrant employees*	30	50	50	50
In-migrants to County (rounded)[3]		70	100	100	100
Total in-migrants:	*Those attracted by new residences plus those attracted by net new employment*				
To State		**230**	**480**	**630**	**630**
To County		**330**	**650**	**840**	**840**

1 Subset of County in-migrants. See footnote 3, below.

2 In-migrant dependents estimated to average 0.2 per in-migrant development employee, and 1.0 per in-migrant operational employee.

3 In-migrants to the County include all those moving to the State plus any that may move between islands due to job opportunities at the Project.

Exhibit 5-1
Real Property Taxes Generated by Development
2010 dollars, in millions, except as noted

	Basis/reference (not in millions unless specified)		2025	2035	2045	After 2045
Total assessed values:						
Improved residential: Primary homes (excludes non-RHUs)	*$370,000*	*Average home value, market and affordable home mix (Ex. 2-1)*	$551.5	$1,164.3	$1,572.5	$1,572.5
Unimproved residential: RHUs[1]	*$17,800,000*	*estimated total value in T3,4&5 residential areas, of which RHUs = 85%*	$9.8	$3.9	$0.0	$0.0
Improved residential: Non-primary homes (excludes RHUs)	*$396,000*	*Average home value, market homes only (Ex. 2-1)*	$103.6	$219.9	$297.0	$297.0
Unimproved residential: Non-primary homes[2]	*$17,800,000*	*estimated total value in T3,4&5 residential areas, of which non-RHUs= 15%*	$1.74	$0.69	$0.0	$0.0
Light industrial - land[3]	*60*	*max. net acres, at: $750,000*	$45.0	$45.0	$29.7	$29.7
Light industrial - improvements	*Vert. cost + indust. share of TI @*	*32%*	$24.1	$45.5	$62.9	$62.9
Commercial - land[4]	*55*	*acres, @ per acre: $475,000*	$26.3	$26.3	$26.3	$26.3
Commercial - improvements	*Vert. cost + comm. share of TI @*	*68%*	$44.7	$69.4	$85.6	$85.6
Lodge and Business Center - land[4]	*5*	*acres, @ per acre: $475,000*	$2.4	$2.4	$2.4	$2.4
Lodge and Business Center - improvements	*Vertical cost (Ex. 3-3)*		$67.2	$67.2	$67.2	$67.2
Hospital, outpatient & SNF/LTC facilities	*Assumed exempt*		$0.0	$0.0	$0.0	$0.0
Schools	*Assumed exempt*		$0.0	$0.0	$0.0	$0.0
Parks, recreation center & other[5]	*Not estimated*		$0.0	$0.0	$0.0	$0.0
Total assessed values			**$315.0**	**$476.5**	**$571.1**	**$571.1**

Notes: !TI - Tenant improvements; RPT - real property tax.

1 T3, 4 & 5 mixed-use areas comprise 564 acres, of which some 90% or 508 are allocated to residential uses for taxation purposes, based on their respective floor areas in the master plan. Such lands are assumed to be valued for tax purposes at *$35,000* per acre, based on the value of unimproved residential zoned lands at Kaloko Heights. This results in a total Kaloko Makai residential land valuation of $17.8 million, which is allocated pro-rata based on remaining number of residential units to be developed in any given time period.

2 Balance of the T3, 4 & 5 mixed-use areas not allocated to residential uses (except site proposed for lodge use).

3 75 gross acres (60 net) proposed for initial zoning, of which 25 gross are assumed to be taken for public use in the third time period. Net acre valuation based on 2011 tax assessed values for land at 13 properties sampled in Kaloko Industrial Park and Kohanaiki Industrial Park (Hawaii Information Service records.)

4 Tax assessed value based on unimproved commercial zoned lands at Kaloko Heights as of 2010.

5 Taxes on parks, recreation center, schools and open spaces not estimated as they are assumed to be exempt (if publicly owned) and/or taxed at a minimal level.

Exhibit 5-1, Continued
Real Property Taxes Generated by Development
2010 dollars, in millions, except as noted

	Basis/reference (not in millions unless specified)		2025	2035	2045	After 2045
Real property tax revenues:						
Potential new revenues -	*FY 2010 rates per $1,000 net taxable value*[6]					
Improved residential: Primary homes	*$5.55*	*Affordable rental & homeowner housing*	$3.1	$6.5	$8.7	$8.7
Unimproved residential: Primary homes	*$5.55*	*Affordable rental & homeowner housing*	$0.1	$0.0	$0.0	$0.0
Improved residential: Other[7]	*$7.10*	*Improved Residential*	$0.7	$1.6	$2.1	$2.1
Unimproved residential: Other[7]	*$8.10*	*Unimproved Residential*	$0.0	$0.0	$0.0	$0.0
Light industrial - land	*$9.00*	*Industrial*	$0.4	$0.4	$0.3	$0.3
Light industrial - improvements	*$9.00*	*Industrial*	$0.2	$0.4	$0.6	$0.6
Commercial - land	*$9.00*	*Commercial*	$0.2	$0.2	$0.2	$0.2
Commercial - improvements	*$9.00*	*Commercial*	$0.4	$0.6	$0.8	$0.8
Lodge and Business Center - land	*$9.00*	*Hotel*	$0.0	$0.0	$0.0	$0.0
Lodge and Business Center - improvements	*$9.00*	*Hotel*	$0.6	$0.6	$0.6	$0.6
Hospital, outpatient & SNF/LTC facilities	*$0.00*	*Assumed exempt*	$0.0	$0.0	$0.0	$0.0
Schools	*$0.00*	*Assumed exempt*	$0.0	$0.0	$0.0	$0.0
Parks, forest & natural spaces[5]	*$0.00*	*Not estimated*	$0.0	$0.0	$0.0	$0.0
Subtotal, potential tax revenues			$5.8	$10.4	$13.3	$13.3
Less deductions -						
RPT payments prior to Project	*$260,000*	*FY 2011, per SCD-TSA*	$0.3	$0.3	$0.3	$0.3
Homeowners' exemption[8]	*$114,000*	*/unit, primary residences (Ex. 2-2)*	$0.9	$2.0	$2.7	$2.7
Subtotal deductions			$1.2	$2.3	$2.9	$2.9
Estimated net additional RPT			**$4.5**	**$8.1**	**$10.4**	**$10.4**

Notes: TI - Tenant improvements; RPT - real property tax.

5 Taxes on parks, recreation center, schools and open spaces not estimated as they are assumed to be exempt (if publicly owned) and/or taxed at a minimal level.

6 For fiscal year ending June 30, 2010. Hawaii County tax rates were raised in FY2011 but remained unchanged thereafter in FY2012 and FY2013.

7 In FY2010, County taxes for non-homeowner residential uses were $7.10 per $1,000 net taxable building value and $8.10 for net taxable land value. To simplify modeling, Mikiko uses the higher land rate only for undeveloped residential lands and applies the lower building rate to the house and land values combined for properties that are built. This results in an understatement of potential real property taxes from these non-homeowner units. (For homeowner residential units, as for affordable rental housing, the County rate was the same for building and land, at $5.55.)

8 Estimated at $114,000 based on Hawaii County policy of a basic home exemption of $40,000 plus 20% of average home value, or: $74,000 as shown above; exemption applied only to the 4,250 units believed to be used as primary residences, as shown in Exhibit 2-2. Homeowners aged 70 and older may qualify for a higher exemption amount of up to $180,000 (not factored in here.)

Exhibit 5-2
Total Annual Revenues to County Government Attributable to Development & In-Migrant Population
2010 dollars, in millions, except as noted

	Basis/reference (not in millions)	2025	2035	2045	After 2045
Bases for projection:					
FTE in-migrants to County -	*Exhibit 4-1*				
Project non-primary residents		*260*	*550*	*740*	*740*
Employees and their dependents		*70*	*100*	*100*	*100*
Estimated tax and other revenues:					
Net new property tax revenues	*Exhibit 5-1*	$4.5	$8.1	$10.4	$10.4
Taxes and other revenue sources from in-migrant residents[1]	*Other than real property taxes* *$222 per person (residents + employees)*	$0.1	$0.1	$0.2	$0.2
Transient accommodations tax[2]	*8.3% of total TAT collections (see 5-2 and 5-3)*	$0.0	$0.0	$0.0	$0.0
Total new County revenues		**$4.6**	**$8.3**	**$10.6**	**$10.6**

1 Includes fuel taxes, licenses and permits and charges for services. Excludes public utility franchise taxes, public service company taxes, investment & other miscellaneous revenues. As stated in County of Hawaii, "Comprehensive Annual Financial Report Fiscal Year Ended June 30, 2010," December 2010. Based on governmental funds statement of revenues, expenditures ad changes in fund balances, pg. 32.

2 Based on Hawaii County share of 18.6% of the 44.8% of the TAT revenues that are distributed among the four counties, per State tax policy. Note 2011 Legislature passed a cap on amount of State TAT collections that may be passed to Counties, which amount may have already been exceeded; however subject property would generate negligible additional TAT for Hawaii County in any case.

Exhibit 5-3
Bases for Projecting State Government Revenues
2010 dollars, in millions, except as noted

	Basis/reference	2025	2035	2045	After 2045
For GET calculations:					
Project development costs -	*Exhibit 3-4, average annual for preceding period*				
Professional services		$2.6	$2.1	$1.3	$0.0
Construction and other		$50.7	$53.3	$32.4	$0.0
Subtotal development cost		$53.2	$55.5	$33.7	$0.0
Real estate sales & marketing costs -	*Based on average activity in prior 5 years*				
Residential	*New and resold units, Exhibit 3-9*	$1.3	$1.7	$1.3	$0.3
Spending by non-primary residents	*In-State spending: Exhibit 3-9*	$10.2	$21.8	$29.4	$29.4
Spending by in-migrant employees to the State & their dependents -					
Number of persons	*Exhibit 4-1, employment impact only*	20	40	40	40
Estimated number households	*2.3 persons per household (compare Ex. 2-2)*	9	17	17	17
In-State spending by hhds[1]	*58% of average of earnings per development and operational job (see notes below)*	$0.4	$0.7	$0.7	$0.3
Lodge and Business Center, all revenues	*Exhibit 2-3*	$3.4	$3.8	$4.0	$4.0
For transient accommodation tax:					
Lodge and Business Center room revenues	*Exhibit 2-3*	$3.2	$3.6	$3.7	$3.7
Total TAT collected	*7.25% of room revenues*	$0.2	$0.3	$0.3	$0.3
For individual income taxes:					
Net new personal income earned -	*Average annual in preceding period*				
Development employment	*Exhibit 3-7 (total personal earnings)*	$36.6	$38.2	$23.2	$0.0
Operational employment	*Exhibit 3-10 (total personal earnings)*	$58.5	$87.8	$93.8	$90.0
Av. personal earnings/FTE job -					
Development employment	*Exhibit 3-7 (total personal earnings), not in millions >>*	$87,000	$87,000	$83,000	$0
Operational employment	*Exhibit 3-10 (total personal earnings), not in millions >>*	$58,000	$59,000	$55,000	$53,000
For other State taxes:					
FTE in-migrants to State	*FTE non-primary residents + employees and their dependents: Exhibit 4-1*	230	480	630	630

1 U.S. Department of labor, Bureau of Labor Statistics, "Consumer Spending Patterns in Honolulu: 2001-02", released April 30, 2004 at www.bls.gov/ro9/cexhono.htm (latest available on BLS site as of July 2011). Estimate uses study findings showing 77.6% of pre-tax income of household units was spent, of which 75.1% were on items likely subject to Hawaii Gross Excise Tax. Excludes spending on shelter (owned dwellings), cash contributions, personal insurance and pensions. Applied to estimated in-migrant households and average of personal earnings for operational employees, as shown. Excludes potential household income from other household members.

Exhibit 5-4
Projected State Government Revenues
2010 dollars, in millions, except as noted

	Basis/reference (not in millions)	2025	2035	2045	After 2045
General excise taxes, on:					
Development[1]		$1.4	$1.5	$0.9	$0.0
Real estate sales and marketing	*4.0% of costs*	$0.1	$0.1	$0.1	$0.0
Lodge and Business Center revenues	*4.0% of revenues*	$0.1	$0.2	$0.2	$0.2
Spending by Project's non-primary residents	*4.0% of spending*	$0.4	$0.9	$1.2	$1.2
Spending by in-migrants to State	*4.0% of employee & dependent spending*	$0.0	$0.0	$0.0	$0.0
Transient accommodations tax, on:					
Lodge and Business Center revenues	*55.2% State share of total collections*[2]	$0.1	$0.1	$0.1	$0.1
Individual income taxes[3]:					
Development employees	*5.2% effective tax rate on av. family AGI estimated at $118,000 based on Ex.3-7*	$1.4	$1.5	$0.9	$0.0
Operational employees	*6.6% effective tax rate on av. family AGI estimated at $76,000 based on Ex.3-11*	$2.9	$4.3	$4.6	$4.4
Other taxes and revenues from in-migrants[4]	*$535 per person*	$0.1	$0.3	$0.3	$0.3
Total, additional revenues		**$6.6**	**$8.8**	**$8.3**	**$6.3**

1 Based on 4% on 100% of professional services and 60% of construction costs, plus a wholesale construction materials tax of 0.5% against 40% of construction costs.

2 2011 Legislature passed a cap on total amount of TAT collections to be shared with counties, so this amount could effectively be higher.

3 Based on average family incomes for all Project-related job holders as shown previously, and on 2010 Tax Tables and Tax Rate Schedules for married taxpayers filing joint returns, as shown at www6.hawaii.gov/tax/2010/n11ins.pdf. Hawaii State tax rates were unchanged in these income brackets in 2011. Adjusted Gross Incomes (AGI) assumed to be 25% less than total average family earnings, considering potential deductions.

4 Based on miscellaneous FY 2009 State tax revenue receipts as reported by State of Hawaii, "Comprehensive Annual Financial Report for the Fiscal Year Ended June 30, 2009," governmental funds, statement of revenues, expenditures, and changes in fund balances (pg. 39.) Includes tobacco and liquor taxes, liquid fuel tax, motor vehicle weight & registration tax, and fines & forfeitures. Excludes licenses, franchise tax, rental motor vehicle surcharge tax, public service companies tax, tax on premiums of insurance companies and other fees and taxes.

Exhibit 5-5
Hawaii County Government Expenditures
Net of Intergovernmental Revenues (State and Federal)
Per Capita in Fiscal Year July 1, 2009 to June 30, 2010

	Expenditures ($thousands)	Service population[1]	Expenditures (not in thousands) per: Resident	Visitor
Current expenditures:				
General Government	$40,585	215,000	$189	$189
Public Safety	$108,798	215,000	$506	$506
Highways and Streets	$20,221	215,000	$94	$94
Health, education and welfare	$25,519	185,100	$138	$0
Culture and recreation	$17,266	215,000	$80	$80
Sanitation	$35,674	215,000	$166	$166
Pension and retirement contributions	$28,509	185,100	$154	$0
Employees' health insurance	$23,573	185,100	$127	$0
Other post-employment benefits	$15,700	185,100	$85	$0
Miscellaneous	$4,773	215,000	$22	$22
Debt service:				
Principal (majority from bond redemption fund)	$20,720	215,000	$96	$96
Interest	$14,584	215,000	$68	$68
Capital outlays (majority capital projects)	$100,653	215,000	$468	$468
Subtotal	$456,575		$2,194	$1,690
Less: intergovernmental revenues (Federal and Stat	($77,613)	215,000	($361)	($361)
Proprietary funds[2]:				
Kulaimano Elderly Housing Project (incl. interest)	$56	185,100	$0	$0
`O`uli Ekahi affordable Housing Project	$58	185,100	$0	$0
Subtotal	$114		$1	$0
Total, in 2009/2010 dollars	**$379,076**		**$1,833**	**$1,329**
Total, in 2010 dollars, based on increase of[3]		0.8%	**$1,849**	**$1,340**

Notes: Based on governmental and proprietary fund financial statements. Excludes fiduciary funds since they represent resources held for the benefit of parties outside of the County. Line items may have debt service and employee benefit expenses within each, but exclude depreciation.

1 Resident population as of April 1, 2010 by U.S. Census Bureau, 2011, Summary File Table P1; de facto population based on residents plus average daily visitor census, as estimated by State of Hawai`i, Department of Business, Economic Development and Tourism, Research & Economic Analysis Division, Hawaii Tourism Authority, "Monthly Visitor Statistics," 2010.

2 Enterprise funds reflecting business-type activities at senior housing projects near Hilo and in Waimea, respectively. Figures shown are change in net assets, or operating revenues plus investment income, less operating expenses and interest expenses.

3 Based on average of 2nd half 2009 and 1st half 2010 vs. full year 2010 Honolulu CPI-U, as reported by U.S. Department of Labor, Bureau of Labor Statistics at http://data.bls.gov, accessed July 2011.

Source: Department of Finance, County of Hawaii, "Comprehensive Annual Financial Report: Fiscal Year Ended June 30, 2010," December 30, 2010. Fund Financial Statements, as shown on pages 32-42.

Exhibit 5-6
State of Hawaii Government Expenditures
Net of Intergovernmental Revenues (Federal)
Per Capita in Fiscal Year July 1, 2008 to June 30, 2009

	Operating expenditures ($thousands)	Service population[1]	Expenditures (not in thousands) per: Resident	Visitor
Governmental funds[2]:				
General government	$597,210	1,471,000	$406	$406
Public safety	$435,414	1,471,000	$296	$296
Highways	$442,421	1,471,000	$301	$301
Conservation of natural resources	$120,693	1,471,000	$82	$82
Health	$798,026	1,471,000	$543	$543
Welfare	$2,119,481	1,291,300	$1,641	$0
Lower education	$2,454,668	1,291,300	$1,901	$0
Higher education	$878,127	1,291,300	$680	$0
Other education	$29,912	1,291,300	$23	$0
Culture and recreation	$107,302	1,471,000	$73	$73
Urban redevelopment and housing	$179,819	1,291,300	$139	$0
Economic development and assistance	$169,547	1,291,300	$131	$0
Housing	$1,909	1,291,300	$1	$0
Other	$1,175	1,471,000	$1	$1
Debt service	$401,722	1,471,000	$273	$273
Less: Intergovernmental revenues	($2,090,058)	1,471,000	($1,421)	($1,421)
Subtotal	$6,647,368		$5,071	$553
Proprietary Funds (Business-type activities)[3]:				
Airports	$58,043	1,471,000	$39	$39
Harbors	$51,429	1,471,000	$35	$35
Unemployment compensation	$247,902	1,291,300	$192	$0
Nonmajor proprietary fund	$34,022	1,471,000	$23	$23
Subtotal	$391,396		$290	$98
Total, in 2008/09 dollars	**$7,038,764**		**$5,360**	**$651**
Total, in 2010 dollars, based on increase of[3]		2.5%	**$5,492**	**$667**

Notes: :Based on governmental and proprietary fund financial statements. Excludes fiduciary funds since they represent resources held for the benefit of parties outside of the State.

General government includes legislative expenses; line items may also have debt service and employee benefit expenses within each. Excludes expenses of "Component Units" including the University of Hawaii, Housing and Community Development Corporation of Hawaii, Hawaii Health Systems Corporation and Hawaii Hurricane Relief Fund. The first three charge for services, and receive capital and operating grants and contributions.

1 Estimated resident population for January 1, 2009 estimated based on data from the U.S. Census Bureau, Population Estimates Program estimates for July 1, 2008 and July 1, 2009; average daily visitor population based on Hawaii State Department of Business, Economic Development and Tourism, Research & Economic Analysis Division, Hawaii Tourism Authority, "Monthly Visitor Statistics," 2010.

2 Expenditures incurred within the General, Capital Projects, Med-Quest Special Revenue and Other Governmental Funds.

3 Enterprise funds reflecting business-type activities. Figures shown are change in net assets before capital contributions, or operating revenues plus nonoperating revenues or expenses (including interest income and expenses and federal grants), less operating expenses.

3 Based on 2nd half 2008 and 1st half 2009 vs. full year 2010 Honolulu CPI-U, as reported by U.S. Department of Labor, Bureau of Labor Statistics, accessed July 2011.

Source: State of Hawaii, Department of Accounting and General Services, "State of Hawaii: Comprehensive Annual Financial Report For the Fiscal Year Ended June 30, 2009," October 20, 2010.

Exhibit 5-7
Annual County Government Expenditures
Attributable to Visitors and to In-migration
2010 dollars, in millions, except as noted

	Basis/reference (not in millions)			2025	2035	2045	After 2045
Bases for County projection -							
FTE in-migrants to County	*Non-primary residents, employees and dependents (Ex. 4-1)*			*330*	*650*	*840*	*840*
Visitors from off-island	*Exhibit 2-3*			*124*	*133*	*133*	*133*
Annual expenditures -							
FTE in-migrants to County	*$1,849*	*per person, ref:*	*Exhibit 5-5*	$0.6	$1.2	$1.6	$1.6
Visitors from off-island	*$1,340*	*per person, ref:*	*Exhibit 5-5*	$0.2	$0.2	$0.2	$0.2
Subtotal new County expenditures				**$0.8**	**$1.4**	**$1.7**	**$1.7**

Exhibit 5-8
Annual State Government Expenditures Attributable to Visitors and to In-migration
2010 dollars, in millions, except as noted

	Basis/reference (not in millions)	2025	2035	2045	After 2045
Bases for State projection -					
FTE in-migrants to State	*Non-primary residents, employees and dependents (Ex. 4-1)*	*230*	*480*	*630*	*630*
Visitors from out-of-State	*Exhibit 2-3*	*52*	*56*	*56*	*56*
Annual expenditures -					
FTE in-migrants to State	*$5,492 per FTE person, ref: Exhibit 5-6*	$1.3	$2.6	$3.5	$3.5
Visitors from out-of-State	*$667 per FTE person, ref: Exhibit 5-6*	$0.0	$0.0	$0.0	$0.0
Subtotal new State expenditures		**$1.3**	**$2.6**	**$3.5**	**$3.5**

Exhibit 5-9
County & State Government Revenue and Expenditure Comparison
2010 dollars, in millions, except as noted

	Basis/reference	2025	2035	2045	After 2045
Hawaii County:					
New revenues	*Exhibit 5-2*	$4.6	$8.3	$10.6	$10.6
New expenditures	*Exhibit 5-7*	$0.8	$1.4	$1.7	$1.7
Net additional revenues		$3.9	$6.9	$8.8	$8.8
Revenue ÷ expenditure ratio[1]		**6.0**	**6.0**	**6.1**	**6.1**
State of Hawaii:					
New revenues[2]	*Exhibit 5-4*	$6.6	$8.8	$8.3	$6.3
New expenditures	*Exhibit 5-8*	$1.3	$2.6	$3.5	$3.5
Net additional revenues		$5.4	$6.2	$4.9	$2.8
Revenue ÷ expenditure ratio[1]		**5.2**	**3.4**	**2.4**	**1.8**

1 New revenues divided by new expenditures. Calculated where denominator (additional expenses) exceeds zero.

2 Excludes potential income taxes from any operating entities and GET on ground lease rents.

Appendix O

Kaloko Makai Social Impact Assessment
John M. Knox & Associates, Inc.
June 2011

J•M•K JOHN M. KNOX & ASSOCIATES, INC.

KALOKO MAKAI SOCIAL IMPACT ASSESSMENT

Volume 1: Background and Community Issues

May 3, 2011

Prepared for:
Stanford Carr Development, LLC.

Prepared by:
John M. Knox & Associates, Inc.

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FOREWORD

John M. Knox & Associates was engaged to prepare a social impact assessment of the proposed Kaloko Makai mixed-use commercial and residential development in Kona. In accord with Kona Community Plan principles of providing housing choices, recreation opportunities, directing growth patterns towards compact villages and encouraging a diverse and vibrant economy, Stanford Carr Development proposes a 1,142-acre development with a strong emphasis on residential development.

The work is presented in three volumes:

1. The current Volume 1 presents background socio-economic conditions and results of a community interview process to surface key issues.
2. Volume 2 is an analysis of housing issues, largely prepared by subcontractor Tom Dinell (Dinell Associates). Mr. Dinell is Emeritus Professor in the University of Hawai'i Mānoa's Dept. of Urban and Regional Planning, teaching courses on housing there.
3. Volume 3 contains results of a 2009 "North Kona Community Planning Survey" that focused on awareness of the new Kona Community Development Plan (CDP) and extent of agreement with key element relevant to the proposed project.

We should note that elements of the project evolved as our studies were completed. Two potential components ***not addressed*** were:

- A possible State Judiciary complex on the project site – because Kaloko Makai was one of 11 potential sites at the time Vol. 1 community interviews were done, we elected not to discuss it because of what seemed its low probability. As of this writing, Kaloko Makai is still one of six remaining sites under consideration.
- A possible small (120-unit) hotel to help serve the proposed hospital, as well as the Judiciary complex if it materializes.

Additionally, other aspects of project planning – such as tentative phasing and changes to road alignments – have continued to evolve during and after the community interview process. Interviewees were given a Project Description (Appendix B) that was less specific than plans available as of this writing (May 2011) and also showed more industrial land than is now planned.

SUMMARY AND ANALYSIS OF VOLUME 1 RESULTS

A. Background Conditions

The report provides extensive description of existing and projected socio-economic conditions for West Hawai'i (defined as North and South Kona, as well as South Kohala) using secondary data such as the U.S. Census and public opinion surveys. At least three broad conclusions can be derived from this analysis –

(1) West Hawai'i is now, and is projected to continue as, Hawai'i Island's economic engine. Most of the island's private-sector businesses and jobs are now located there, and the clear trend is for further development. Housing options will be needed so that Kona residents can live and work in the same place.

(2) Historically, the island has undergone sharp cycles in its economy. The economy briefly avoided its usual mid-decade downturn, resulting in a virtually unprecedented full decade of steady economic growth – growth associated in opinion polls with resident complaints about cost of housing, traffic, and perceived government failure to assure that infrastructure keeps up with growth. However, the Great Recession thereafter hit West Hawai'i and other Neighbor Island resorts particularly hard.

(3) Socially and demographically (and arguably architecturally), West Hawai'i is looking more and more like California, especially with the recent boom in vacation home development. However, Native Hawaiians comprise the area's second-largest ethnic group. The West Hawai'i region is important in Native Hawaiian history, and vice-versa. While the nature of this project mostly does not lend itself to any particular cultural flavor, the possible preservation and reinvigoration of the historic Kohanaiki ("Road to the Sea") Trail is an important exception.

B. Community Issues and Perceived Impacts

Approximately 30 community leaders or other stakeholders were interviewed in November 2010 and February 2011 in order to surface issues and concerns regarding the proposed project. This type of process does not comprise the sort of representative cross-sample of the community as the telephone survey discussed in Volume 3, but does allow for more in-depth discussion and probing of perceptions.

1. Consultant Comments on Context of Interviews: The West Hawai'i community has been whip-sawed by the recent cycle of extremely rapid prolonged growth, followed by a deep (and also prolonged) economic downturn. Some people remain very focused on the historical challenges posed by rapid growth, and assume that any new proposal will trigger those same challenges. However, we also encountered a strain of economic anxiety and concern about the future – a fear that some mix of structural economic change and worsening air quality (i.e., vog) may permanently affect the area's

prospects – that we never came across in our previous three decades of social impact interviews there. In the mid-2000's, there was a desire for "growth-absorbing" projects that would provide housing and needed community amenities (which is essentially what the Kaloko Makai proposal does), as opposed to "growth-inducing" economic development. Now, some people asked, "Can't this project include even more jobs?"

At either end of this spectrum are people who look at a proposed large new mixed-use residential development with limited enthusiasm – the first out of apprehension that "If you build it, they will come," and the second out of the opposite apprehension that nobody at all will be coming to buy these units. The first group is inclined to oppose the project (or any others that would either cause or reflect further growth), while the second is not so much opposed as uncertain of need. Both groups were minorities among our particular interviewees – with more people in the middle – but they illustrate the varying shades of impact on attitudes from the sustained economic downturn.

Beyond the immediate economic situation, it is important to understand two key pieces of historical context:

1. There have been several decades in which rapid growth has outstripped the provision of key infrastructure – particularly roads, but also things like schools, parks, water/wastewater treatment, and even sufficient housing for local residents because much of the growth has been focused on resorts and resort-type housing.

   This has generated ***substantial distrust***, not only of developers but also (and sometimes more so) of State and County government agencies seen as failing to provide that infrastructure and/or failing to enforce conditions imposed on developers. This distrust manifests itself in many ways – different ways for different people – but one of those ways is to care more about nailing down infrastructure considerations than almost anything else, including housing affordability. (Again, there tends to be some suspicion that proposed housing developments will really <u>be</u> "affordable" to any significant part of the resident population.)

   For example, some interviewees for this project felt the developer should be required to construct and/or pay for – not just partner with other entities to assure provision of – elements such as the project's link for the Ane Keohokalole ("Mid-Level") Highway, the proposed hospital, and actual school structures, despite possible impacts on housing prices. A project such as the proposed Kaloko Makai development will therefore need to spend particular time explaining its market assumptions and underlying financial structure to a skeptical community that includes many people at least moderately familiar with real estate development.

2. In an attempt to remedy past problems, many of the community's most active members have been involved in creating and/or overseeing implementation of the Kona Community Development Plan (CDP). As one of the first major proposed developments under the new Kona CDP, Kaloko Makai has begun to receive scrutiny as to Plan compliance – especially because its planning consultant (the Wilson Okamoto Corporation) was also the prime consultant for the Kona CDP.

One key element of scrutiny involves the proposed hospital. The Kaloko Makai area is currently designated on the CDP as a "Neighborhood Transit-Oriented Development (TOD) Center," which would not permit the extent of development being proposed. However, the CDP also says a Neighborhood TOD Center will "automatically" be granted "Regional Center" status, permitting higher densities and more development, if a new full-service hospital is included. Therefore, the development team can expect pointed questions about the certainty and exact timing of the hospital. Also, because there have been other proposed new medical facilities (not all of them full-service hospitals), it will likely be critical for the developer to show not only that Kaloko Makai's hospital will likely be the first or the only actually to materialize, but also that it is still filling a vital community need.

Beyond the hospital, the development team will need to respond to questions from the community that more typically come from local government planners – detailed aspects of urban design, green spaces, exact placement of transit stops, etc. These were not necessarily the most important issues for the bulk of our interviewees, but the fact that key community leaders have invested so much time and attention in them means their importance is more likely to grow than to diminish.

2. Response to Overall Plan: Interviewees were excited, or at least cautiously optimistic, about many of the proposal's specific components. ***Most interviewees spoke to possible changes to the current proposal, instead of discounting or rejecting the entire plan.*** That is, they did not simply take a stand for or against the Project, but offered meaningful insight into how some of its components could be adjusted or changed to make it fit into the area, or be more suitable to area residents. The majority of our particular interviewees felt it made more sense to plan for growth than to resist it.

The ***most frequent concerns*** expressed about the plan in general were:

1. As noted above, conformity to the Kona CDP – Regional versus Neighborhood TOD Center status and other urban design specifics.

2. Scale of the project (5,000 units) permitted under the "Regional Center" designation. Even though people intellectually recognized the proposal envisions a 30-year buildout, the visceral impact of "5,000 units" was difficult for many people to absorb.

Things that people tended to like most about the project included:

1. Possible economic contributions – i.e., 30 years' worth of construction jobs, plus work at the hospital and retail areas, as well as a greater tax base.

2. Infrastructure improvements, most particularly another extension to the needed Mid-Level Road.

3. Green space – the unique 150-acre dryland forest preserve and the restoration and integration of the Kohanaiki "Road to the Sea" Trail.

3. Issues About (Other) Specific Plan Elements:

Residential Housing: Despite concerns about project size, there was substantial agreement that housing is needed (in the future if not immediately), and employers in particular welcomed a prospective large addition to supply. The great concern was, "Will this really be affordable?" One of the most recurring themes in the interviews was the feeling that County guidelines for the "affordable" definition did not seem to produce enough housing that workers in West Hawai'i's core service industry can really afford. Related to this was the suggestion of inequity in housing development – provision of housing for off-islanders rather than "local" people.

Phasing: Though a detailed phasing plan was not available at the time of the interviews, most people approved the general information then provided – i.e., the project would begin with key infrastructure and with industrial/commercial property along Queen Ka'ahumanu Highway. There was, of course, concern that infrastructure would actually materialize on time as proposed.

Hospital: Again, there were questions as to whether and when this would actually materialize (and some feeling there could be competition unforeseen when the Kona CDP was finalized). However, almost everyone agreed the current hospital in South Kona is inadequate for both present and future needs. And some people urged that the hospital have more of an economic development – e.g., include a medical research component and/or be a specialty hospital drawing in off-island clientele.

Roads and Infrastructure: Again, the plans generally seemed good to people, and the Mid-Level Road was seen as vital. The question was whether and when the plans would be carried out. There were some specific concerns about exact road alignments and a desire for more information about water/wastewater facilities.

Retail/Commercial Component: The location of the bulk of such activity on Queen Ka'ahumanu Highway, by the existing Kaloko Industrial Park, seemed appropriate to most people. There were questions about the extent of demand for the amount of land initially planned by the developer (since scaled back) and some concern about impacts on local groundwater and coastal waters.

Schools: Most people approved the proposed one middle-school and two elementary school sites. Some people so distrusted government follow-through on building the structures in a timely way that they thought the developer should build those.

Trails, Parks, and Open Space: While the dryland forest was seen as a particularly valued project amenity, there was a strong desire for most project green areas to be useable by the community, not just passive open space. The Road to the Sea trail was also seen as a highly desirable characteristic, though there was a feeling by trail stakeholders that more work needs to be done to locate and define the actual historic trail alignment. (There had been some issues on this matter in regard to Stanford Carr Development's Kaloko Heights project; stakeholders said the current project is at least starting out in a much more positive way, with greater consultation.)

4. Kaloko-Honokōhau National Historical Park: The northern part of the Kaloko-Honokōhau National Historical Park is located directly across Queen Ka'ahumanu Highway makai of the Project site. It is likely the most sensitive "neighbor" to the proposed project, and therefore we made the effort to interview National Park Service (NPS) officials. For the most part, the NPS interviewees directed us to their letter in response to the project's Environmental Impact Statement Preparation Notice, and so Table 3.5 of this report summarizes issues raised in that latter – primarily physical environmental impacts but also concerns about cultural resources, connectivity to the Park through the Road to the Sea Trail, and cumulative impacts on Park resources.

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1. INTRODUCTION

1.1 Purpose and Scope of Report

This report is an assessment of potential social impacts of the proposed "Kaloko Makai" project in the Kealakehe ahupua'a of North Kona, County of Hawai'i. It has been prepared for the project developer – Stanford Carr Development LLC. – and is intended to be an appendix to the project Environmental Impact Statement (EIS) being prepared for Stanford Car Development LLC by Wilson Okamoto Corporation.

Social impact assessments are made in order to identify and disclose information of use to decision makers and citizens, as they evaluate the implications of proposed development. Because the "social" realm is extensive and not precisely defined, assessments typically contain substantial attention to community issues and perceptions, in addition to consultant analyses of selected issues.

The report consists of three chapters:

(1) The current Chapter 1 contains introductory material;

(2) Chapter 2 presents data on historic, existing, and anticipated future socio-economic conditions in the West Hawai'i study area.

(3) Chapter 3 – in many ways the heart of this study – reports on issues and concerns about the project itself.

1.2 Project Description

The project is described at length in the overall EIS. Briefly –

Size and Location: About 1,142 acres, extending mauka from Queen Ka'ahumanu Highway. The Queen Ka'ahumanu portion is located just north of the existing Kaloko Industrial Park. Hina Lani St. forms the southern (Kailua-side) border of the lower part of the property, but the upper part includes land on both sides of Hina Lani.

Current Use and Land Use Designations: Vacant and undeveloped. County General Plan – Urban Expansion and Conservation. Keāhole to Kailua Development Plan – Urban Expansion, Residential Village, and Golf Course. (*The current General Plan "Conservation" designation was for a once-planned golf course that would be deleted under the new plan; the developer will ask the County for Urban designation of the former golf course land after State Land Use approval.*) Kona Community Development

Plan (CDP) indicates the general Kaloko Makai area as one of the designated "villages" for transit-oriented development.

State Land Use now Conservation, Agricultural, and Urban – request is to change about 224.5 acres from Conservation to Urban and 728 acres from Agricultural to Urban. (The State Urban designation would follow the County's Kona CDP designation as an urban area.) A 150-acre dryland forest preserve will be created. An EIS is being prepared.

Development Concept/Phasing: Consistent with the Kona CDP, Master-planned residential community, with supporting commercial, educational, recreational, open space, and related infrastructure. Primarily a residential development, with some business/commercial job centers. To be developed in three phases (or "villages") over an estimated 28 years. First homes by 2015.

Key Components:

- Residential - At full development about 5,000 new single- and multi-family residential units at low (up to 3 units per acre) and medium (up to 20 units per acre) densities.
- Commercial – About 120 acres in various locations. Largest would be a business park that may potentially include Scientific Research & Development facilities, retail, and a regional hospital along the Mid-Level Road. Mixed-use areas of the project are designed to include residential and commercial uses within close proximity of each other (this may include affordable residential on top of a variable commercial component).
- Preservation / Open Space / Recreation – In addition to the dryland forest (150 acres of preserved forest and natural habitat), the project will preserve a historic trail which is commonly referred to as the *Road to the Sea*. While the boundaries of this trail (within the Kaloko Makai property) have yet been determined, it is evident that the trail originates in the mid-section of the property just east (makai) of Kaloko Makai (in the site, properly named Kaloko Heights) and meanders down through the KM parcel. A series of archaeological outcroppings have also been noted in the Archaeological Inventory Report. Depending on the nature of each archaeological site buffer zones will be provided accordingly.
- Facilities and Roads – Land set aside for elementary and middle schools. Active parks and recreation areas. The proposed Mid-Level Road would cut across the project.

Estimated Housing Prices and Types *(Current Developer Assumptions)*:

- "Affordable" Component – Will be 20% of units (about 1,000), targeting residents with income levels between 60%-140% of area median income. Based on 2007 HUD numbers, that would include at least some units for rental to 3-person low-

income families at $972/month and for sale at $152,600 (2007 numbers). Final mix of affordable not yet known.

- Market Component – A wide range of products, in today's dollars from mid to high $200,000's up to $1,000,000. The target market is the local rather than the offshore buyer. Overall, the project is intended to respond to already-planned economic growth rather to generate more of it.

2. EXISTING AND ANTICIPATED FUTURE SOCIO-ECONOMIC CONDITIONS

This section provides background description of the overall area assumed to be affected by potential project development – the "study area" – and projected changes occurring with or without the project. Covered in this section are:

- Definition of the "study area;"
- Overview of population and settlement patterns;
- Demographic and social characteristics;
- Business characteristics and tourism growth;
- Workforce, labor supply and income; and
- General community issues and attitudes.

2.1 Definition of Study Area

We consider the *primary* Study Area to be the district of North Kona, which is equivalent to the U.S. Census Bureau's "County Census Division" (CCD) of North Kona. The *overall* Study Area – "West Hawai'i" – would also include the CCDs of South Kona and South Kohala.[1] (See Figure 2.1), which also shows the general location of the Kaloko Makai project in North Kona.)

Within North Kona, the 2000 Census has data for five "Census Designated Places" (CDPs) – Kalaoa, Kailua, Hōlualoa, Kahalu'u-Keauhou, and Honalo. Figure 2.1 shows the location of those CDPs within the North Kona CCD.[2] As of 2000, the Census found that North Kona's total population (28,543) was distributed as follows – 24% in Kalaoa, 35% in Kailua, 21% in Hōlualoa, 7% in Honalo, 8% in Kahalu'u-Keauhou, and just 5% in the mauka areas above the five CDPs.

Some data in this section are presented by ZIP Code areas. Figure 2.2 indicates we will be particularly interested in the Kailua ZIP 96740 (as it includes the project area), but the overall "West Hawai'i" study area also includes the Kamuela, Waikoloa, Hōlualoa, Kealakekua, and Hōnaunau ZIPs.

[1] Between 1990 and 2000, the U.S. Census Bureau made some very minor boundary adjustments among the West Hawai'i CCDs. We ignore those changes when comparing historical data from the Census – i.e., we compare 1990 and 2000 populations for "North Kona" despite the slightly changed definition of the area.

[2] There are also Census Designated Places in South Kona and South Kohala, but we will focus on those closest to the project site – i.e., in North Kona.

Figure 2.1 West Hawai'i Study Area (Census Boundaries)

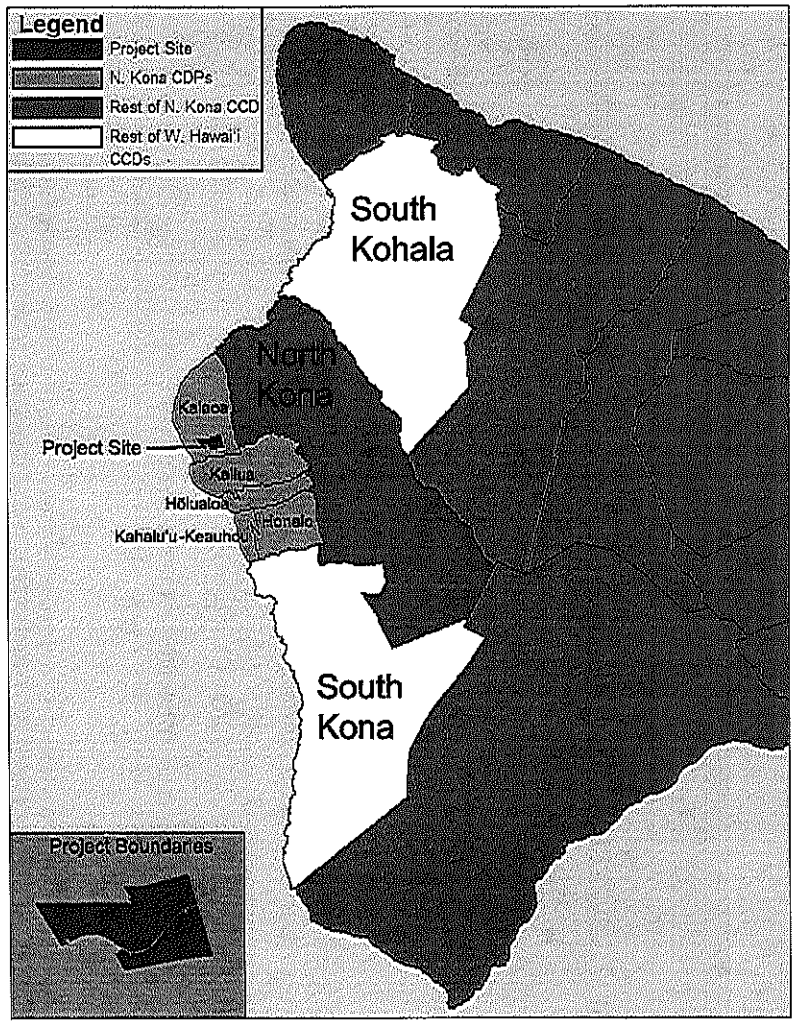
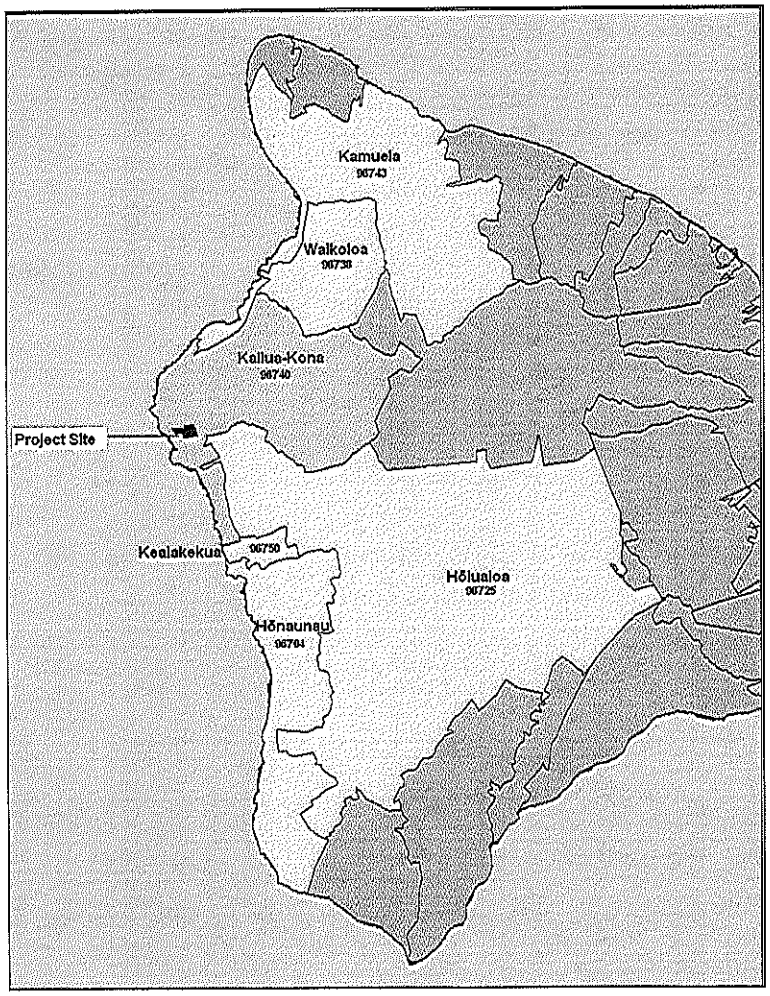


Figure 2.2 West Hawai'i Study Area (ZIP Code Boundaries)



2.2 Overview of Population and Settlement Patterns

2.2.1 Early History

The Kaloko-Makai project area is characterized by lava rock, dry scrub brush and large expanses of volcanic soil; the area shows no evidence of human settlement. There is evidence, however, that a trail to the sea, an ancient and often used transportation route, did pass through the project area[3]. Evidence of a Hawaiian fishing village makai of the project area, in Kaloko-Honokōhau, is to be found in the complex stone infrastructure in the area developed by the ancient Hawaiians. It is believed the area was a village at the time of the first known historic contact with Europeans, when Captain James Cook visited Kealakekua Bay in 1776. Later, nearby Kailua – a few miles to the south – became a part-time residence for Kamehameha I, Hawai'i's first ruling king, and for a time the area served as the capital of a newly-united nation of Hawai'i.

After the death of Kamehameha I, Kona lapsed into a period of diminished political and economic significance. Because the land in Kona is hilly and divided between dry coastal areas and steep hillsides, it did not lend itself to the sugar plantation agriculture or large-scale ranching that developed in other more prosperous areas of the island during the 19th century. In North and South Kona, most towns were small villages situated at least 1,000 feet up the slopes of Mauna Loa or Hualālai where rainfall was adequate to support coffee or other diversified agriculture. For many years, coffee and beef prices were low, and the area remained mostly rural. The political, economic, and population centers concentrated mostly in Hilo on the other side of Hawai'i Island.

A few small villages were located along the dry coast line of West Hawai'i. Kailua became a center for tourism, with particular emphasis on big-game fishing. However, most civic facilities were located mauka and south of Kailua, where they still remain.

Over the past several decades, tourism-driven economic development and extensive in-migration have precipitated an urban expansion that has altered the rural character of West Hawai'i. By 2000, the U.S. Census Bureau estimated that only about one-third of West Hawai'i's population still lived in "rural" areas, and two-thirds in "urban clusters." North Kona has become particularly urbanized, with only 22% of its population still living in areas considered "rural."

[3] According to the EISPN (Wilson Okamoto, 2010), "Significant archaeological and cultural sites, which include historic trails, will be integrated into the land plan. Archaeological and cultural sites will be protected and maintained with appropriate treatment and buffers from adjacent uses as necessary".

2.2.2 Population Levels Over Time

Figure 2.3 and Figure 2.4 on the following page provide a 120-year perspective on population growth in the county and West Hawai'i. It may be seen that an islandwide population decline after 1940 was suddenly and dramatically reversed from 1970 on, and also that West Hawai'i has been increasing as a percentage of islandwide totals. These figures are based on full-time residents only, excluding part-time residents or visitors staying in transient accommodations.

In 2000, the North Kona residential population was 28,453, and the total West Hawai'i Study Area population was 50,173. In 2010, the North Kona population reached 37,875, and the total West Hawai'i Study Area population was 65,499 –or 35.4% of the countywide population, up from 33.7% in 2000. Thus, West Hawai'i population growth in the past 20 years exceeded population growth for the rest of the county, although not as dramatically as it did from 1970 to 1990. See Figure 2.3 and Figure 2.4 on following page.

2.2.3 In-Migration

The county's population build-up during the 1990s occurred in the face of a general statewide economic slowdown. County planners hypothesized that in-migration into the County was taking place for reasons not driven by opportunities in the primary economic sectors on the island (i.e., agriculture and tourism) but was due to individuals seeking a clean environment and a rural lifestyle.[4] From 1990 to 2000, 63% of Hawai'i County's population increase was due to net in-migration, a higher percentage than for any other county. From 2000 to 2009, it was 72%, again highest of all counties.[5]

Census data for 2010 are not yet available on this topic, but earlier Census data indicate the percentage of residents born outside the state of Hawai'i rose from 39.5% in 1980 to 48.9% in 2000 for West Hawai'i (and to more than half, 51.7%, for North Kona in 2000). Comparable percentages for the rest of the county were 25.9% in 1980 and 31.0% in 2000. Thus, in-migration has clearly been funneled into West Hawai'i – North Kona in particular – more so than into the rest of the county.

More recent Census data show that Hawai'i Island's population grew faster than any other Hawai'i county from 2000 to 2010. While the statewide population grew 12.3% and the City and County of Honolulu's population grew just 8.8%, Hawai'i County's resident population grew around 24.5%.[6] This was in excess of Maui County's 20.8% growth and far ahead of Kaua'i's 14.8%.

[4] *County of Hawai'i General Plan*, February 2005, p. 1-13. However, part of the continued residential population build-up is also likely attributable to secondary economic sectors being developed and playing "catch-up" in the years following intense resort construction.

[5] *Hawai'i State Data Book 2009*, Table 1.60.

[6] U.S. Census Bureau figures posted as Table 1 on Hawai'i State Data Center website, http://Hawai'i.gov/dbedt/info/census/Census_2010/PL94-171/index_html.

Figure 2.3 County and Area Populations, 1890 – 2010

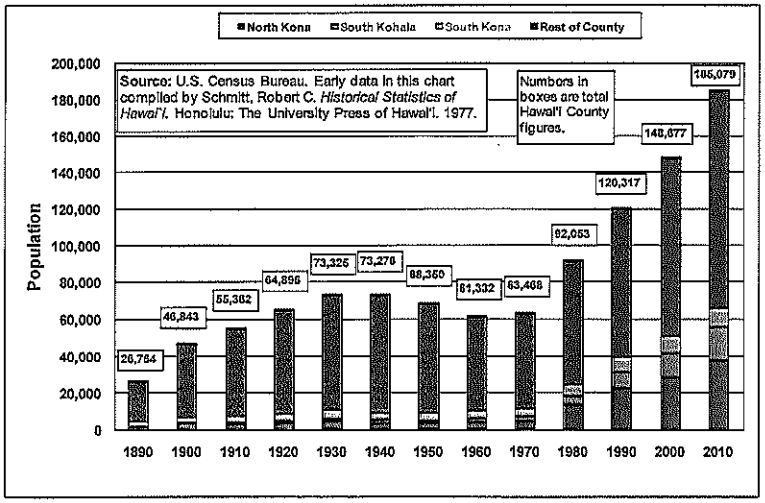
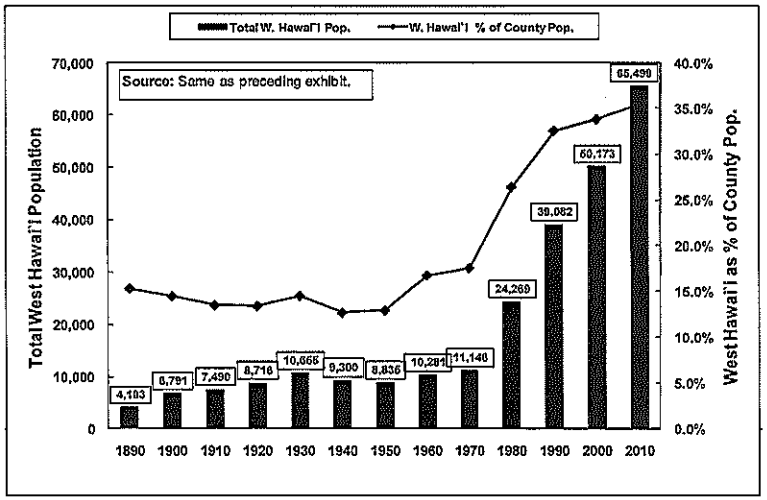


Figure 2.4 West Hawai'i Population Relative to County, 1890 – 2010



2.2.4 Housing Prices and Affordability

Housing prices in Kona have long been considered difficult for the average resident to afford, in some part because a substantial amount of new development has been targeted to the affluent off-island second-home or retiree market, with limited new supply for the actual on-island resident workforce. The Great Recession has brought down prices – particularly limiting West Hawai'i's off-island market – but also put the brakes on residential demand as well.

Figure 2.5 shows historical data from 1990 through the beginning of the recession on median prices and number of sales ("volume") for West Hawai'i vs. the nation as a whole. The median price in North Kona (including the resort-residential homes) has generally been about three times the national average. Sales volume actually started dropping before the recession but prices remained high until the recession hit, and thereafter have not dropped as rapidly as volume.

Figure 2.6 plots the same median prices against an index of "affordability" – median resale housing payments as a percentage of median family income. It shows (a) how much less affordable West Hawai'i homes have generally been than has been true for the island as a whole and the nation as a whole, and (b) the tremendous swings in housing affordability over time, with economic "good times" associated with far higher peaks in unaffordability for West Hawai'i and Hawai'i Island generally than has been true for the country as a whole.

More recently, the Kona region has ranked high among areas in the state for foreclosures.[7] Hawai'i itself was reported to be tenth in the nation in terms of number of foreclosures in February 2011. Of the 953 properties for which foreclosures were filed in February 2011, 270 were on Hawai'i Island and 92 of those were described by national consultant RealtyTrac as being in the Kailua Kona area.

Sales activity and selling prices appear to be recovering in the Kona area based on March 2011 data, though it is always advisable to use caution in predicting trends based on limited data.[8] There were 33 single family home sales in February 2011 compared to 21 a year ago, and the median price rose to $430,000 from $417,000 in February 2010. Condo sales in North Kona, however, indicated a different trend: 23 sales this year compared to 24 a year ago and a median price this past March of $149,000 compared to $247,000 last February. The condos sold this year may have been a very different class of units than those sold last year. Again, these data make no distinction between off-shore buyers and speculators, on the one hand, and local residents on the other.

In summary, it appears the real estate market in Kailua area may be close to bottoming out, but (1) recovery will be slow; and (2) housing affordable to most residents will continue to be a challenge.

[7] Magin, J.L. 2011. "Hawai'i's Foreclosure Rate Down Slightly." *Pacific Business News*, March 10, 2011, based on data from RealtyTrac. http://www.bizjournals.com/pacific/blog/2011/03/hawaiis-foreclosure-rate-gets-a.html.

[8] Andrew Gomes, 2011. "Big Isle and Kaua'i Home Sales Soar." *Honolulu Star-Advertiser*, March 8, 2011. http://www.staradvertiser.com/business/20110308_Big_Isle_and_Kauai_home_sales_soar.html.

Figure 2.5 Nationwide vs. West Hawai'i Price and Sales Volume, 1991 to Mid 2008

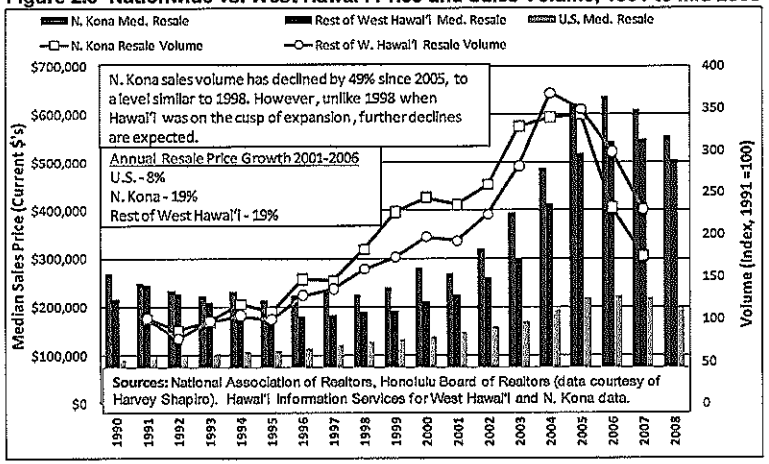
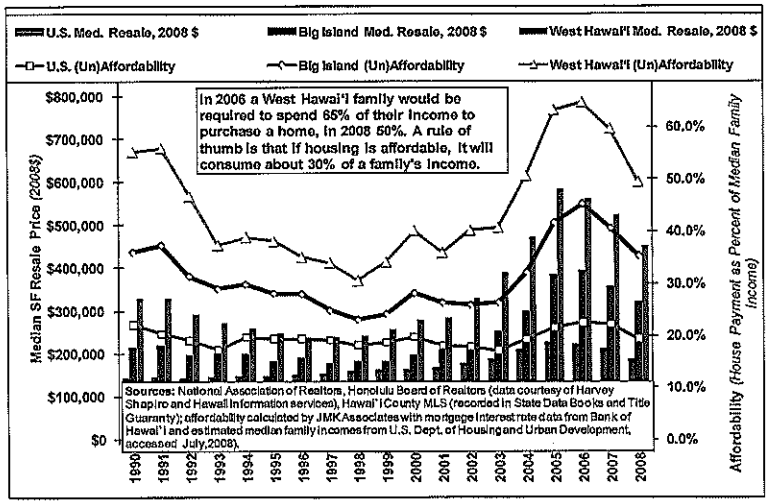


Figure 2.6 Nationwide vs. Hawai'i County vs. West Hawai'i Single-Family Home Resale Values and Affordability Levels, 1991 to Mid 2008



2.2.5 Population Forecasts

Table 2.1 provides three alternative residential population forecasts developed by the County of Hawai'i, while Figure 2.7 reflects forecasts generated by the Hawai'i State Department of Business, Economic Development, and Tourism (DBEDT). The State DBEDT numbers are for the overall island, not West Hawai'i alone. Economic growth is expected to be primarily in West Hawai'i, but actual population growth there will depend in large part on housing supply. As of 2009, the actual islandwide population was most consistent with the highest of the three alternative County forecasts, which assumes a growth rate more similar to the boom years of 1975-90 than to the slower average rate since 1990. However, in the future, the State's projected islandwide population is closer to the lower County forecast figures.

The County's *General Plan* is the one document that does hazard estimates of future resident populations by districts, though percentages are the same for the three different series of projections – i.e., 37% for West Hawai'i (see Table 2.1 below). This percentage is reasonably consistent with historical trends since 1980 (see Figure 2.4) but less consistent with trends for recent job growth located almost entirely in West Hawai'i (see later Table 2.6 and Figure 2.10.). The *General Plan* population forecasts for West Hawai'i therefore implicitly assume (although perhaps inadvertently) continued housing shortages and commuting into West Hawai'i.[9]

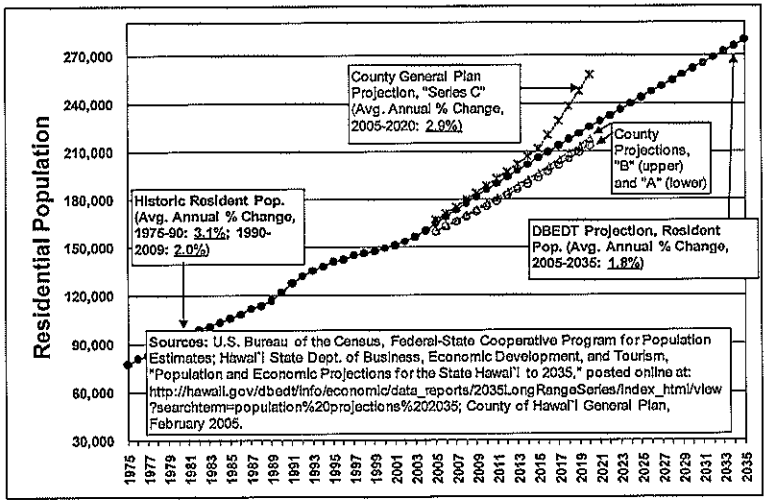
Table 2.1 Projected 2020 Resident Population, West Hawai'i and Total County

		Series A	Series B	Series C
North Kona	No.:	41,447	42,275	46,082
	% of total:	*19%*	*19%*	*19%*
South Kohala	No.:	23,947	24,426	26,625
	% of total:	*11%*	*11%*	*11%*
South Kona	No.:	13,816	14,092	15,361
	% of total:	*6%*	*6%*	*6%*
West Hawai'i	No.:	79,210	80,793	88,068
	% of total:	*37%*	*37%*	*37%*
Rest of County	No.:	134,242	136,925	149,255
	% of total:	*63%*	*63%*	*63%*
Hawai'i County Total		213,452	217,718	237,323

Source: *County of Hawai'i General Plan*, P. 1-17

[9] This is not to say the General Plan "calls for" or "builds in" housing shortages -- just that its assumed West Hawai'i population does not mesh with other evidence about probable job growth and so could be accurate only if new housing supply does not match new employment supply.

Figure 2.7 Historic Vs. Projected Hawai'i Island Resident Population



2.3 Demographic and Social Characteristics

2.3.1 Race/Ethnicity

With increased in-migration, it is generally believed that the West Hawai'i area is becoming more "White" (Caucasian) over time. However, changes in the U.S. Census wording of its question about race/ethnicity make it difficult to compare 2000 results with those of previous decades. Within the 2000 results (Table 2.2)[10] though, it may be observed that Whites are definitely more numerous in West Hawai'i, particularly in North Kona ... and also that Native Hawaiians represent the second largest ethnic group.

[10] The 2010 Census has results for "Native Hawaiian and Pacific Islanders Only," but does not presently allow breakout of mixed-race people who reported some Native Hawaiian.

This is also true for the averaged 2005-09 American Community Survey (ACS) census results, some of which are presented later. The ACS has replaced the old decennial "long-form" survey, so the 2010 Census gives results for only a few items, such as population and broad race categories. In areas such as North Kona, the ACS sample size for any one year is too small to permit reliable results, so the Census releases these only in rolling five-year averages. The averaged 2005-09 numbers are the first and, as of this writing, only such averaged numbers to be releases, but more will be forthcoming.

Table 2.2 Year 2000 Race/Ethnicity Characteristics, West Hawai'i and County

	% White Only	% Native Hawaiian*	% All Other	Total
North Kona	47.3%	25.0%	27.7%	100.0%
South Kohala	38.8%	31.3%	29.9%	100.0%
South Kona	34.1%	30.8%	35.1%	100.0%
Total W. Hawai'i	42.8%	27.7%	29.5%	100.0%
Rest of County	25.8%	29.6%	44.6%	100.0%
County of Hawai'i	31.5%	28.9%	39.5%	100.0%

* Alone or in combination with other races.

Source: U.S. Census 2000, Summary File 2

2.3.2 Age, Education, and Family Structure

As with the rest of the state and nation, West Hawai'i residents are becoming older and more educated, on average. Over the years, the educational level has increased somewhat more rapidly in West Hawai'i than in the rest of the county.

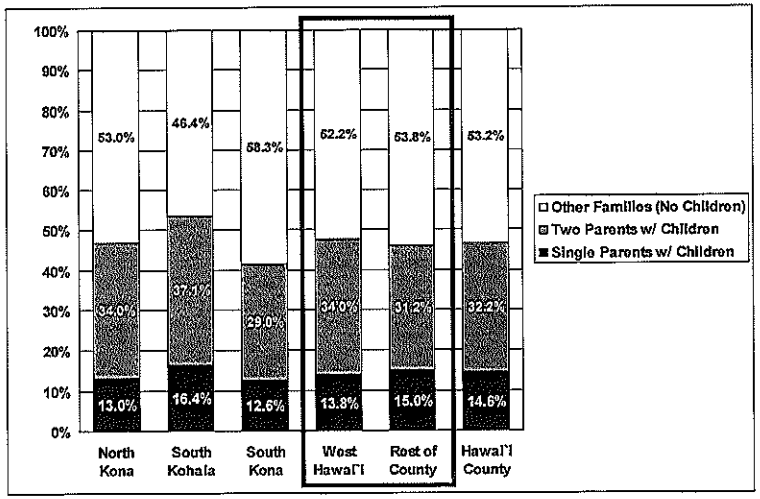
Table 2.3 Age and Education, West Hawai'i and County, 1970 – 2005-09

	Median Age (in Years)					% Pop. 25+ with B.A. or Higher				
	1970	1980	1990	2000	2005-2009	1970	1980	1990	2000	2005-2009
North Kona	28.6	28.4	34.7	39.4	40.3	8.8%	18.8%	20.5%	24.7%	27.5%
South Kohala	28.1	28.9	32.1	36.2	36.7	13.1%	20.7%	26.2%	27.4%	31.1%
South Kona	29.7	29.1	34.6	41.2	45.1	6.3%	12.5%	20.3%	22.5%	24.8%
Total W. Hawai'i	N/A	N/A	N/A	N/A	N/A	8.8%	17.7%	21.8%	25.0%	28.1%
Rest of County	N/A	N/A	N/A	N/A	N/A	8.8%	14.3%	16.9%	20.6%	25.1%
County of Hawai'i	25.0	29.2	34.3	38.6	39.4	8.8%	15.2%	18.5%	22.1%	26.2%

Source: U.S. Census Bureau, Summary File 1, 1970, 1980, 1990, 2000; American Community Survey, 2005-09 averaged data

As the population has aged, the percentage of all households consisting of families has declined (from 74% islandwide and 72% in West Hawai'i as of 1990, to 70% both islandwide and in West Hawai'i as of 2000, and to about 68.5% both islandwide and in West Hawai'i as of the 2005-09 ACS). The percentage of all families with children is dropping, and the percentage of children in single-parent households is rising. As of the 2005-09 ACS, family structure was roughly the same in West Hawai'i as the rest of the county, though South Kohala was notable for having fewer families with children (Figure 2.8).

Figure 2.8 Family Structure, West Hawai'i and County, 2005-09 Average



2.3.3 Other Social Characteristics

The 2000 Census found about 10% of the population (both in West Hawai'i and the rest of the county) was foreign-born. Roughly one-fourth of the households in both parts of the island spoke a non-English language at home – primarily Asian and Pacific languages (e.g., Hawaiian or Filipino dialects) rather than Spanish (spoken by just 3.4% of West Hawai'i households, despite widespread awareness of scattered Mexican in-migrants in recent years).

Additionally, the University of Hawai'i's Center on the Family (COF) prepared a summary of social and educational indicators available in the early 2000s for various communities as defined by public high schools covering those areas. Table 2.4 gives descriptions of three areas roughly comparable to "West Hawai'i" as discussed in this report:

Table 2.4 Summary of Social and Educational Community Indicators

North Kona (Keālakehe School Complex)	South Kohala and Hāmākua (Honoka'a School Complex)	South Kona (Kona Waena School Complex)
This community has one of the lowest proportions of unemployed in the State, and the per capita income is just above the State average. Residential stability, however, is lower than in most communities, with fewer than half of the people who live in the North Kona Area having been born in the islands. The child abuse rate is double the State average and the percentage of "idle teens" (not in school and not working) is higher than in most of the communities Statewide. In a Statewide survey of 6th, 8th, 10th, and 12th graders, more than half of the adolescents responding in the North Kona Area reported a lack of interest in school, which is evident in a graduation rate that is lower than in most communities. Despite these problems, the data for other indicators of child and family well being in this area are more positive. The North Kona Area ranks in the upper third of communities for adults who hold a high school diploma or a college degree. The community has the third-highest number of public school teachers with advanced degrees. In addition, more than half of the adolescents responding to the student survey reported close family ties.	There are a number of challenges for children in the Honoka'a Area. It ranks in the lowest third for school safety (as reported by teachers, parents, and students). The percentage of 3rd graders with low SAT reading scores is higher than the State average. In a Statewide student survey, about one-half of the adolescents responding in this community reported poor parental supervision as well as a lack of interest in school. Only about two-thirds of the high school seniors in 2002 planned to attend college, a percent that is lower than the State average. However, about two-thirds of those students were accepted, a result that is above the State average. ...While Hawai'i County as a whole has a higher percentage of children living in poverty than the rest of the State, in the Honoka'a Area the child poverty rate is lower than the State average. The proportion of the population relying on the Food Stamp and Temporary Assistance to Needy Families (TANF) programs is less than elsewhere in the State and much less than Hawai'i County. Almost 60% of the adolescents responding to the student survey reported close family ties.	Although unemployment is low, the per capita income in the South Kona Area is lower than the State as a whole. The poverty rate for children under age 5 is high, and the child abuse rate is double the State average. Residential stability—the percentage of people living in the same home for more than 5 years—is higher than the County and State levels. However, teachers here rank last in the State for longevity in their current school setting, and the percentage of graduating public school seniors is one of the worst in the State. The data for other indicators of child and family well being in the South Kona Area are more positive. Most adults have a high school diploma and the percentage with a college degree is higher than the County level. The 3rd graders do slightly better on the SAT reading test than the State as a whole. Teachers in this community report one of the highest percentages of school safety, and 8th graders' reports of feeling safe at school are the best in the State. More than half of the adolescents from this area who responded to a Statewide survey of 6th, 8th, 10th, and 12th graders reported adequate parental supervision and close neighborhood and family ties.

Source: University of Hawai'i Center on the Family, http://uhfamily.Hawai'i.edu/cof_data/profiles/profiles.asp
Note: Child abuse rates mentioned here based on just one year, and these rates can fluctuate greatly.

The COF's organization of Census data by school area also indicated the West Hawai'i regions had particularly high percentages of children aged 0-5 with both parents in the workforce. North Kona was the highest, with more than 70% of young children in this situation. The county average was 63%.

2.4 Business Characteristics and Tourism

2.4.1 Overview of Private-Sector Economic Activity

While tourism and related growth has been a driving force, other economic activity also serves the population. Figure 2.9 and Figure 2.10, as well as Table 2.5, on the following pages are all based on U.S. Census "County Business Patterns" data, which provide both county-level and ZIP code information from 1994 for number/type of business establishments, number of employees, and total business payroll. Note that government jobs are not included here.

The most recent available data are from 2008, thus capturing the onset of the Great Recession. As a result of that recession, visitor arrivals fell across the state, and there were reverses in employment, payroll, and numbers of business establishments. However, the figures also show longer-term trends from 1994.

The figures (as well as some Census data not directly show in the figures) indicate:

- Hawai'i Island's economic growth from 1994 to 2008 took place almost entirely in West Hawai'i – 79% job growth in the six West Hawai'i ZIP code areas vs. 16% in the rest of the island. In 1994, 42% of the island's private-sector jobs were in West Hawai'i, including 21% in Kailua; as of 2008, these figures were 53% and 31% respectively. (However, Hilo remains the core for government.)
- The Kailua-Kona ZIP code area (which includes the project site) accounted for 60% of all West Hawai'i businesses and 55% of all West Hawai'i jobs in 2006. The Kailua growth rate has been a little greater than average for the rest of West Hawai'i.
- Overall, the Kamuela area is currently the second most important economic center in West Hawai'i, though the Waikoloa area has been growing very rapidly. In terms of percentage growth in jobs, Kamuela and Kealakekua have been growing least rapidly. The job growth rate for Hōlualoa has been particularly high since 2002.[11]
- Since 1994, adjusted for inflation, payroll per private-sector employee increased by 26% in West Hawai'i (vs. 15% in the rest of the island) and by 29% in the Kailua ZIP area. This includes some declines in payroll from 2006 to 2008.
- Employment has been growing more rapidly than the number of businesses islandwide, particularly in West Hawai'i. This suggests a structural transformation in the economy – more large business and/or expansion of existing businesses, rather than addition of many small new ones. Socially, more West Hawai'i workers are now employed by medium- or large-sized establishments, suggesting more benefits but less intensive social interactions with co-workers.

[11] A note of caution: County Business Pattern estimates are based in part on actual data, in part on economic modeling, and the modeling effects can particularly impact numbers for less populated areas such as Hōlualoa. Figures are considered best for years ending in "2" or "7," when the Economic Census is done and provides more direct data.

Figure 2.9 Growth in Business Establishments, 1994 – 2008

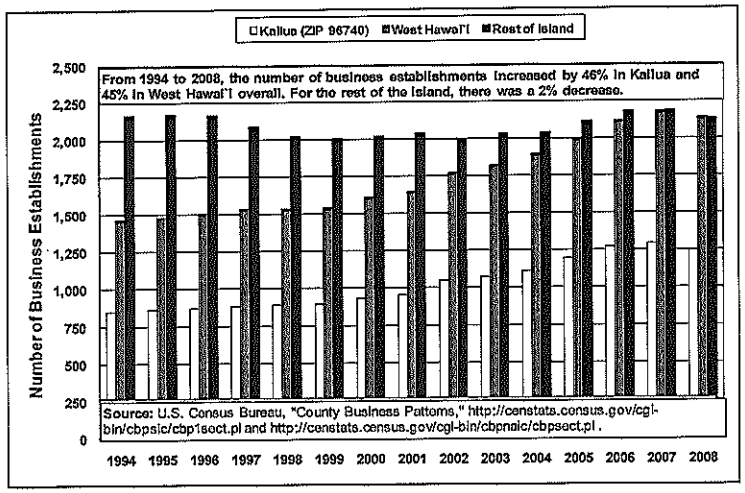


Figure 2.10 Growth in Employees and Total Annual Payroll, 1994 – 2008

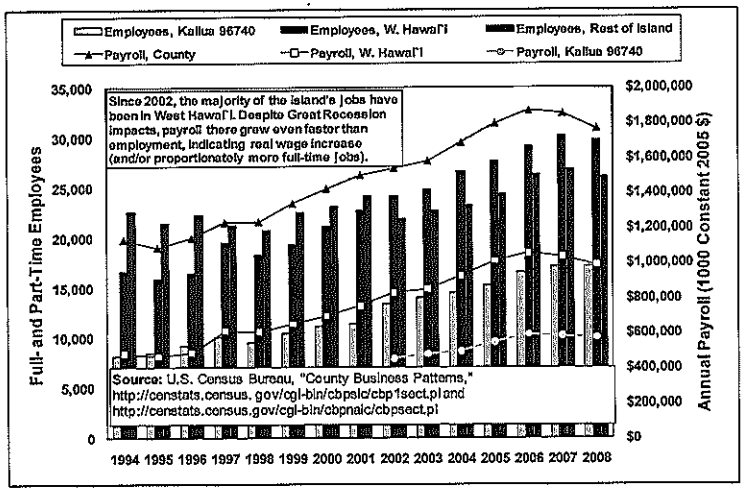


Table 2.5 Business Activity Differences by Geographical Areas

	2008 West Hawai'i Distributions and Data				Total Percentage Change, 1994-2008			
	% of West Hawai'i Total		Averages					
	No. of Businesses	No. of Full- or Part-Time Workers	Workers Per Business	Payroll Per Worker[a]	No. of Businesses	No. of Full- or Part-Time Workers	Workers Per Business	Payroll Per Worker[a]
Kamuela 96743	21%	29%	14.6	$36,963	32%	5%	-21%	21%
Waikoloa 96738	7%	7%	19.4	$40,823	274%	1112%	224%	22%
Kailua 96740	***60%***	***55%***	***13.7***	***$35,691***	***46%***	***110%***	***44%***	***29%***
Hōlualoa 96725[b]	2%	1%	4.2	$29,789	85%	107%	12%	52%
Kealakekua 96750	7%	5%	12.3	$39,425	7%	39%	30%	39%
Hōnaunau 96704[b]	3%	3%	11.1	$31,451	2%	125%	121%	13%
Total West Hawai'i	100%	100%	13.9	$33,203	45%	79%	23%	15%
Total, Rest of Island	(NA)	(NA)	12.3	$29,870	-2%	16%	18%	3%

[a] In constant 2008 dollars.

[b] Small areas (in terms of economic activity) like Holualoa and Honaunau naturally vary more over time. Thus, percentage changes could also differ more, depending on the years selected.

2.4.2 Volatility in Tourism

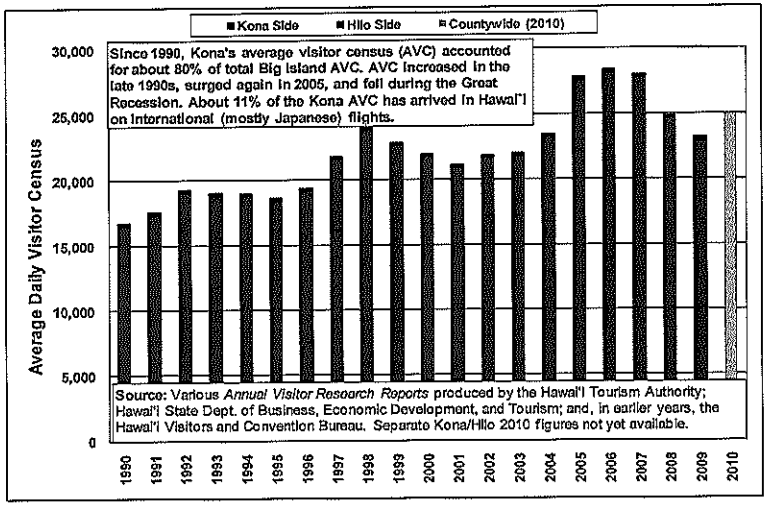
Tourism, West Hawai'i's primary industry, has a recent history of volatility. Figure 2.11on the following page shows that, since 1990, the average daily visitor census (AVC) for Kona and Hawai'i Island generally grew through 1998; dipped for a few years thereafter; surged strongly from 2001- 2006, when Hawai'i became increasingly recognized as a safe tropical destination for Americans afraid of traveling abroad; and fell sharply during the Great Recession. Kona-specific numbers are not yet available, but countywide trends were again upwards for the first part of 2010.

However, Kona tourism may suffer some further setbacks from Japan Airlines' (JAL's) decision to end direct service to Kona from Narita at the end of October 2010. This was the only flight from Japan to Hawai'i Island, and recovery in international arrivals had been the strongest component of the island's rebounding tourism numbers through August 2010. In the previous few years, Kona and the rest of the state's tourism industry were affected by the demise of Aloha Airlines and reduced cruise ship service.

On a more hopeful economic note, through August of 2010, Kona had gained about 16% additional scheduled domestic airplane seats over the previous year to date figure, which was the largest gain of any Hawai'i airport.[12] And the late 2010 addition of nonstop service from the Northwest to Kona could help soften the impact of the JAL withdrawal.

[12] State of Hawai'i Department of Business Economic Development and Tourism. Various Monthly Visitor Statistics reports.

Figure 2.11 Kona and Hawai'i Island Average Visitor Census, 1990 – August 2010



Some recovery in Hawai'i Island's (and likely Kona's) visitor industry is apparent for 2010 in terms of visitor counts, though hotels were offering discounts in order to attract visitors who were spending less as the economy continued its slow national recovery.

2.4.3 Economic Forecasts for Future

Recent economic cooling on Hawai'i Island is expected to continue through at least 2009.[13] The visitor industry faces major headwinds as does Hawai'i Island's agriculture industry.[14] The construction industry is also in decline.[15] Some Hawai'i Island industries are doing well – the Natural Energy Laboratory of Hawai'i Authority for example, is well positioned to prosper as a producer of boutique drinking water in an otherwise dreary current economic environment.

The 2005 *County of Hawai'i General Plan* – prepared by the Hawai'i County Planning Department – contains a series of three different islandwide forecasts for visitor units

[13] University of Hawai'i Economic Research Organization. County Economic Forecast, May, 2008.

[14] Honolulu Star Bulletin. *Wilting Slowly*, May 11, 2008. http://starbulletin.com/2008/05/11/news/story08.html.

[15] First Hawaiian Bank Economic Forecast for Hawai'i County, *"Hawai'i County's Growth Muted"*. Analysis by Leroy Laney. http://www.fhb.com/pdf/EconForecastBigIsland07.pdf.

and for "total visitors" (total annual count, not average daily census), though these forecasts were actually prepared in 2000 and extend only to the year 2020. All three forecasts are for about the same number of visitor units (about 11,450), though the projected number of visitors ranges from 1.5 million to 2.3 million (vs. a little under 1.3 million in 2000). The *General Plan* explicitly assumes the possibility of somewhat more growth outside the visitor industry than does the DBEDT forecast. But several of the non-tourism factors mentioned in the plan – such as a Hilo Call Center and a new State prison – now appear less likely to occur.

2.5 Workforce, Labor Supply, and Income

2.5.1 Civilian Labor Force, Unemployment, and Labor Supply

The Civilian Labor Force (CLF) consists of all prospective workers, employed or unemployed. The Hawai'i State Department of Labor and Industrial Relations (DLIR) provides estimates CLF only at county-wide levels, but the decennial Census does have figures for County Census Divisions (such as North Kona) for years ending in "0,"[16] as well as the averaged 2005-09 ACS numbers.

Table 2.6 shows Census figures since 1970. Note that, as of 2000, only about 38% of the CLF lived in West Hawai'i, though the preceding Figure 2.10 indicated close to 50% of the private-sector jobs were then located in West Hawai'i (and the figure rose to more than 50% in subsequent years). This indicates that commuting into West Hawai'i for employment is clearly higher than commuting out.

Note also that the average annual rate of growth in labor force has been consistently larger for West Hawai'i than for the rest of the county. In general, the growth rate was declining over time to 2000, but then rose (particularly in North Kona and South Kohala) in the boom of the 2000s prior to the Great Recession. Because the percentage applies to a larger base figure, this means the absolute average growth in workforce for the early 2000s has actually been larger than that experienced in the 1990s, in terms of absolute numbers

[16] Census and DLIR figures differ somewhat for years ending in "0," because the Census count is for April 1 and the DLIR estimate is for the year's average.

Table 2.6 Countywide and West Hawai'i Civilian Labor Force, 1970 – 2009

Total Civilian Labor Force	1970	1980	1990	2000	2005-09
North Kona	2,022	7,292	11,898	15,848	21,063
South Kohala	951	2,110	4,882	6,862	9,357
South Kona	1,535	2,823	4,029	4,467	4,796
Total West Hawai'i	4,508	12,225	20,809	26,813	35,216
Rest of County	21,381	28,781	36,177	43,779	53,246
County of Hawai'i	25,889	41,006	56,986	70,592	88,462

Average Annual Percentage Increase	1970-1980	1980-1990	1990-2000	2000 to 2005-09
North Kona	13.7%	5.0%	2.7%	4.1%
South Kohala	8.3%	8.8%	3.5%	4.5%
South Kona	6.3%	3.6%	1.0%	1.0%
Total West Hawai'i	10.5%	5.5%	2.6%	4.0%
Rest of County	3.0%	2.3%	1.9%	2.8%
County of Hawai'i	4.7%	3.3%	2.2%	3.3%

Source: U.S. Census Bureau, Decennial Census for 1970-2000; Census Bureau American Community Survey for averaged 2005-09 data. For estimating percentage increase from 2000, a seven-year period was assumed.

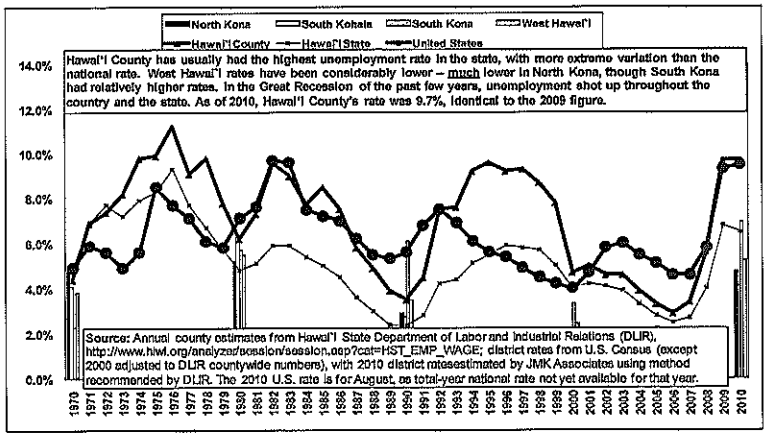
A key social characteristic of Hawai'i Island's workforce has been its high female civilian labor force participation rate (CLFPR – the percentage of the population aged 16+ actually in the CLF). Both male and female CLFPR have been much higher in West Hawai'i than the rest of the county, with no appreciable female differences between North Kona, South Kohala, and North Kona but higher male rates in South Kohala and lower in South Kona (Table 2.7).

Table 2.7 Civilian Labor Force Participation Rates (CLFPR), 2000 and 2005-09

	Hawai'i County	Rest of County	West Hawai'i	North Kona	South Kohala	South Kona
2000 Census						
Male CLFPR	64.7%	60.0%	73.7%	73.2%	76.3%	71.7%
Female CLFPR	58.7%	55.7%	64.7%	65.1%	65.2%	62.6%
2005-09 ACS						
Male CLFPR	68.6%	64.7%	75.4%	74.7%	81.4%	68.0%
Female CLFPR	60.9%	58.0%	66.0%	65.9%	65.1%	67.9%

Compared to other Hawai'i counties, Hawai'i Island has generally had a high unemployment rate, but current estimates indicate an atypically low one. Note, however, the great swings that have characterized the island's economic cycles over time, and the absence or delay of the historically "normal" increase in unemployment that might have seemed expectable for the first part of the last decade:

Figure 2.12 Unemployment Rates – U.S., County, and West Hawai'i, 1970 – 2010



Hawai'i County's 2009 unemployment rate was 9.7%, and was unchanged in 2010. Much of the preceding 2005-07 low unemployment had to do with a construction boom that has now become a construction bust. Though no recent Kona-specific data are available, it is likely that the unemployment rate there remains lower than the rest of the county, as it has in the past (Table 2.7).

2.5.2 Employment by Industry

As might be expected, Census data show residents of West Hawai'i were much more likely than those of East Hawai'i to be in the "Accommodation and Food Services" sector, less likely to work in Public Administration or Education. This was particularly true in South Kohala, while the South Kona pattern was more like that of East Hawai'i.

(Note: The averaged 2005-09 figures in Table 2.8 were little changed from the comparable percentages that could be calculated from the 2000 Census.)

Table 2.8 Distribution of Resident Workers by Industry, 2005-09 Average

	Hawai'i County	Rest of County	West Hawai'i	North Kona	South Kohala	South Kona
Agriculture, forestry, fishing and hunting, and mining	4.3%	4.5%	3.9%	2.4%	4.0%	9.6%
Construction	11.4%	10.6%	12.7%	12.6%	12.1%	14.5%
Manufacturing	2.8%	2.8%	2.9%	2.7%	3.4%	3.0%
Wholesale trade	2.7%	3.6%	1.4%	1.6%	0.8%	1.6%
Retail trade	12.8%	12.3%	13.4%	15.5%	9.4%	12.2%
Transportation and warehousing, and utilities:	4.1%	4.1%	4.2%	4.5%	4.3%	2.5%
Information	1.3%	1.3%	1.1%	1.3%	1.0%	0.7%
Finance, insurance, real estate and rental and leasing	6.1%	5.0%	7.6%	8.8%	5.7%	6.0%
Professional, scientific, management, administrative, and waste management services:	8.6%	7.2%	10.7%	11.3%	10.1%	9.8%
Educational services	9.9%	12.6%	6.0%	4.8%	7.6%	7.9%
Health care and social assistance	8.6%	10.5%	5.8%	6.1%	3.2%	9.7%
Arts, entertainment, and recreation	3.0%	2.9%	3.0%	2.8%	3.9%	2.0%
Accommodation and food services	14.7%	11.1%	20.0%	18.8%	28.2%	9.1%
Other services (except public administration)	4.5%	4.4%	4.7%	4.8%	4.2%	5.0%
Public administration	5.3%	7.0%	2.7%	2.0%	2.1%	6.5%

Source: American Community Survey, 2005-09 averaged figures.

(Green shading indicates relatively high numbers, and yellow, relatively low ones.)

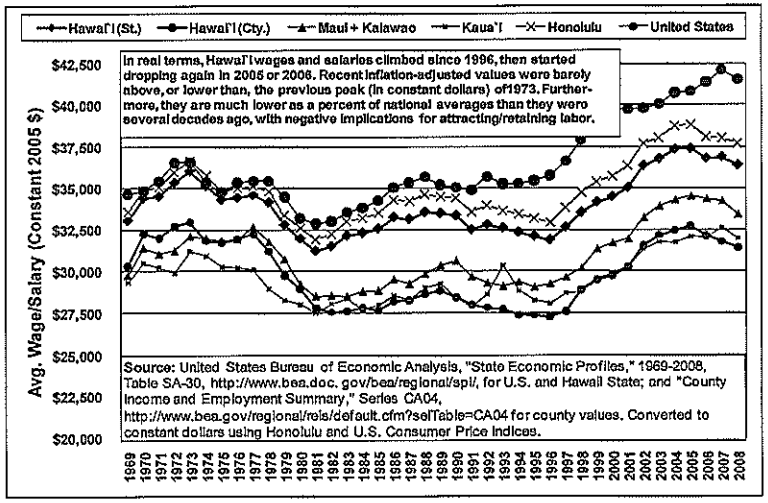
2.5.3 Wages and Income

Annual data about average individual wage and salary (as compared to aggregate measures such as "household income") comes from the U.S. Bureau of Economic Analysis, though it is for the county as a whole and not for individual areas such as West Hawai'i. Figure 2.13 on the following page shows that inflation-adjusted wages declined nationally and throughout Hawai'i as the country moved from an industrial to more of a service-based economy, hit a low point around 1980, then started rising again since 1996. However, housing-driven inflation slammed on the economic brakes and drove real earnings back down around 2005 or 2006. Furthermore, Hawai'i as a whole – and Kaua'i and Hawai'i Island in particular – have greatly and consistently lagged national averages for many years.

Within Hawai'i Island, a variety of indicators from the 2000 Census suggest higher incomes in the West Hawai'i study area than for the rest of the island. Both poverty and public assistance rates for the combined three West Hawai'i districts were about half that for the rest of the county. And aggregate median incomes were higher in 2000:

	Countywide	N. Kona	S. Kohala	S. Kona
Median family income:	$46,480	$51,525	$56,905	$48,989
Median household income:	$39,805	$47,610	$51,379	$42,058

Figure 2.13 Average Wage & Salary, 1969 – 2008, U.S. Vs. Hawai'i and Counties



Aggregate measures such as family and household income can represent incomes from different numbers of household workers for different times and places. Table 2.9 on the following page shows that:

- Inflation-adjusted household income, especially at the county and North Kona levels, remained essentially stagnant from 1980 to 2000, then apparently increased somewhat in the later 2000s (though the ACS 2005-09 figures average income reported during both an economic boom and also the following Great Recession).
- However, the number of workers per household – perhaps contrary to general impressions, but in line with the aging of the population – actually decreased rather than increased in the same timeframe. (The number edged back up again in the late 2000s, though the averaged five-year timeframe makes that difficult to interpret.)
- Thus, at least through 2000, fewer workers per household were needed to bring in roughly the same household income, and so the "average" real wage – consistent with Figure 2.13 above – increased (particularly in West Hawai'i).

Income data are multi-faceted and complex. Other data could demonstrate that income inequality increased during the same period, and it is not certain that average or median increases were equally enjoyed by all segments of the society. Also, the economic changes since 2000 may have altered this picture. (As noted below, the Great Recession in the last few years appears to have driven down per-worker incomes.) But

the long-term picture is one of increasing real income since Hawai'i's low point of 1980, and more so for West Hawai'i than for the rest of the county.

Table 2.9 Effect of Changing Number of Household Workers on Income

	1980	1990	2000	2005-09
A. Median Household Income (2009 Dollars) for Preceding Year				
County of Hawai'i	$52,558	$53,109	$52,839	$55,645
North Kona	$60,648	$63,212	$63,200	$64,802
South Kohala	$54,948	$71,243	$68,203	$75,912
South Kona	$50,159	$55,934	$55,830	$58,849
B. Employed Civilian Labor Force Per Household				
County of Hawai'i	1.30	1.31	1.23	1.31
North Kona	1.50	1.46	1.41	1.41
South Kohala	1.33	1.53	1.43	1.51
South Kona	1.44	1.46	1.35	1.41
C. Median Household Income Divided by Employed Civilian Labor Force Per Household (A divided by B), 2009 Dollars				
County of Hawai'i	$40,279	$40,516	$43,086	$42,394
North Kona	$40,374	$43,218	$44,669	$46,122
South Kohala	$41,197	$46,450	$47,786	$50,272
South Kona	$34,915	$38,299	$41,243	$41,717

Source: U.S. Census Bureau, 1980 - 2000 Summary File 3; American Community Survey 2005-09 averaged data. Divisions and inflation adjustments (using Honolulu Consumer Price Index) by John M. Knox & Associates, Inc.

2.5.4 Employment Forecasts

The previously mentioned DBEDT forecasts anticipate roughly 96,000 people employed islandwide in 2020 and 124,000 in 2035 (up from 69,000 in 2005 – roughly an 80% increase from 2005 to 2035). Based on trends over the past decades, it may be assumed that most of these additional jobs will be *located* in West Hawai'i, though housing issues make it less certain that the additional workers will *live* there.

The *County of Hawai'i General Plan*'s three different forecast series for 2020 range from 103,500 to 117,500 jobs (which is different from "people employed" due to factors such as multiple job-holding, part-time vs. full-time employment, etc.).

From a 2005 base of 69,000 jobs, the County's projection for job growth is greater than the State's, County numbers equate to anywhere from 50% growth (for Series A) to 70% growth (for Series C) in just 20 years while the State projects just under 40%. However, the County document remains silent on the geographical distribution of the projected heavy job growth.

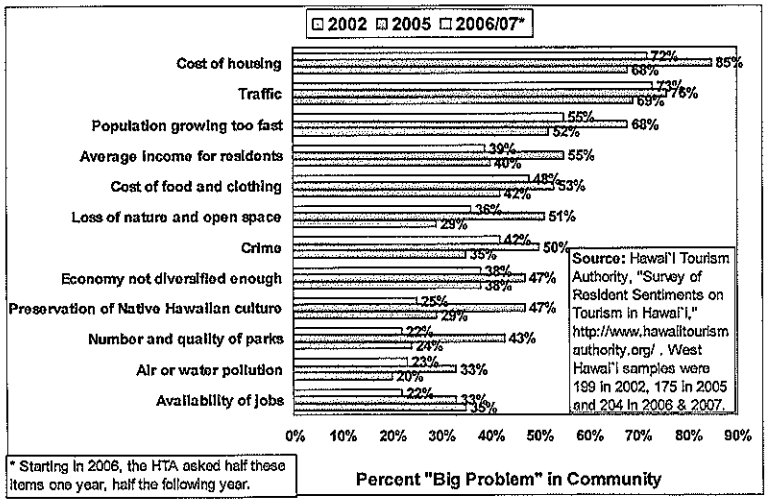
2.6 General Community Issues and Attitudes

In addition to stakeholder interviews described in following sections, we here examine opinion survey evidence related to community issues.

In 2002, 2005, and a split 2006-07 survey, the Hawai'i Tourism Authority (HTA) included small "West Hawai'i"[17] samples in its statewide "Survey of Resident Sentiments on Tourism in Hawai'i." The survey began with a list of potential community problems – with no specified links to tourism.

Figure 2.14 indicates that *cost of housing* and *traffic* were the critical issues as of 2006-07, followed by *population growing too fast*. The figure also indicates that *availability of jobs* was the least important of the listed issues and that even its perceived importance had dropped off by 2006.

Figure 2.14 West Hawai'i Resident Perceptions of Major Community Problems



[17] "West Hawai'i" for this survey included a somewhat larger area than otherwise used for the current report – "Pa'auilo through the Kohalas, Konas, and Ka'ū." It should also be noted that the list of community issues for the survey was restricted to particular concerns often associated with tourism. One issue of more general concern in rural Hawai'i – substance abuse – was not included on the list.

Note: The HTA did another resident survey in 2009, but did not break out West Hawai'i results.

3. COMMUNITY ISSUES AND PERCEIVED IMPACTS

This section focuses on results of community interviews. It covers the following topics:

- Purpose and methods;
- "Background" issues and concerns (context for project);
- General project – awareness and overall issues;
- Specific project elements – issues and concerns; and
- Perspective of adjacent National Historical Park.

3.1 Purpose and Methods

Purpose: Social impacts involve values and perceptions. They also involve many concerns that cannot be "objectively" determined with certainty, because cause-effect relationships are not always easy to determine. Over the several decades that we have been doing this sort of work in Hawai'i, we have talked to social agency representatives who believe that social problems are due largely to rapid economic development... and to others who believe the exact same problems are due to lack of economic development. Both may be right. The point is that "experts" cannot always draw a clear and accurate conclusion. In the long run, social impacts may have to do not only with *whether* a project occurs, but with *how* it is carried out.

Therefore, an important part of social impact assessment involves interviewing knowledgeable community leaders and observers – "stakeholders" from a wide spectrum of beliefs and interests. The results are not like the survey percentages reported at the end of the foregoing section, because interviewees were deliberately rather than randomly selected. There is therefore no way to know if the opinions expressed by our interviewees are representative of the population or not.

However, the community interview method complements survey results by:

(1) Allowing for a much more in-depth discussion; and

(2) Focusing on specifically affected groups – such as nearby residents, business owners, or local political leaders – who could be greatly under-represented in a typical telephone survey.

Ultimately, the purpose of these interviews is to disclose social issues and concerns. (The term "social" is used broadly here, since many interviewees find it difficult and irrelevant to make fine distinctions among social, environmental, economic, and other issues.) When possible, we will also make analytic comments and offer suggestions for mitigations and enhancements.

Methods: A total of 24 interviews (with 29 individuals as some interview sessions comprised of more than one interviewee) were conducted for this Social Impact Assessment. All interviews were conducted from November 2010 through March 2011, by face-to-face meetings (the majority), and via telephone. Interviewees were assured that:

- All discussions were confidential – we would list names but not quote anyone by name.
- Information about community affiliations would be reproduced only to show the range of interests represented and why these people were selected. ***No interviewee was speaking on behalf of any organization listed in Table 3.1.***

Although discussions could be free-flowing and did not necessarily follow a script, we developed an interview guide (Appendix A) along with a then-current Project Description (Appendix B) that contained three broad types of questions:

1. Background issues affecting West Hawai'i, independent of the project;
2. Overall issues specific to the project; and
3. Specific issues related to project elements, focusing on these main project components: hospital; adherence to the Kona Community Development Plan; project phasing; residential component; roads and infrastructure; commercial, retail and high tech elements; schools; and trails, park space and open area.

Table 3.1 List of Community Interviewees

Name	Title, Affiliation
Kathy Billings*	Park Superintendent, Kaloko-Honokōhau and Pu'uhonua O Honaunau National Historical Parks, National Park Service
Aric Arakaki	Superintendent, Ala Kahakai National Historic Trail, National Park Service
Sallie Beavers	NPS Marine Ecologist and Chief of Resources, National Park Service
Rick Gmirkin	Community Archaeologist, Ala Kahakai National Historic Trail, National Park Service
Fred Keakaokalani Cachola	President, Makani Hou; Chairman Nā Kōkua
Denny Coffman	Representative, House of Representatives, 6th District
Laura Dierenfield	Executive Director, People's Advocacy for Trails Hawai'i (PATH)
Bob Ward	Board Vice President, People's Advocacy for Trails Hawai'i (PATH); Member, Kona CDP Action Committee
Fritz Harris Glade	Member, Kona CDP Action Committee; Former Vice Chair, Kailua Village Design Commission; Board Member, Kailua Village Business Improvement District
Glennon Gingo	Agent/Broker, Hawai'i & Pacific Commercial Properties; Director of Manta Pacific Research Foundation
Kelly Greenwell	Hawai'i County Council District 8
Marni Herkes	Vice President of Public Affairs, Kona Outdoor Circle
Jacqui Hoover	Executive Director and CEO, Hawai'i Island Economic Development Board; President, Hawai'i Leeward Planning Conference

Name	Title, Affiliation
Paul Horner	General Manager, Keauhou Beach Hotel
Bo Kahui	Executive Director, La'i'opua 2020
Irving Kawashima*	Section Manager, Hawai'i Nā Ala Hele, Department of Land and Natural Resources
Clement Chang	Access Specialist, Hawai'i Nā Ala Hele, Department of Land and Natural Resources
Vivian Landrum	President, CEO, Kona Kohala Chamber of Commerce
Gretchen Lawson	Member, Kona CDP Steering Committee; President and CEO, The Arc of Kona
Elizabeth Lee	Kona Community lineal descendant, Kūpuna
Reggie Lee	Hui O Na Kūpuna
Susan Maddox	Interim Executive Director, Kona Neighborhood Place; Executive Director, Friends of the Future
Ken Melrose	Chairman, Kona CDP Action Committee; Senior Project Manager, Pa'ahana Enterprises LLC.
Ken Obenski	Acting Chair, Kona Traffic Safety Committee
Rob Pacheco	CEO, Hawai'i Forest and Trails; Board Member, Board of Land & Natural Resources; Board, Hawai'i Island Visitors Bureau; President TREE Hawai'i
Aaron Stene	The Kona Blog
Phil Tinguely	President, Tinguely Development, Inc.
Curtis Tyler	Property Manager, Small Business Owner; Former Councilman
Rodney Watanabe	Executive Vice President, Member Services, Hawai'i Community Federal Credit Union

* Note: These interviews were conducted as a group, with person(s) whose name(s) is/are italicized below.

Although we have done West Hawai'i community interviews only occasionally over time, we have noted increased difficulty in getting participation there – either non-responses or refusals – particularly on the part of environmentally-oriented interest groups. Among those who declined, a common theme was ***suspicion of developer representatives*** (in general, not Stanford Carr in particular) and concern that any comments they made would be ignored and/or misrepresented as indicating some type of endorsement. Here are some examples from people who asked that their names not be included:

Mahalo for the email. As a rule, I don't take part in developers' interviews, as it has lead to nothing but misrepresentation by those community members and groups who have taken part in them. Unfortunately, it seems that these types of interviews are used to make a project look good, rather than truly improve the project.	*If Stanford Carr presents an environmentally- and culturally-sensitive KCDP-conforming project (not just according to what the current County administration calls "conforming" but truly so), they'll have a better chance of a glitch-free permitting process. If the project abuses the land, the laws, or the Kona community, it won't be so easy.*	*My experience in meeting with developer representatives is that my concerns are not properly addressed even while I'm listed as having been consulted. I will submit written comments once you have issued your EISPN.*

3.2 Background Community Issues and Concerns

Most of our interviews began with general questions intended to shed light on values and background issues, independent of the project – both positive aspects and problematic issues about West Hawai'i in general. The themes outlines in Table 3.2 represent issues and concerns most frequently mentioned during our interviews.

Table 3.2 Current Issues on People's Minds about Kona in General

Current Issues and Concerns
Health Care and Education Issues
Lack of good health care, facilities, and caregivers
Lack of education opportunities for local residents
Current Economic Issues
Lack of jobs and good paying jobs, and imbalance between where jobs are located and the location of housing for the workforce
High cost of living
Economic vitality: dependence on imports, lack of new money coming in, need sustainable economic growth, not only short term
Ranching and cattle raising facing strong challenges
Community and Effects of Rapid Growth Issues
Managing growth: sustainability vs. growth conflict, speed of development
Influx of outsiders who may not understand local lifestyle promoting "land for profit" as opposed to "land for living"
Crime and drugs
Housing Issues
Not enough affordable housing
Access and Infrastructure Issues
Harbor is old, county infrastructure is aging (sewer specifically)
Queen Ka'ahumanu Highway widening issues: access
Traffic
Political Issues
Perverse incentive: Hilo benefits from tax revenues generated by developments in Kona, but Kona suffers from the resulting traffic and socio-economic impacts
Inefficient planning: Projects approved out of Hilo, no infrastructure to support projects, no following through on conditions
Too many land use conversions (conservation and agricultural to urban land uses)
Lack of good political leadership
Population growth: demographics incoming vs. demographics being planned for
Polarization in planning issues
Environmental Issues
Vog and threat of volcanic activity – worries about permanent impacts on quality of life, housing value
Increasing negative impacts to the natural environment, coastal areas and cultural resources
Lack of open space

Health Care and Education Issues: Interviewees often mentioned concerns about health care and education in Kona – including lack of access to medical facilities, reportedly leading to people having to be evacuated to Honolulu for treatment, insufficient staff, lack of good doctors, nurses and health care specialists, and inadequate facilities. A few people said the hospital has been having funding problems, which has made it difficult to keep doctors, specialists and nurses in Kona.

Current Economic Issues: The entire nation has been having difficult economic times, and Kona is not immune. Issues associated with the impacts of the national economic crisis include a lack of new money coming in, local businesses suffering (even affecting the success of longtime industries ranching and cattle raising), higher cost of living, lack of local jobs (and good paying jobs), and lack of adequate housing for workers, especially low-income ones. Residents also reported a perceived imbalance between where jobs are located and the location of "affordable" housing for the local workforce.

Community and Effects of Rapid Growth Issues: Interviewees expressed concern about the rapid growth occurring in Kona, and the difficulties associated with managing this growth. The speed of development, as well as population growth, were both viewed with apprehension. The ongoing influx of people and rapid development were seen as leading to cultural, social, and environmental problems. Some people said newer resident may not understand local lifestyle and have more of a "land for profit" as opposed to "land for living" mentality. Increased crime and drug use were also reported as concerns attributed to rapid growth (though it should be noted that we also often encounter the same issues in rural areas with stagnant economies).

Housing Issues: Lack of housing options for the local workforce is a great concern for the people in Kona. Interviewees, on the whole, all said they concurred that there is just not enough affordable housing options for the Kona workforce, and that what is being planned in the region often does not seem to meet that demand, but rather caters to off-islanders – vacation and/or retirement homes for the affluent.

Access and Infrastructure Issues: According to interviewees, access and infrastructure issues are a significant concern in Kona. Interviewees remarked that the Kona Harbor is old, that county infrastructure is aging (sewers specifically), and that access and traffic are an escalating issue in Kona. There have also been many problems with the Queen Ka'ahumanu Highway widening project.

Political Issues: A decades-old issue involves the fact that West Hawai'i is the County's prime source of growth in tax revenues, but planning and infrastructure decisions are made in the East Hawai'i county seat (Hilo). Interviewees said they perceived a perverse incentive in the fact that Hilo benefits from developments in Kona, but Kona suffers from the resulting traffic and socio-economic impacts of these approvals. They saw this as inefficient planning, as planning projects are approved with no adequate infrastructure to support projects, from a remote place that won't feel the consequences of failing to plan properly.

Lack of good political leadership was also seen as the root cause for perceived frequent conversion of land uses (conservation and agricultural to urban land uses), and developments being allowed to move forward, with no follow-through on conditions.

Environmental Issues: Although vog and volcanic activities were of some concern to interviewees, threats *to* the environment – as opposed to threats *from* the environment – was at the forefront to of interviewee concerns. People said they were seriously concerned about increasing negative impacts to the local natural environment, coastal areas and cultural resources due to development and population growth.

3.3 Overall Project – Awareness and General Issues

3.3.1 Level of Awareness of Project

Interviewees were asked whether or not they had heard about the Kaloko Makai proposal prior to our contacting them, as well as their perceptions as to whether this project was well known in the community.

Interviewees, on the whole, seemed to be aware of the proposed Project at Kaloko Makai, though they were not always aware of all details. Since this Project has been "in the works" for quite some time, it did not come as a surprise to most interviewees – who, as community leaders, tend to track development proposals more closely. However, most interviewees said they thought the project is ***not yet well known to the majority of Kona residents.***

> *"There's awareness, but I don't think people understand scope of it."*

> *"No doubt, the project is known to county and land-use planners, but probably less known by the general public."*

3.3.2 Image of Developer

We also inquired about whether the Stanford Carr Development company is well known in the Kona community, and if it has a particular image (positive, negative or neutral). ***Most interviewees reported a neutral to positive image*** – focused more on Mr. Carr himself than on the company as a whole – although a few people mentioned concerns over the suspended work at Kaloko Heights and reported unresolved business issues with a local contractor.

Especially because Kaloko Heights and other area developments have come to a stop, there was also some degree of surprise as to the developer's confidence about proposing such a large development in this economy.

> *"What concerns me is the fact that they are wanting to get this huge project started. So many projects have been stalled since the recession and are not completed from the recession of the early 90's. Lots of completed places have not even sold yet."*

There was also some sense that ***Stanford Carr, as a "local" (Hawai'i-born) developer, could be perceived more favorably than other developers.*** For some, this increased expectations for the Kaloko Makai project.

> *"Stanford Carr is uniquely positioned to set the bar for Kona in terms of livability, because a project of this magnitude would draw lots of attention."*

3.3.3 Issues about the Project in General

Interviewees were asked what they saw as both the most positive and also the most problematic things about the Kaloko Makai Project. Interviewees were excited, or at least cautiously optimistic, about many of the proposal's specific components. ***Most interviewees spoke to possible changes to the current proposal, instead of discounting or rejecting the entire plan.*** That is, they did not simply take a stand *for* or *against* the Project, but offered meaningful insight into how some of its components could be adjusted or changed to make it fit into the area, or be more suitable to area residents.

Table 3.3 on the following page summarizes overall issues. Most comments about the project (both positive and negative) had to do with overall growth in Kona; potential economic benefits of the project and planned infrastructure; the provision of green spaces and trails; the project's placement within Kona and particular component placement; and the proposed hospital, schools, mixed housing and affordable homes.

Growth in Kona

The most frequent and the most critical issues involved ***perceptions about the project's scale (5,000 units),*** and about its ***conformity to the Kona CDP.*** A majority of people interviewed were aware – and appreciated – that the Project is located within the Kona CDP designated growth corridor. This growth corridor was determined in the plan as an appropriate central location for future development, and most interviewees agreed growth in Kona should be directed toward the general project area, where industrial areas and roads have already been built and planned. While there is still fear that growth may lead to loss of unique community character, most recognized that Kona was going to continue to grow and that planning for this growth through the CDP makes sense.

Some interviewees were in fact pleased by the thought of a large development occurring at Kaloko Makai. However, apprehension over the Project's size was *very* often mentioned during our interviews, and was clearly the single greatest concern. Many people found this development proposal to be "too large" especially because of multiple developments concurrently proposed in the area. Even though people intellectually recognized that the proposal envisions a 30-year buildout, the visceral impact of "5,000 units" was difficult for many people to absorb.

Table 3.3 Summary of Broader Issues Related to Project

Project Specific Benefits and Concerns		
Theme	**Potentially Positive Aspects**	**Potentially Negative Aspects**
Growth in Kona	• Project is located within the Kona CDP designated growth corridor	• Apprehension over the Project's size • Needs to adhere to Kona CDP guidelines • Quick growth now occurring in Kona, leading to a sense of loss of what makes the area unique • Community would like to have some (more) input, in terms of planning • Project name could be misleading (keep traditional name of the place)
Economic Benefits and Planned Infrastructure	• More jobs, an increased tax base, and the improvements to the local infrastructure and local facilities • Planned infrastructure • More connection with existing and/or planned area developments • Long phasing period, gradual development • Increased road connectivity and the building of the Mid Level Road, and the provision of more roads	• Plan will need to provide some evidence of concurrency
Green Spaces and Trails	• Provision of open space, dryland forest, trail system, and parks	• Roads proposed as part of this Project may be cutting across ancient trail segments • Need to identify the historic trail alignment on the ground
Project Location	• Well positioned to earn community acceptance because of its placement mauka of the Queen Ka'ahumanu Highway	• Concerns about some of the plan's components, in regards to their proximity and potential impact to near shore waters and resources
Hospital, Schools, and Housing	• Community members appreciate the idea of more medical facilities projected in the area • Potential impacts medical waste could have on the environment • Schools will be needed • There is a great need for housing in Kona; project can help address need	• Proposal for placement of a hospital may allow for developing higher densities now, but it may take some time for a hospital to be built, if at all. • The location at Kaloko Makai is not right: should be in the Waikoloa region • Who is going to pay schools to be built in this economy? • Fear homes will be at a price point not accessible to the people who live and work here

According to the Project EISPN, "concepts such as *smart growth* and *sustainability* were incorporated into the Project plan, focusing on community quality of life." However, a handful of people still felt the proposed Project "needs to adhere [more] to Kona CDP guidelines and intended principles of "smart growth." These people said that they wished the Project attempted to present a better Transit-Oriented Development (TOD)

concept and incorporate even more smart growth principles such as those outlined in the Kona CDP Village Design Guidelines.[18]

While many interviewees agreed with the Kona CDP that development in this area would make the highest and best use of Kaloko Makai lands, there were some who said they still did not want to see any change to Conservation or Agricultural designations.[19]

Some community members said they hope to have more input to project planning. One person said the traditional name of the place should be preserved. According to this person, in ancient times the area was actually referred to as Kaloko Waena (center-middle) and not Makai, which would have actually been the name of the area near the shoreline. A few others simply said that use of the name "Makai" could cause opposition from people who would assume it is located on the ocean side of the highway – an area where there is much stronger opposition to any further development.

Economic Benefits and Planned Infrastructure

Most could see the potential economic benefits which will ensue from such a development in the area, including the possibility of ***more jobs, an increased tax base, and the improvements to the local infrastructure and local facilities***. For some people, the "up" side of the project's size included the idea of construction jobs extending over three decades. People especially liked the idea of planned infrastructure in the area. They talked about the longstanding need in Kona for more road connection with existing and/or planned area developments, as well as better communication between area landowners about infrastructure planning in general.

Although many appreciated the long phasing period, gradual development proposed at Kaloko Makai, some thought that the phasing not well described in the proposal. These people suggested the Plan will need to provide ***more evidence of concurrency*** between the provision of infrastructure and developments (such as housing etc). Many also suggested timing for construction would be critical, in order to avoid adding to the area's already large traffic problem.

Increased road connectivity and the building of the Mid-Level Road roused particular interest from interviewees. Issues and opportunities relating to roads and infrastructure will be explored in more detail in Section 3.4.5, when we discuss particular project components. However, the provision of more roads is seen as a major advantage for this Project:

[18] According to the Kona CDP: "These guidelines were adopted as one of the instruments of implementation of the Kona Community Development Plan (KCDP) to provide standards of development for Traditional Neighborhood Design (TND) and Transit-Oriented Design (TOD) villages. This is a form-based code, meaning it envisions and encourages a certain physical outcome at the community, BLOCK, or building level. This form is compact, walkable, and mixed-use, and is meant to be comfortable, safe, and ecologically sustainable." (Wilson Okamoto, 2008)

[19] According to the Project EISPN, the Project will need a State Land Use District Boundary Amendment to reclassify approximately 952 acres from Conservation and Agricultural Districts to the Urban District.

"Overall, it's pretty good! Now that I'm looking at it, the Kamanu extension might create connectivity all the way through to Wal-Mart and Henry St. That would provide an alternate route to all those big box stores!"

Although more jobs were mentioned as a favorable consequence of this project, a few people said they worried about these jobs actually being offered to the local Kona workforce. They suggested that developments typically bring in outside workers.

Green Spaces and Trails

The Project's provision of ***open space, dryland forest, a trail system, and parks were among the proposal's most attractive features***. Community members, especially longtime residents, appreciated the Project's intent to preserve access for recreational and/or cultural practices, and acknowledge the presence of an ancient historic trail through the property. However, some pointed out that many roads proposed as part of this Project may end up cutting across ancient trail segments, and there was some concern about the need to identify the historic Trail to the Sea's actual alignment on the ground, in order to prevent building on or destroying portions of it. Section 3.4.8 will examine the Project's Trails, Parks, and Open Space component in further detail.

Project Location

Many interviewees suggested this development is well positioned to win community acceptance because of its placement mauka of the Queen Ka'ahumanu Highway. However, some had concerns about the project's relative proximity to, and potential environmental impact on, near shore waters and resources. Specifically, there were issues regarding the placement of the waste water treatment plant (WWTP), the light industrial uses, the large amount of impervious surfaces, and suggested dry wells. The concerns were how these would increase runoff and non-point source pollution, potentially harming underground water sources or the nearby National Park's Kaloko Pond. The Project EISPN states that the EIS will include both a Ground Water and Marine Water Quality Assessment to address how to mitigate these concerns.

Hospital, Schools, and Housing

These project components will be considered at greater length below in Sections 3.4.3, 3.4.7 and 3.4.1 respectively. The following few paragraphs provide an overview.

For the hospital, there were both positive reactions and also concerns over placement and over other proposed medical sites for the area. The project's EISPN states: "*The proposed project is [currently] identified as a Neighborhood Transit Oriented Development (TOD) in the Kona Community Development Plan. Kaloko Makai will be setting aside land for development of an urgent care medical facility, as well as land for a future hospital. A hospital developer/operator is being pursued. When a hospital commits to locating a hospital at Kaloko Makai, the TOD will automatically be designated as a Regional Center TOD. Therefore, Kaloko Makai is being conceptually designed on the assumption that Kaloko Makai will be a Regional TOD.*"

A Regional Center could have a much larger land area and higher densities. The Kona CDP now targets four Regional Centers for the area from Keauhou to Keāhole; with the hospital, Kaloko Makai would become a fifth. [20] While community members seemed to appreciate the idea of more medical facilities projected in the area, some saw this proposal to build a hospital as a "poor attempt" at getting higher densities on the proposed parcel; these people felt that authorizing higher densities would result in instant benefits for the developer, while the community benefit of a hospital may be delivered much later, or perhaps never actually materialize at all. Additionally, a few people had concerns about the potential environmental impacts of medical waste could have on the environment, and one or two – definitely a minority among the interviewees – thought the Waikoloa region would be a better site.

The planned provision of three school sites seemed to please most people. However, the question of "who is going to pay for actual construction?" often came up. Finally – although everybody we interviewed said they perceived a great need for housing in Kona and were happy to see more housing being planned – many or most had a hard time trusting that Kaloko Makai would actually be priced at levels affordable for the Kona workforce.

3.4 Discussion About Specific Project Components

After having identified broad areas of concern in West Hawai'i, and general impressions about the Project in general, interviewees were asked about their thoughts about specific project components – specifically, these eight main project components:

1. Residential Housing
2. Phasing
3. Hospital
4. Transit-Oriented Development under the Kona Community Development Plan
5. Roads and Utility Infrastructure
6. Retail, Commercial, and High-Tech Business Development
7. Schools
8. Trails, Parks, and Open Space

Issues relating to housing, namely Kona's current need for more affordable housing, as well as project phasing were particularly important to these interviewees. Project phasing issues in regards to the housing, infrastructure and industrial-commercial components, as well as the plans for the Mid-Level Road were also "hot button" topics. Therefore, these topics will be covered first. (It should, however, be noted that proper alignment and protection of the trail is also very important to certain groups.)

[20] Pages 4-128 and 4-129 of the Kona CDP have language about hospitals and Regional status: "To encourage the private sector to negotiate a site for the hospital, the TOD in which the hospital decides to locate within shall be automatically designated a Regional Center TOD if the Official Kona Land Use Map has designated it as a Neighborhood TOD. As a Regional Center TOD, there would be incentives for medical offices and other hospital-related businesses to develop in the vicinity"

3.4.1 Residential Housing

Interviewees were asked if there really is a need for housing among the existing workforce in Kona – and, if so, what type of housing was needed, and what they thought would determine whether this project does a good job of meeting this need.

They were then asked whether they thought the affordable housing approach presented in this proposal seemed like a good approach and if they perceived it as any better or worse than other developers' approaches to affordable housing. We also asked them what their ideas would be about a better way to mix affordable units into an overall development – mix them up with the market rate units, or have some concentrated pockets. Interviewees had strong opinions to share about affordable housing.

Residential Housing Need in Kona

The largest portion of the Project involves the construction of 5,000 new single- and multi-family residential units at low- and medium-densities over about 30 years, with an "affordable" component set at 20% of units (about 1,000), targeting residents with income levels between 60%-140% of area median income.

The EISPN states that the Project is a response to a need for more housing for Kona workers. Higher-density housing will presumably be more affordable. The Kona CDP permits higher densities for TODs, and Kaloko Makai is one of the first developments proposed that would follow these provisions.

As previously noted, there was ***substantial agreement that housing is needed (in the future if not immediately), but there were also substantial concerns about the size of the Project.*** For many, there was a fear that this project could end up another sprawling subdivision, with too many units that would inevitably add to traffic.

However, some local residents emphasized the positive opportunities in the Project:

> *"It's a large project in a good location. That land is marginal and not good for agriculture. Its highest and best use is for development."*
>
> *"If this is built, you'll put people to work and they'll have some stability. Construction workers have been testifying for several developments these days."*
>
> *"While government has taken on the job of building housing in some areas, history tells us that the housing problem is probably best solved by the private sector."*

Some people did not think this much housing (5,000 units) is needed in Kona. First, a number of people pointed to current recession impacts on the housing market – substantial vacancies in (i.e., lack of demand for) existing new housing projects. While many interviewees assumed Kona's growth will resume as the economy recovers, some

interviewees worried that a mix of structural economic changes and persisting air quality problems could put a permanent crimp in Kona tourism and housing values.

Second, some suggested that developers keep planning and building for an upscale (often second-home) market that is no longer investing in the region. Despite the project's stated intent to market the project to the local workforce rather than affluent off-islanders, there was suspicion among some interviewees the project would not actually respond to the needs of the local population. There was also a certain level of skepticism about what the demand will actually be in 30 years.

> *"The need is first for jobs. As far as housing, we have quite a few rentals. But if you don't have a job or any stability, you're not going to buy a house."*

> *"There's a need first and foremost for affordable rentals. That word 'affordable' needs a specific definition. I can't remember the last time I saw a house here in Kona for $152K."*

> *"Demand is not really the concern. The concern is with affordable. What does affordable mean for the developer? We need to be able to afford it if it is affordable housing. I understand that the developer needs to make money. If the developer simply sells units at a discounted price, it doesn't mean that they will sell for that in the future."*

> *"There is so much on the market now. The market is still flooded with bank-owned properties, so right now it's challenging."*

> *"A more important conversation is the need for basic infrastructure. It's not fair to say 'people are screaming for affordable housing,' and using that as a reason to ignore basic infrastructure. And we're in a dry place – we must confront whether we have enough water to support that level of growth. For housing, everybody needs a hook-up!"*

Regarding project design, a few interviewees felt the conceptual plan failed to convey a sense of community, and the relationships of the lots within the plan could be improved to increase connectivity.

Affordable Housing Component

Definition of "Affordable:" Almost every single interviewee told us that *affordable homes*, as defined by the US Department of Housing and Urban Development (HUD) and what is currently affordable to people living and working in Kona are two different things. Whether or not this project offers "affordable" homes, the consensus among interviewees was that the ***lowest-income groups cannot meet HUD's "affordable housing" criteria***. Several people noted that ***longtime "local" area residents (such as Native Hawaiians) were particularly affected by this issue.***

> *"Really, affordable here is $140,000 and below."*

> *"Affordable housing includes people who make more than 140% of median income. What they are providing is housing for the middle class, not working local people."*

> *"The people I deal with are often Hawaiian or Filipino trying to support large families on hotel worker salaries. The system effectively shuts them out."*

This theme was so strong and frequent that a chapter within Volume 2 ("Housing Issues") examines available Census data to determine the extent to which there are actually inequities built into the HUD and County guidelines for eligibility for "affordable" housing.

Many interviewees liked the idea of a varied mix of housing being offered by the private sector at market-driven prices. But others wanted this project – or any project – to provide an even larger share of affordable homes.

> *"We need all types, not necessarily MacMansions, but all socio-economic groups, including the elderly or others on fixed income. The Project's affordable housing approach seems reasonable; I think one of the things I like is that it's private-sector, market driven. So it is not just trying to do subsidized housing and make the numbers work."*

> *"They offer 20% here, but other developments have represented higher."*

> *"The newer trend is to think in terms of affordable 'community,' not just affordable 'housing.' The true cost includes getting to places to shop, work, education, not just the cost of the house alone."*

Concentration of Affordable Component: The Project EISPN specifies that the affordable housing component will be provided (in accordance with County rules) and that the mix will be integrated into the master plan. In accordance with this, most interviewees strongly felt it would be ***better to disperse than to isolate lower-income housing.***

> *"Much better to sprinkle the affordable units – no ghettoes!"*

> *"Segregating people in an 'affordable' housing area, away from the higher-end homes, doesn't necessarily build good communities."*

3.4.2 Phasing (Housing, Infrastructure, Industrial-Commercial)

In order to elicit reaction to proposed phasing and timetables, we shared information about project phasing from the Kaloko Makai Environmental Impact Statement Preparation Notice (EISPN) prepared by the Wilson Okamoto Corporation in Sept. 2010.

> Development of the project is anticipated to commence with the construction of infrastructure improvements to begin immediately following the necessary land use approvals and permits. The delivery of the first residential homes is scheduled for 2015. The project proposes to develop major infrastructure by 2025. Kaloko Makai will be implemented in three phases and completed in 2035. Construction of residential units will be on a phased basis according to market demand. (P. 2-9)

(It should be noted that developer plans for phasing continued to evolve during and after the interviews, and have become more specific.)

Many viewed the project's phasing favorably, and were content with the proposal to start the construction with infrastructure improvements. However, in regard to major infrastructure being provided in 20 years, many also said the community just can't wait that long.

> *"The developer's need to phase the project according to market conditions is understandable from an economic perspective, but may be a very hard sell to a community that has heard so many promises and, often seen different results. SCD is already on hold with Kaloko Heights, and it is unknown when that important community infrastructure will be provided."*

There was also general ***approval for the idea that industrial/commercial property on Queen Ka'ahumanu Highway should be the first project phase:***

> *You're building for a hoped-for market that won't evolve until new job opportunities are in place. So get that commercial stuff up and running first!*

The long phasing (over 30 years), which could provide construction jobs for years to come, seemed favorable to many. However, based on experience from other projects, interviewees were ***apprehensive about such a long project phasing approach***. They also had concerns about likely government conditions for the project – how, in their perception, these never seem to be timed and overseen adequately, and for which there has been no consistent follow-through. Some interviewees recommended certain conditions be imposed on particular phases.

> *"They have to do it this way, and each condition should match: Conditions should be imposed in phases too, not only when project is finished."*

> *"You see, there is a history here of people proposing thing and getting approvals for projects and they make promises that when they build this, they have to build this. But they end up dragging on and whatever they promised never ends up being built. They say 30 years – who knows what could happen over 30 years?"*

3.4.3 Hospital

Interviewees were asked whether they felt existing hospitals for West Hawai'i (the 94-bed Kona Community Hospital 11 miles south of the Project and the 50-bed, North Hawai'i Community Hospital in Waimea) were adequate to cover the growth from this

proposal and other projects in West Hawai'i. They were also asked whether the new regional hospital site proposed at Kaloko Makai seemed a good location.

Need for a New Hospital in North Kona

In regards to the need for a hospital in the region, ***most people felt the current facilities in the region are not adequate*** to cover current and future demand. .

> *"The South Kona hospital is only accessible by a private two-lane road. You can't expand the medical facility there with such inadequate road access."*

> *"The availability of diverse medical services in West Hawai'i is problematic. There is a shortage of facilities and medical professionals. Some residents have moved away because of this and others, especially, seniors, may not want to move here because of these shortages. There is no question that additional hospital/medical facilities are needed in North Kona, especially in the project area, but it is not certain the State will approve a certificate of need. On the other hand, maybe a new private hospital is the answer."*

However many interviewees were aware of other proposals in the region for health care facilities. Some interviewees said there was competition for the "hospital spot" supported by the Kona CDP, because other area developers are planning to site a full service hospital within their developments as well. Others said smaller facilities, such as clinics, rather than full-service hospitals, are already being built/planned throughout the area. (It should be noted that smaller facilities would be unable to offer services that a full-service hospital would, such as specialty surgery and testing), and a few even felt Kona's medical needs might better be addressed by many smaller medical facilities rather than one large regional hospital.

Because of this perceived competition for medical sites, ***many interviewees questioned whether the project's designation of a hospital was likely to become reality.***

> *"Sure, we need more hospitals and if everything gets built that is planned, we are going to need it. But right now there are not enough homes to support it. These things take years, and cost too much money."*

> *"Our current facilities are not adequate. But I recall at least five other major medical facilities proposed in this urban growth area. For some, land actually has already been acquired; others consistently displayed as likely, and working on agreements. This is not the only proposed site. Kaiser Permanente owns a site that is north of Kealakehe Parkway, just mauka of Queen Ka'ahumanu. Pālama Nui has always proposed a medical campus, in the area of Ane Keohokalole and University Drive. The QLT long-range projection also shows one. La'i'opua 2020 is looking at potential partnerships on DHHL land. So there is quite a variety of possible places!"*

"Other sites have also been proposed. The word 'potential' is often used in regard to hospitals and schools and such."

"Based on the theory they'll find somebody, which they haven't been able to do in last 12 years at least, that means they're designing it on the anticipation of something that doesn't exist"

"At the time the Kona CDP was drafted, there didn't seem to be any viable hospital site. Since then, many have been suggested. The developer needs to be pretty confident the hospital would occur, because the situation has changed. And now it seems like more smaller facilities would be better than one large one hospital."

Some interviewees suggested other solutions to respond to the need for a hospital in the region. They offered a variety of ideas, including ***a desire for the hospital to be more of an economic driver*** than a medical amenity alone:

"I am thinking the hospital should be bigger, such as tying into a research facility. Maybe it should have some kind of specialty, like sports medicine. There are no orthopedic surgeons on this island, so maybe having a specialty like that could actually bring people to this island."

"If the hospital wants to be there, make it a research hospital, a component of some economic driver."

"We need a medical center, not just a hospital – i.e., offices and clinics. La'i'opua will have a West Hawai'i Community Health Center, which makes a nice synergy. And Kaiser is also moving out there somewhere."

Although the commitment of a hospital was generally well received by community members, ***interviewees repeatedly asked whether Stanford Carr Development was committing a site, or whether it would actually build (or otherwise assure construction of) the medical facility itself.***[21] Some people were dubious that any new hospital anywhere in Kona will be feasible in the foreseeable future. Those people commented on the struggling economy and the lack of doctors, nurses, and staff for existing hospitals on the island, all of which they said pointed to problems that must be solved before a new hospital becomes feasible.

Hospital Location

Because of the population growth in North Kona, most interviewees liked the idea of a hospital sited farther north than the current one in South Kona. And most seemed to think ***siting of a hospital in the Project area would be appropriate***, stating:

[21] However, Policy LU-2.6 of the Kona CDP says "public financing sources shall pay 100%" for costs associated with "Major proposed trunk transit route," among other development components.

"This location is good. It is close to the airport, close to schools, pretty centrally located, and fits into area that needs it."

"I don't think you could find a better location – very central. It covers the mauka area, too. I live on the upper road, and would be just 10 minutes down to this area. Same from Kailua, just 10 minutes. That's where most of the traffic is – to me it's the center."

One person suggested a hospital would make more sense sited more to the north, perhaps in Waikoloa, as Kona already has a hospital. A somewhat more frequent alternative was to locate a new hospital more makai and/or closer to Kailua town.

"I am happy it's included in this project, though a much better site would be down by the Civic Center, because that's where all the government services are concentrated. It is better if it's all centralized"

"My view is the hospital should be more focal to the evolving urban core of Kailua."

In regards to other concerns about the placement of a Regional Hospital at Kaloko Makai, we were told that this proposed ***hospital site is too close to shoreline***, potentially causing issues with the management of waste and other harmful contaminants:

"My concern is the medical waste management issues – this hospital would be just a mile from the coast and upslope from the National Park. The EPA and the NPS both have growing concerns about emerging contaminants, pharmaceutical waste, and human waste near sensitive eco-systems."

(It should perhaps be noted, however, that most hospitals throughout the state are located within a mile of the coast.)

Timing

Finally, the lack of a specific timetable for the hospital phasing bothered several interviewees, as its provision was the core basis for the Regional TOD proposal:

"If the hospital were truly a core component and a realistic driver for change to the more dense Regional TOD, then one would expect that that core/focal element would be early in the project."

"I don't think the hospital can wait. We need it in the next five years. If you don't have an anchor like that, whoever comes up with the first hospital, that'll be it. If he's hanging his hat on this being the draw, he [Stanford Carr] needs to get it in place fast."

3.4.4 Transit-Oriented Development (TOD) Under the Kona CDP

We asked interviewees whether they were aware of the Kona Community Development Plan (CDP) and whether they were involved in the community outreach efforts that led to drafting of the plan. The great majority of interviewees were aware of the CDP, and many were involved in the efforts which led to it. Because of this, many were able to speak not only to the appropriateness a TOD placement at Kaloko Makai, but also to whether or not they had concerns about whether the TOD would be a Neighborhood or Regional Center TOD with a hospital.

Placement of a TOD at Kaloko Makai

The Kona CDP designates Kaloko Makai as a Neighborhood TOD Center. This County document was enacted into law in 2008 after a series of community outreach efforts conducted over several years. Not surprisingly, most interviewees were aware not only of the plan, but also of the plan's vision for a TOD at Kaloko Makai, and there was ***general concurrence the project location conformed to the CDP.***

> *"Yes, it's a good place for a TOD. If I were a developer, I'd target that area. I've lived here long enough to know what would work and what doesn't. The closer you are to the Mid-Level Road, it is definitely more of an advantage. Again, this is corridor to government services and traversing back and forth to the core areas of Kailua-Kona."*
>
> *"Yes, it follows the documented vision."*
>
> *"Yes, especially considering we already have two industrial parks near there. It's already slated for development, and it is mauka of the highway."*

TOD Becoming a Regional as Opposed to a Neighborhood Center

A Regional Center could have a much larger land area and higher densities than a Neighborhood TOD. The Kona CDP now targets four Regional Centers for the area from Keauhou to Keāhole. With the hospital, Kaloko Makai would become a fifth. Many interviewees had been and continue to be involved with the Kona CDP. Because of this, they often had strong feelings in regards to making modifications to the community plan.

There was a particular split among interviewees about creating a fifth Regional TOD Center. Many – including some people heavily involved in the Kona CDP process – said there are currently enough Regional Centers planned in the Kona region, stressing that the Plan's current four Regional Centers were originally chosen because of their location on existing or planned central intersections. Others said promoting higher densities in an already growing area (by supporting a Regional Center TOD) made a good deal of sense.

Table 3.4 summarizes interviewee thoughts and concerns about the Project's proposal to develop a Regional Center TOD at Kaloko Makai with a hospital site, in lieu of a Neighborhood Center, as was proposed in the Kona CDP:

Table 3.4 Regional or Neighborhood Center TOD

Designating Kaloko Makai as a Regional (Rather than Neighborhood) TOD Center	
Positive(s)	**Negative(s)**
A Regional TOD is good idea; TOD placement is appropriate, and Kaloko Makai is an ideal spot for a hospital	Hospital is not needed, need to commit access if offering hospital
Forward thinking: A TOD in this location follows the Kona CDP vision; a hospital is a plus and a good source of financial support, development of such a TOD could serve as model for other districts	There are enough Regional Centers, should instead provide higher residential density Neighborhood Centers
Larger Regional preferable to infuse money in the economy	Not originally designated as Regional TOD; there is no need for a regional TOD
Appropriate to have higher densities at Kaloko Makai	Want hospital but would rather keep neighborhood feel; smaller medical sites may make more sense
Project is already within a corridor to government services, in a central location already ready to be developed	There is a disconnect between this proposal and the intent of the KCDP; the placement of TOD should be on central intersections

It should be noted that the change from a Neighborhood Center TOD to a Regional Center TOD would not actually require a plan *amendment.* The plan states, "To encourage the private sector to negotiate a site for the hospital, the TOD in which the hospital decides to locate within shall be ***automatically*** designated a Regional Center TOD if the Official Kona Land Use Map has designated it as a Neighborhood TOD."[22] Still, some interviewees focused more on the importance of limiting the number of Regional TODs and the significance of placing Regional Center TOD's with an urban core situated along a main transportation artery, rather than this provision when objecting to a Regional Center TOD at Kaloko Makai.

However, we also heard positive comments about the desirability of a Regional Center TOD with a Hospital site at Kaloko Makai. Some people thought it made sense to have a Regional TOD because a hospital is greatly needed in the region, and because they saw Kaloko Makai as the best place to direct growth over the next decades. These people were often aware of – and agreed with – the idea that a hospital in North Kona is such a pressing need that the Kona CDP appropriately calls for the possibility of converting a Neighborhood TOD to a Regional TOD if a hospital is provided.

> *"Kaloko Makai would be the logical and accessible place for West Hawai'i to grow into – it has been in development plans for a long time. I think it would be better to be Regional. The proximity to light industrial area at bottom, all the neighborhoods surrounding it – as a Regional Center, there will be better transportation nodes and freeways."*
>
> *"I think it's necessary to think in future tense, the Regional is very important to me. Seeing what Kona has been and become, need to keep thinking about future."*

[22] Kona CDP, Pages 4-128 and 4-129, emphasis added.

3.4.5 Roads and Utility Infrastructure

After discussing the proposed segment for the long-planned Mid-Level Road, we asked interviewees if they had any questions or advice for the developer about the importance of getting it built. We then asked them if they saw any other opportunities for this project to help with solving traffic issues, either from the project itself or from general growth.

Proposed New Roads

Interviewees favored the early completion of Kamanu, Maiau and the Mid-Level Road, but also a connection at Hulikoa Street. According to virtually all interviewees, ***the most critical aspect of the proposal has to do with the building of the Mid-Level Road (Ane Keohokalole Highway).*** The Mid-Level Road will help alleviate, traffic as all travel won't have to occur only on Queen Ka'ahumanu Highway:

> *"The key component is definitely the Mid Level Road. It would take traffic off of Queen Ka'ahumanu. Hina Lani already resolves some of the mauka-makai traffic challenge. So getting just the Mid-Level Road built, as well as providing a connection to Kaimikani Street, is a priority!"*

> *"Making that happen is necessary for any development to work in this general area. It will help with transiting through the subdivision, getting to services, creating much better north-south flow etc. It is imperative for any of this to happen."*

> *"The mid-level connection to Kaiminani is the big banana, the key, because it would connect to the college in one direction, and you'd also be able to go to civic center on Kealakehe Parkway."*

> *"The Mid Level Road is critical. This is an important project for a number of reasons – one of them is that construction jobs are badly needed. This project couldn't start fast enough for me!"*

Ane Keohokalole Highway, like all major arterials, is planned as a taxpayer-funded road built by government. The project's EISPN states:

> The Federal Highways Administration (FHWA), in cooperation with the State Department of Transportation and the County of Hawaii is proposing the Ane Keohokalole Highway (Mid-Level Road) from Palani Street to Hina Lani Street. The proposed roadway will provide a link, approximately 3 miles long, and is parallel to Queen Kaahumanu Highway. The proposed roadway would function as a major collector roadway and consist of four lanes of two-way vehicular traffic. [P. 3-26]

However, a few people we talked to felt strongly the ***developer should bear the cost of its construction.*** The reason for this assertion – which would obviously increase the price of housing if carried out – seemed to be rooted in both the community's historical distrust that government would provide needed infrastructure and also in the general

perception that developers have deep pockets and should be "giving back" more to the community.

> *"SCD should cover the cost of the Ane Keohokalole Highway (Mid-Level Road) portion through its property. I don't see it in the plan, but, as previously noted, it is important to have this roadway segment completed. SCD should pay for this."*

> *"It is absolutely critical that the Mid-Level Road be built now – The Recovery Act won't be there forever. As far as the intersecting roadway system is concerned, it should not be all that expensive if you do it at one time. I don't know how in the world to schedule something like that, because that means an awful lot of up-front money would be spent. However, this county's proportional share of stimulus money is around $700M. They'll have to do more stimulus, and we have to be ready."*

> *"There is a yin and yang to it. Doing that part of Mid-Level Road will help. But to afford to do that, they will have to build a lot more units. So we will get good with bad..."*

If this condition were actually imposed, it would of course increase the price of Kaloko Makai homes substantially – an issue that was little discussed by those who wanted "the developer" to bear the cost. However, many of those who advanced this idea did say they knew it would be expensive and may cause potential delays and/or stop this project altogether. According to one interviewee, the cost of building the Mid-Level Road may actually be unusually elevated:

> *"The first section of the Mid-Level Road was built using federal funds and needed to meet federal standards. This drove the price way up. Design of the Kaloko Makai segment will have to be consistent with standards for what's been done, what's being done now."*

Road Re-Alignments

The current plan's ***proposed alignment of the Mid-Level Road*** seemed to raise some concerns with some interviewees. Others also expressed concerns about the changes made to the ***Kamanu Street alignment*** from what was discussed in the Kona CDP:

> *"The alignment of Mid-level Road needs to follow the alignment shown on the CDP. Kamanu Street also needs to follow the preliminary design. The Hina Lani Intersection was built to increase the capacity of connectors."*

> *"The original alignment of Kamanu Street was supposed to lead through the Kaloko industrial Park area directly south of the project, go around to the water tank and then through the industrial Park- The owner of the Industrial Park set aside land for that. He wouldn't be happy to have it veer away from his property*

like that. It wasn't decided if the road was going to connect with the industrial park in the middle, or at the top, but that guy will want his connection there."

To address a better connection between industrial uses proposed as part of the project (to be addressed in more detail in the subsequent Section 3.4.6), someone suggested the realignment of Hina Lani Street through SCD as well:

"I would suggest a change to the Hina Lani route as shown on the map in order to better facilitate the traffic flow on the collector and allow better integration into the light industrial area."

Phasing of Road Construction

Kona's traffic problems – despite some alleviation from widening of Queen Ka'ahumanu Highway near Kailua – are so longstanding that many people assumed the congestion would continue whether or not the Project's projected roads are built. Some also ***feared that any mis-phasing for road construction would aggravate the traffic situation:***

"The biggest fear I have is Hina Lani being overtaxed, so phasing in would have to be done with other project roadways, to avoid putting all the pressure on Hina Lani. It's always a concern that infrastructure could get out of synch with actual population growth."

"People buying a new home may want to have services and infrastructure immediately after they purchase of a home. Timing is big part of it."

"In general, when you add 5,000 units, they all have to come out on either old Māmalahoa Highway or Queen Ka'ahumanu. Even with the Mid-Level Road, you'll have to get to one of those major highways. The project impacts are adding to, not resolving needs; the development will be constrained by what's on either end."

Other Infrastructure Issues

Other concerns involved ***water*** (both additional in an area which is already experiencing shortages and the treatment of it), and non-point source pollution issues. Interviewees felt the Waste Water Treatment Plant would be a key benefit to the Project, but also felt ***more in-depth planning (or more information) about water and wastewater is needed for a project this size***. It should be noted that an EIS would normally address most or all of these types of issues.

"With so many impermeable surfaces in project, we feel there's not enough infrastructure to deal with the run-off. Dry wells are what's used in the county, and there have been no anti-pollution measures in the design of those dry wells."

"You can't just provide housing. Water will also be critical."

"I think that the placement of a WWTP is huge, that they're planning to include all that in project to mitigate impacts is really great."

Finally, some people offered suggestions for improving the design of the proposal's services and infrastructure:

"As a trail-oriented person, I'd just like to see special treatment for the place where trail crosses the road – safety features."

"I would like to see more design for multi-modal, shared use path for bikers, skaters, and all alternative non-motorized modes – such as open shoulders to provide transportation for more skilled cyclists."

3.4.6 Retail, Commercial and High-Tech Business Development

Interviewees were asked for reaction to the proposed plans for about 120 acres of commercial space in various locations – of which the largest would be a business park off Queen Ka'ahumanu Highway that may potentially include scientific research & development facilities, plus some retail dispersed throughout. We asked if these proposed uses and locations seemed appropriate.

The proposed ***location of most industrial uses along Queen Ka'ahumanu Highway was generally well received.*** (Someone observed, however, that the County of Hawai'i may require an 800-foot setback from the highway for these uses, and said this may not be conducive to successful commerce.) People also liked the idea of a business park with scientific, research, and development facilities in that location:

"Location-wise, this project's retail/commercial/high tech components are very good, largely because of their proximity and adjacency to Hina Lani Street."

"The Project's proximity to both NELHA and to the new West Hawai'i campus, as well as to the National Park, makes it a good area for that sort of product! It will be considered appropriate in-fill if the right tenants can be recruited. No need for big boxes there!"

"That kind of element provides places that small businesses need ...and in this marketplace opportunities are still not sufficient even today. There is especially a need for places that have more of a finished appearance than light industrial areas usually do. That location by the airport would be very beneficial."

On the other hand, although the plans seemed to make sense to most, some questioned the need for additional substantial supply[23] of ***commercial, retail, and high tech development facilities during the current poor economy***, when so much of Kona's existing inventory lays vacant. Someone even questioned whether tech

[23] **Note:** These comments were in response to an older project description (Appendix B) that has since changed. SCD and its consultants came to the same conclusion and reduced planned industrial space.

development would be allowable in a neighborhood TOD. Along with lack of demand for commercial and retail spaces, some even suggested the long-range demand for high tech may be difficult to anticipate and plan for:

"A tech area would be a special area – I am not 100% sure that that would be allowed in a neighborhood development; It would have to be a special, separate area. We have a fair amount of commercial development already in the area."

"If there were a demand for that much more light commercial ... The concern I have is that lots of Kaloko Industrial Park has not yet been absorbed. Half of it is empty, and there is more to be developed."

"I am concerned about demand for light industrial or high tech. One would have to create demand for high-tech, it requires lots of public-private effort. You need incentives to get them in. NELHA is tied to the ocean, but more terrestrial activities would have to be brought in. I'd be concerned about what the market can sustain."

As with the proposed roads and utility infrastructure components of this Project, the industrial component raised some concerns in regards to how this could potentially have an ***impact on local groundwater and coastal waters***:

"That part of the development will be sandwiched between two existing industrial areas. There are waste issues associated with these types businesses. USGS has found contaminants in our dry wells in the past. The existing industrial park is an urban area with contaminants moving directly to groundwater that goes quickly to the National Park and then to ocean. The exact source of release is not known; however, there was a spill of some sort in the industrial park in the 90s. It is assumed that anything upslope would be contributing to non-point source pollution."

Some final recommendations heard in regards to the industrial areas included

"Move it mauka – we have enough on the highway."

"Will there be green space or a buffer within the industrial area? Industrial areas don't have to be ugly! A lot of effort was put into landscaping in the Kaloko Industrial Area, and I think that's an important requirement that makes an industrial area a lot more attractive."

3.4.7 Schools

At issue were proposed sites for two elementary schools and a middle school.. ***Interviewees generally responded favorably to the idea of more schools to serve existing and future students.*** However, some also said that although they appreciated the SCD effort to provide school sites, land alone would not be enough – they wanted the developer actually to build the school structures early on and then turn them over to the State for future need. Others recognized this is not the normal procedure and would

increase the price of housing, but still thought the developer needs to be involved in assuring the schools become a reality.

"Kealakehe Elementary, Intermediate and High Schools are already open and located nearby. I am not saying schools are not needed; at full build, it will become necessary, we would have to have more schools. The costs of any impacts generated by the development should be paid by that development."

"It will be years before they develop the school, so the designation of the land is good – it's all you can do! The State doesn't have money to hire teachers anyway!"

"I don't think the State has the capacity to get things done in time and on budget. It will take developer working closely with the State to make sure [schools get built] on time."

The persistent theme that the developer should provide substantial "upfront" infrastructure (schools, major regional highway, even the hospital structure) – with limited thought about implications for housing affordability – seems to reflect ***a pervasive distrust in Kona that government can actually deliver infrastructure when needed.*** It may also reflect an implicit assumption that private-sector housing developments are targeted mostly to upscale purchasers – and that it is therefore financially feasible to extract some of the developer profit and/or that the additions to housing price would not really affect the local economy.

Along these lines, we also uncovered some questions about the assumptions made about the future demographics of the area. Some people we spoke to said that from what they could see of the proposed plan, it could attract an older, financially sound demographic and not young families with school-aged children. (This is contrary to developer representations, though it should be noted such representations were not emphasized in the EISPN project, including the portions shared with interviewees.)

Because of this assumed (or feared) older and upscale market, some interviewees feared schools would never materialize on the site. Again, this may be a case of people talking less about this project than about their perceived cumulative experience with development in Kona. By becoming a Regional Center TOD the development effectively could provide a greater mix of housing, as greater densities would be allowed within its urban core. These mixed-use and multi-unit dwellings are actually intended to lower housing costs across the entire development, making it affordable for the Kona workforce, especially those with families.

Finally, a few people who doubted the real need for regular schools in this project thought the sites could still be used for alternative educational purposes.

"I would say what will work out there (Kaloko Makai) will be specialty schools, such as trade schools and charter schools that could lace themselves into the plan."

3.4.8 Trails, Parks, and Open Space

We showed interviewees that the proposal included a historic trail, 65 acres of interconnected park space, and 150 acres of dryland forest open space area. We then asked whether there were any particular community needs they thought could be met with the development of these new areas, as well as what sorts of facilities should be provided. Many interviewees ***approved the Project proposing so much green space and protection of cultural/natural landscapes***.

Dryland Forest

This was generally seen as a particularly valued project amenity.

> *"Other developments don't happen to have such a nice dryland forest that can be incorporated into their development! I view that as a gift. It makes this property quite unique; it contains some very special botanical resources, and I'm very glad they'll set it aside."*

> *"This is the wave of future; walkable green spaces, and taking advantage of historic trails as assets rather than something inconvenient to work around."*

> *"The dryland forest is an attraction for the larger community, because native dryland forest areas are becoming rare; this could offer a tremendous educational benefit. If the West Hawai'i University of Hawai'i campus gets built nearby, it would be an educational resource for them as well."*

Trail

Incorporating the historic Road to the Sea (or Kohanaiki) Trail was also seen as a ***highly desirable project characteristic***. However, a number of interviewees said ***more work needs to be done to locate (and define) the historic Trail alignment*** meandering through the lower portion of the parcel. Although interviewees seemed optimistic about the prospects of working with SCD to make that happen, the history of the events which unfolded during the process of making the plans for Kaloko Heights (another Stanford Carr development) remained fresh in people's memories.

In the opinion of some interviewees, SCD failed to involve the community early enough into the Project for its development at Kaloko Heights. The view was that many problems could have easily been avoided if SCD had consulted more with area residents, descendants and other community members instead of ignoring the trail's presence. Although the "messy" history still remains in people memories, the efforts to incorporate the trail into the plan, and their attempt to try to locate its alignment have not gone unnoticed at Kaloko Makai:

> *"For Kaloko Makai, they did much better. They did not show up with subdivision already mapped out. Instead, they invited [us] to check where their archaeologist*

> *thought the trail goes, and acknowledged the importance of consulting lineal descendants. The whole approach was much more thoughtful and much more respectful. The feeling of being included early made a great difference."*

> *"I find that to be a strong positive for the project. Any time you allow public access, it makes a project stronger. When developments stop access to previously accessible areas, it hurts the community. It is very important to provide people access to natural areas."*

Some questions were also brought up as to how the developer would respond if other trail segments were to be uncovered throughout the parcel. The Historic Trail has been part of the regional cultural landscape and played a role in getting people back and forth across the ahupua'a for a very long time:

> *"The Road to the Sea Trail has been identified as the main artery for the ahupua'a, connecting fish ponds with homesteads. These were places where memories were passed on to living generations of kūpuna or ancestors going up and down the trail. So much elevation change with this trail that many different types of things were gathered up and down the trail as people went. While the trail is an extremely important feature, there are also cave sites, burials, home sites – all attached to currently living people with very deep connections to them."*

> *"This trail served and provided for my grandparents, as this was the main access to the shoreline."*

Other Parks and Green Space

Although most people were pleased this plan leaves many acres of green space intact and/or protected, interviewees suggested that with such a large development, ***parks and open space need to be well maintained for active use***, not just passive uses or unused space. Community members had various ideas and suggestions in regard to green space, trails, and community spaces:

> *"There's no real park land from down from town to Waikoloa – no soccer fields, or ball parks. Everything takes place in town. The dryland forest would not address this, nor would a trail. We need more active playing fields."*

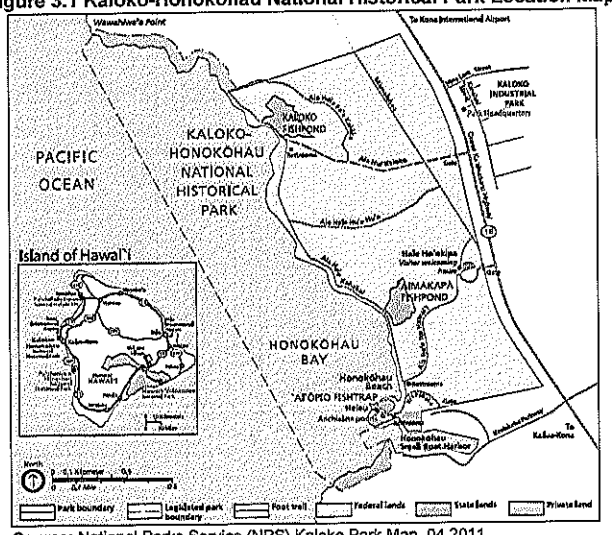
> *"Ideally, what I'd like to see is that the trail becomes an attractive alternative to walking along roads – e.g., for after-work walk or school children to schools. Make it a living, relevant feature, not just something to look at and say, 'Oh, that's what used to be!' If dryland forest plants can be planted adjacent, it would be much more pleasant. I have yet to see that happen, but it's not out of the question!"*

> *"What we need is to have more open, maintained, accessible space. It has to be open and maintained. People have to feel safe there. If it is not maintained, you're going to have people growing pakalolo over there, more crime etc."*

3.5 Particular National Park Service (NPS) Concerns

We did not ask interviewees direct questions about the impact of the project on neighboring parcels. However, we made a conscious attempt to try to contact nearby and adjacent landowners in order to make sure to capture their concerns, if any. Although we did not get a response from all the people we attempted to reach, we did have an opportunity to speak with four NPS staff[24] on March 10, 2010. The northern part of the Kaloko-Honokōhau National Historical Park is located directly across Queen Ka'ahumanu Highway makai of the Project site (Figure 3.1). The Kaloko Fishpond is located directly down slope from Hina Lani Street, which is at center of the project site.

Figure 3.1 Kaloko-Honokōhau National Historical Park Location Map



Source: National Parks Service (NPS) Kaloko Park Map. 04,2011
http://www.nps.gov/kaho/planyourvisit/loader.cfm?csModule=security/getfile&PageID=124438

According to its website,[25] the Park was:

> Established in 1978 for the preservation, protection and interpretation of traditional native Hawaiian activities and culture, Kaloko-Honokōhau NHP is an

[24] Kathy Billings, Park Superintendent, Kaloko-Honokōhau and Pu'uhonua O Honaunau National Historical Parks; Aric Arakaki, Superintendent, Ala Kahakai National Historic Trail; Sallie Beavers, Marine Ecologist and Chief of Resources; Rick Gmirkin, Community Archaeologist, Ala Kahakai National Historic Trail, Interview Conducted on March 10, 2011.

[25] http://www.nps.gov/kaho/faqs.htm

> 1,160-acre park full of incredible cultural and historical significance. It is the site of an ancient Hawaiian settlement which encompasses portions of four different ahupua'a, or traditional sea to mountain land divisions. Resources include fishponds, kahua (house site platforms), ki'i pōhaku (petroglyphs), hōlua (stone slide), and heiau (religious site).

Additionally, the Ala Kahakai National Historic Trail Program began in 2000, when the Ala Kahakai National Historic Trail was added to the National Park Service's inventory of federal trails within its system. This coastal trail is of considerable historical and cultural significance. The Project EISPN discussed the preservation of the Road to the Sea which makes its way to the ocean, from the inland sections mauka of the Project Site, connecting to an ancient network of trails, including the Ala Kahakai Trail. The National Park Service Ala Kahakai National Historic Trail Staff therefore also spoke to us.

However, the interview responses were limited and largely focused on referring us to NPS/Ala Kahakai comments in their letter responding to the project EISPN. In this letter, the NPS specified a number of issues of concerns. Ways they suggested these concerns be addressed are outlined below:

Table 3.5 NPS Comment Letter Concerns

Theme	NPS Concern	Suggested Ways to Address Concern
Surface Water Drainage, Non-Point Source Pollution	The quality of the groundwater entering Kaloko-Honokōhau National Historic Park should be preserved	"The EIS should contain a thorough and rigorous analysis of potential impacts, direct and cumulative, to groundwater and groundwater-fed ecosystems." "A full analysis if drainage construction techniques beyond what are required by the county and state, such as filtered drainage systems appropriately and specifically engineered to be effective in Kona's arid, low soil environment to reduce non-point source pollution to the groundwater and marine waters."
Water System	Water conservation measures need to be incorporated into the Plan	"A quantitative analysis if the potential changes to groundwater flow and quality within the aquifer system must be made to identify the impacts on the National Park inland and nearshore marine waters"
Wastewater System	Proposed methods for dealing with wastewater treatment, effluent, and their direct and cumulative impacts need to be analyzed	"Septic Systems should not be considered for this proposed project." "Methods for disposal of medical wastes and prevention of accidental releases of hazardous wastes from the medical facilities should be described in more detail."
Roadway System and Traffic	Address significant additional noise and traffic on Queen Ka'ahumanu and at access point to the National Park and Park headquarters	"The EIS should analyze the effects of the increase in traffic, including direct, indirect, and cumulative impacts to visitors accessing the National Park and the measures planned to alleviate traffic congestion, including a detailed discussion of the proposed interchange connecting Kaloko Makai with the Queen Ka'ahumanu Highway."

Theme	NPS Concern	Suggested Ways to Address Concern
Noise	An analysis of direct and cumulative increased noise generated y the project needs to be conducted (during construction and at full build-out phases)	"Address the soundscape within the National Park."
Air Quality	Air quality and its effect on human health needs to be addressed	"The EIS should discuss how new sources will be controlled and appropriate mitigations for improving post-construction air quality."
Visual Resources	Mitigate adverse changes to viewshed, night sky, topography and vegetation within the Project area	"The EIS should include a viewshed analysis form the National Park looking mauka to examine and analyze direct and cumulative impacts to cultural landscape, park viewshed, night sky and a description of how these impacts will be mitigated." "Include a more detailed analysis of building designs that will minimize viewshed impacts and blend development into the landscape, as well as including a discussion of appropriate plantings to reduce those visual impacts."
Archaeological and Cultural Resources	Should include the Kaloko-Honokōhau National Historic Landmark designation in Project's listing of archaeological and cultural resources	"There should be discussion in the EIS regarding early consultation and engagement with lineal descendants and the Native Hawaiian community specifically about the development plans and archaeological/cultural resources, cultural landscape, and potential places of significance."
Preservation/ Open Space and Connectivity to the National Park	Preserving and fostering connectivity between the National Park and the Ala Kahakai National Historic Trail	"The EISPN discusses preserving and protecting archaeological sites, the Road to the Sea, establishing open space and preserving coastal dryland forest. These are integral parts of the cultural landscape of the Park and the ahupua'a."
Impacts to Coastal and Recreational Resources	An analysis of the impacts to coastal and recreational resources because of this projects should be conducted	"The EIS should analyze direct and cumulative effects of 5,000 additional resident families utilizing the National Park and its coastal resources. This analysis should include direct, indirect and cumulative impacts resulting from recreational uses on the National Park's law enforcement and visitor services, the park's future Cultural Live-in Center, archaeological sites, fisheries, fish, coral and protected species inhabiting near-shore waters and beaches."
Contextual Issues, Cumulative Impacts	Existing and proposed developments around the Project area should be taken into account	"Cumulative, direct and indirect impacts that will affect Park resources, visitors and those engages in traditional and cultural practices, particularly traffic, noise, air pollution, night sky light pollution, mauka viewshed, increased park visitation, coastal recreational use, and the quality and quantity of ground water resources."

APPENDIX A: KALOKO MAKAI INTERVIEW GUIDE

Interviewee Name:
Affiliation:
Date:
Method of Interview:

Aloha and thank you for taking the time to answer these questions. We are independent consultants, retained but not employed by Stanford Carr Development, LLC, the proposed developers of Kaloko Makai in the Kohanaiki and Kaloko ahupua'a of North Kona, County of Hawai'i. We're conducting a social impact study to be included in the development's Environmental Impact Statement, which is being prepared by Wilson Okamoto Corporation.

As part of this study, we are interviewing a cross-section of community leaders from West Hawai'i. We intend to print the names and affiliations of the people we interview, but not quote anyone by name. We will summarize the general themes, issues, and concerns, but we will not tell the developers or anyone else who said what. We are not the developer's representative, and we're better able to ask questions than to answer them. If you have any questions, please write them down. The developer has retained a representative, Peter Young, and we can give you his contact information if you'd like to follow up with him.

General West Hawai'i Questions

1. Please tell me a little about yourself, the organizations you're involved in. What are the main community issues you and these groups have recently been focusing on?

2. What do people most value about living here, what's going well, what makes it desirable or different from the rest of the state?

3. And what are the major problems for West Hawai'i, the things that people are most concerned about these days? What needs or complaints do you know about?

Project-Specific Questions

4. What, if anything, have you heard about the Kaloko Makai project? Is this proposal pretty well-known to the people in your organization(s), or not?

5. Is the Stanford Carr Development company known in Kona? Does it have any particular image?

6. From what you (know of the project / can see in the project description), what do you think are potentially the most positive things about the project – ways it could be good for West Hawai'i or for the people in your group(s)?

7. And what do you think are potential problems – ways it could be bad for West Hawai'i or for the people in your group(s)?

8. Right now the major hospitals for West Hawai'i are the Kona Community Hospital (94 beds) 11 miles south of the Project and the North Hawai'i Community Hospital in Waimea (50 beds).

   a. Do you think these facilities are adequate to cover the growth from this proposal and other projects in West Hawai'i?

   b. This Kaloko Makai project includes a site for a new regional hospital. Does this general location seem a good one for that purpose?

9. Are you aware of the Kona Community Development Plan (CDP)? Were you involved in the community outreach efforts which led to the drafting of the plan?

10. The project's EISPN states: "*The proposed project is identified as a Neighborhood Transit Oriented Development (TOD) in the Kona Community Development Plan. Kaloko Makai will be setting aside land for development of an urgent care medical facility, as well as land for a future hospital. A hospital developer/operator is being pursued. When a hospital commits to locating a hospital at Kaloko Makai, the TOD will automatically be designated as a Regional Center TOD. Therefore, Kaloko Makai is being conceptually designed on the assumption that Kaloko Makai will be a Regional TOD*".

    A Regional Center could have a much larger land area and higher densities. The Kona CDP now targets four Regional Centers for the area from Keauhou to Keāhole; with the hospital, Kaloko Makai would become a 5th[26].

    a. Do you feel the Kona CDP's placement of a TOD community at Kaloko Makai is appropriate?

    b. Does it matter to you whether the TOD planned at Kaloko Makai is a Neighborhood or Regional Center TOD with a hospital? Why?

11. The developer says the first things to be constructed would be the roads and basic infrastructure, along with "Village I" just above the Queen Ka'ahumanu Highway.

[26] Pages 4-128 and 4-129 of the Kona CDP have language about hospitals and Regional status: "To encourage the private sector to negotiate a site for the hospital, the TOD in which the hospital decides to locate within shall be automatically designated a Regional Center TOD if the Official Kona Land Use Map has designated it as a Neighborhood TOD. As a Regional Center TOD, there would be incentives for medical offices and other hospital-related businesses to develop in the vicinity"

Everything else would be built to respond to residential market demand, probably over a roughly 30-year period. Does this strike you as a reasonable phasing approach?

12. The largest portion of this project is the construction of 5,000 new single- and multi-family residential units at low- and medium-densities over about 30 years. Please tell me a little about what people in West Hawai'i are saying about the need for housing these days.

    a. First, do you believe there really is a need among the existing workforce?

    b. What type of housing is needed, and what do you think will determine whether this project does a good job of meeting actual need?

    c. Please review the available information about the developer's intention to develop "affordable housing" as part of the project.

       - Overall, does this seem like a good approach? Does it seem any better or worse than other developers' approaches to affordable housing?

       - What do you think is the better way to mix affordable units into an overall development – mix them up with the market rate units, or have some concentrated pockets, which could make them even more affordable but less well integrated?

    d. Can you think of other recent housing developments in West Hawai'i that generated either positive or negative impacts? (If so, what made them good or bad, what were the "lessons learned" for residential development here)?

13. Plans include roughly 140 acres of roads and utility infrastructure to support the development. Do you have any comments regarding how the development might impact the current transportation and infrastructure needs of the area?

14. You'll note this project includes a segment of the long-planned Mid-Level Road that would provide an alternate to the Queen Ka'ahumanu Highway for getting from Kailua to the airport.

    a. We'd like to know if you have any questions or advice to the developer about the importance of getting this built.

    b. Do you see any other opportunities for this project to help with solving traffic issues, either from the project itself or from general growth?

15. The development plans also include retail, commercial and high tech business development. Do you believe these proposed uses seem appropriate – any thoughts or issues on those particular parts of the proposal?

16. Kaloko Makai plans include two elementary schools and a middle school. Do you believe those plans mesh with existing and future community education needs?

17. Finally, the project includes a possible historic trail, 65 acres of interconnected park space, and 150 acres of dryland forest open space area

    a. Currently, what current similar areas are utilized by the community?

    b. Are there any particular community needs you think could be met with the development of these new areas?

    c. What sort of facilities should be provided?

18. If this project could be changed in just one way to make it better for West Hawai'i, what would that change be?

19. know if we can talk to everyone in West Hawai'i, but what other groups do you think would be particularly affected by, or interested in, this project? Who else should we make an effort to contact?

Mahalo for your time! Do you have any questions?

APPENDIX B: KALOKO MAKAI PROJECT DESCRIPTION

Size and Location: About 1,142 acres, extending mauka from Queen Ka'ahumanu Highway. The Queen Ka'ahumanu portion is located just north of the existing Kaloko Industrial Park. Hina Lani St. forms the southern (Kailua-side) border of the lower part of the property, but the upper part includes land on both sides of Hina Lani.

Current Use and Land Use Designations: Vacant and undeveloped. County General Plan – Urban Expansion and Conservation. Keāhole to Kailua Development Plan – Urban Expansion, Residential Village, and Golf Course. (*The current General Plan "Conservation" designation was for a once-planned golf course that would be deleted under the new plan; the developer will ask the County for Urban designation of the former golf course land after State Land Use approval.*) Kona Community Development Plan (CDP) indicates the general Kaloko Makai area as one of the designated "villages" for transit-oriented development.

State Land Use now Conservation, Agricultural, and Urban – request is to change about 224.5 acres from Conservation to Urban and 728 acres from Agricultural to Urban. (The State Urban designation would follow the County's Kona CDP designation as an urban area.) A 150-acre dryland forest preserve will be created. An EIS is being prepared.

Development Concept/Phasing: Consistent with the Kona CDP, Master-planned residential community, with supporting commercial, educational, recreational, open space, and related infrastructure. Primarily a residential development, with some business/commercial job centers. To be developed in three phases (or "villages") over an estimated 28 years. First homes by 2015.

Key Components:

- Residential - At full development about 5,000 new single- and multi-family residential units at low (up to 3 units per acre) and medium (up to 20 units per acre) densities.
- Commercial – About 120 acres in various locations. Largest would be a business park that may potentially include Scientific Research & Development facilities, retail, and a regional hospital along the Mid-Level Road. Mixed-use areas of the project are designed to include residential and commercial uses within close proximity of each other (this may include affordable residential on top of a variable commercial component).
- Preservation / Open Space / Recreation – In addition to the dryland forest (150 acres of preserved forest and natural habitat), the project will preserve a historic trail which is commonly referred to as the *Road to the Sea*. While the boundaries of this trail (within the Kaloko Makai property) have yet been determined, we are sure that the trail originates in the mid-section of the property just east (makai) of Kaloko Makai (in the site, properly named Kaloko Heights) and meanders down through the KM parcel. A series of archaeological outcroppings have also been noted in our Archaeological Inventory Report. Depending on the nature of each archaeological site buffer zones will be provided accordingly.
- Facilities and Roads – Land set aside for elementary and middle schools. Active parks and recreation areas. The proposed Mid-Level Road would cut across the project.

Estimated Housing Prices and Types *(Current Developer Assumptions)*:

- "Affordable" Component – Will be 20% of units (about 1,000), targeting residents with income levels between 60%-140% of area median income. Based on 2007 HUD numbers, that would include at least some units for rental to 3-person low-income families at $972/month and for sale at $152,600 (2007 numbers). Final mix of affordable not yet known.
- Market Component – A wide range of products, in today's dollars from mid to high $200,000's up to $1,000,000. The target market is the local rather than the offshore buyer. Overall, the project is intended to respond to already-planned economic growth rather to generate more of it

For a more complete description, you can download the EIS Preparation Notice from:
http://oeqc.doh.hawaii.gov/Shared%20Documents/EA_and_EIS_Online_Library/Hawaii/2010s/2010-09-23-HA-EISPN-Kaloko-Makai.pdf.

[**IN FINAL PDF, ELIMINATE THIS PAGE AND INSERT THE PDF'S OF TWO MAPS SHARED AS PART OF PROJECT DESCRIPTION!]

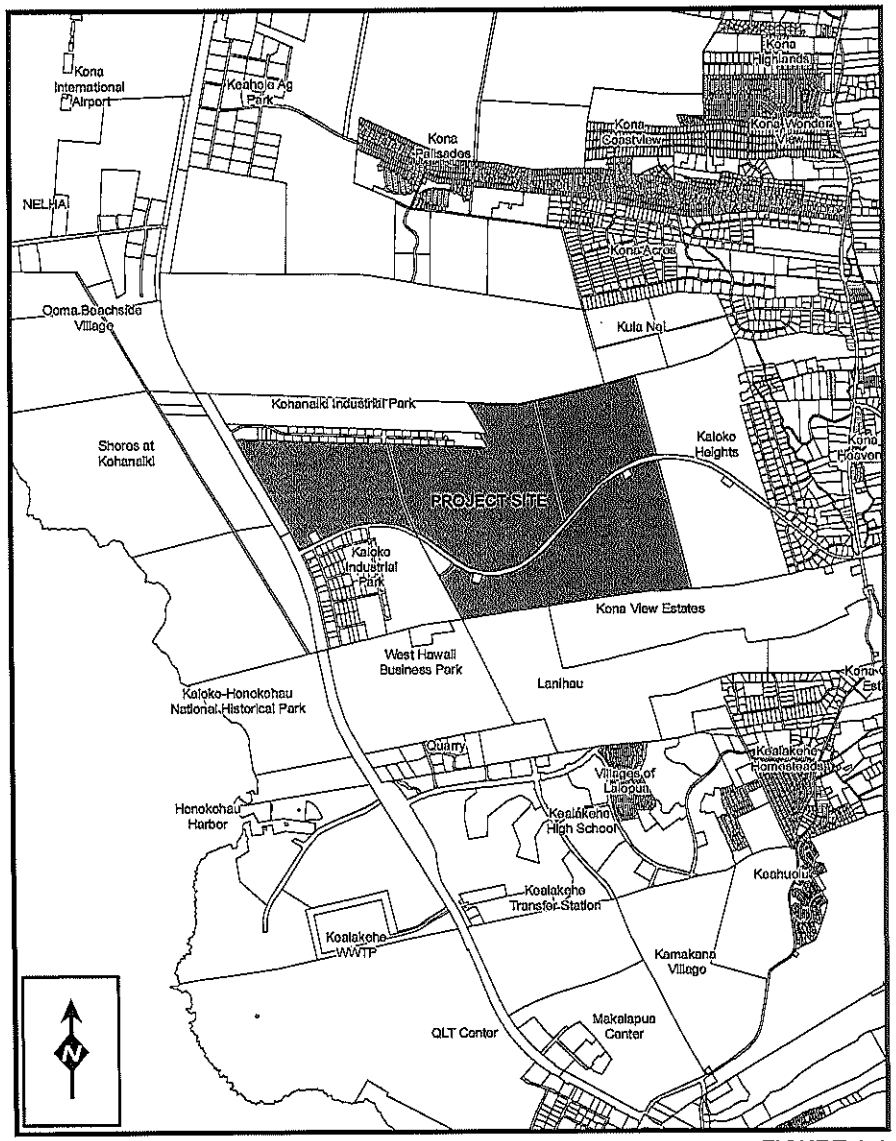
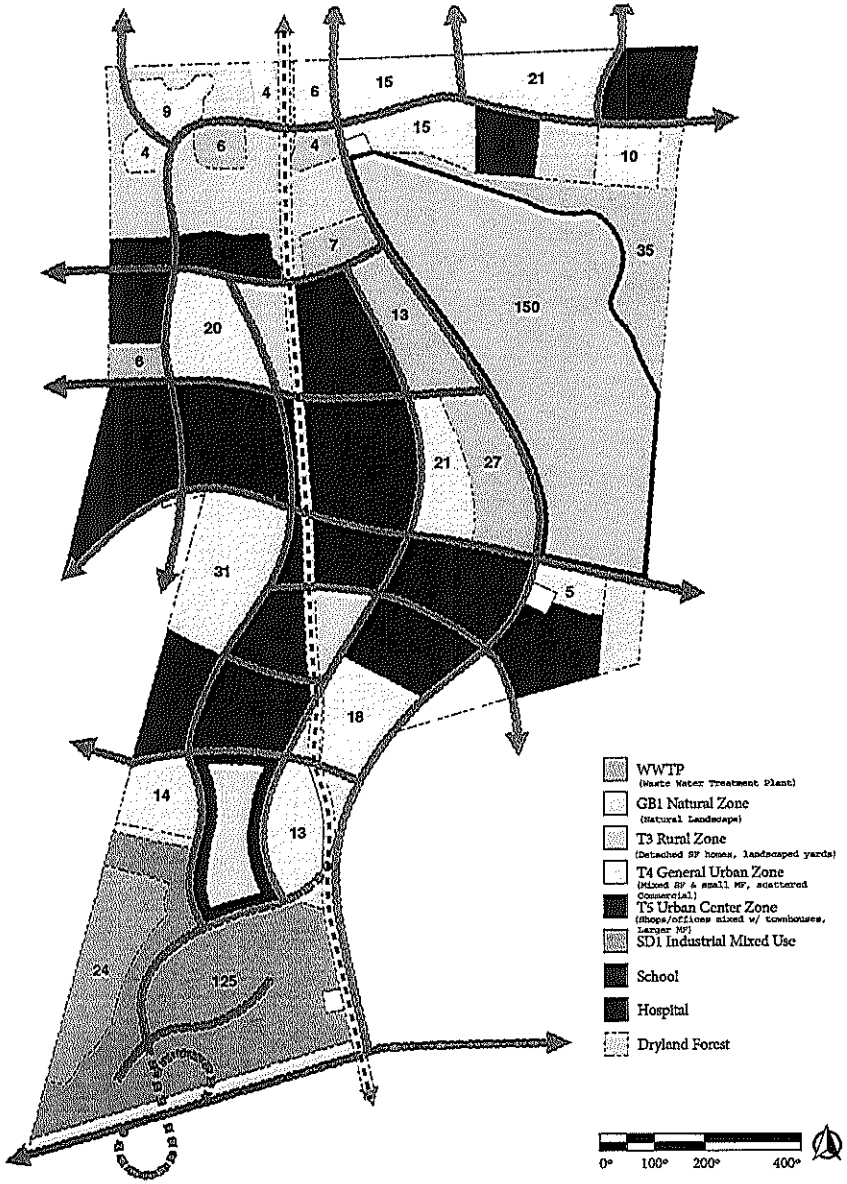


FIGURE 1-4
Existing and Proposed Uses Within the Vicinity of the Project Site
Kaloko Makai



Kaloko Makai Village Plan

°DAEDALUS DESIGN Confidental

Transect Zone Allocation

Scale 1"= 250'

J•M•K JOHN M. KNOX & ASSOCIATES, INC.

KALOKO MAKAI SOCIAL IMPACT ASSESSMENT

Volume 2: Housing Issues

June 9, 2011

Prepared for:
Stanford Carr Development, LLC.

Prepared by:
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FOREWORD

John M. Knox & Associates was engaged to prepare a social impact assessment of the proposed Kaloko Makai mixed-use commercial and residential development in Kona. In accord with Kona Community Plan principles of providing housing choices, recreation opportunities, directing growth patterns towards compact villages and encouraging a diverse and vibrant economy, Stanford Carr Development proposes a 1,142-acre development with a strong emphasis on residential development.

The work is presented in three volumes:

1. Volume 1 presents background socio-economic conditions and results of a community interview process to surface key issues.

2. The current Volume 2 is an analysis of housing issues, prepared in part by subcontractor Tom Dinell (Dinell Associates). Mr. Dinell is Emeritus Professor in the University of Hawai'i Mānoa's Dept. of Urban and Regional Planning, teaching courses on housing there.

3. Volume 3 contains results of a 2009 "North Kona Community Planning Survey" that focused on awareness of the new Kona Community Development Plan (CDP) and extent of agreement with key element relevant to the proposed project.

SUMMARY AND ANALYSIS OF VOLUME 2 RESULTS

Chapter 1: The Policy Framework and the Kaloko Makai Project

Chapter 1 demonstrates that there is a demand for the type and quantity of housing that the Kaloko Makai Project will provide, especially in terms of affordable housing. The County policy documents – the General Plan, the Kona Community Development Plan, and the other Hawai'i County ordinances and rules relating to housing – describe this demand in general terms and the Market Assessment for Kaloko Makai, prepared by Mikiko Corporation, documents this demand as do the data presented in Chapter 2 of this Volume.

Chapter 1 also shows that the proposed Kaloko Makai Project is consistent with and implements the County General Plan, the Kona Community Development Plan, and the Village Development Guidelines. There is a close fit between these plans and guidelines on the one hand and the Kaloko Makai Project, as described in the Environmental Assessment/ Environmental Impact Statement Notice (September 2010), on the other.

The General Plan goals for housing do a good job of describing the Kaloko Makai Project – i.e., (1) constructing safe, sanitary, and livable housing for the residents of Hawai'i County; (2) providing a diversity of housing that allows a variety of choices; (3) creates a viable community with affordable rental and fee-simple housing in (4) a variety of sizes to satisfactorily accommodate the needs and desires of families and individuals; (5) ensures availability to all persons regardless of age, sex, marital status, ethnic background, and income, (6) in reasonable proximity to employment centers, while simultaneously (7) encouraging and expanding home ownership opportunities for residents.

The Kona Community Development Plan (CDP) specifies that the master plan for a TOD (transit oriented development) is to (1) promote transit-oriented and pedestrian-oriented development, increase transit use to manage traffic congestion; (2) encourage mixed-use, compact development that is pedestrian in scale and sensitive to environmental characteristics of the land and facilitate the efficient use of public services; (3) have residences, shopping, employment, and recreational uses located within close proximity of each other and efficiently organized to provide for the daily needs of the residents; (4) provide for a range of housing types and affordability within pedestrian-oriented, human-scale neighborhoods; (5) incorporate natural features, open space and cultural features; (6) provide efficient circulation systems for pedestrians, non-motorized vehicles, and motorists that serve to functionally and physically integrate the various land use activities; and (7) promote strong neighborhood identity and focus.

The proposed Kaloko Makai Project is designed to successfully meet each of the Kona CDP objectives. For example the inclusion of the Dryland Forest and the Historic Trail speak specifically to incorporating natural features, open space, and cultural features.

The Village Design Guidelines specify that TOD villages (1) are to be compact, pedestrian-oriented and mixed use; (2) that the ordinary activities of daily living are to occur within walking distance of most dwellings, allowing independence for those who do not drive; (3) that interconnected networks of transportation corridors are to be designed to disperse traffic and reduce the length of automobile trips; (4) that within neighborhoods, a range of housing types and price levels are to be provided to accommodate diverse ages and incomes; (5) that appropriate building densities and land uses are to be provided within walking distance of transit stops; (6) that civic, institutional, and commercial activities are to impart a focused town center and gathering place; (7) that schools are to be sized and located to enable children to walk or bicycle to them; (8) that a range of open space including parks, squares, and playgrounds are to be distributed within neighborhoods and villages; and (9) that the growth of each villages stays within a defined edge and thereby helps to establish a compact sense of place.

The requirements set forth in the Village Design Guidelines also do a good job of describing the plan for the Kaloko Makai Project. The schools, for example, are located so children can walk or bike to them. The walkability of the Project will vastly reduce the need for short vehicle trips. There is a range of open space in each village and all the villages have defined edges.

Chapter 2: Data on Social Issues Relating to Affordable Housing

In response to the frequent community concerns (as outlined in Vol. 1) about social impacts of high housing costs – particularly the sense that "local" residents are inequitably affected and often cannot qualify for officially designated "affordable" housing under HUD/County guidelines – we analyzed Census data on ethnic differences in housing outcomes for the Big Island and West Hawai'i in Chapter 2. (Ethnicity is used as a proxy for newcomer/local, as the great majority of "Whites" were <u>not</u> born in Hawai'i, while the great majority of Asians, Native Hawaiians, and Mixed Race population <u>were</u>.) Among the conclusions of the analysis:

- All groups – newcomer/longtime residents or ethnic/racial groups – face serious affordability issues in regard to housing in West Hawai'i (especially North Kona). Whites tend to pay more for housing in West Hawai'i and islandwide, even in areas where their average incomes are not higher than those for other groups.

- Native Hawaiians (and perhaps Filipinos) are particularly challenged in West Hawai'i due to lower overall incomes that reflect differences in overall education, age, and family structure (e.g., single parents). There is no evidence of deliberate discrimination, but these differences do result in unequal housing outcomes.

- "Affordable housing" guidelines tend to be harder for West Hawai'i residents to meet than for people elsewhere on the island for the perhaps ironic reason that incomes are higher there. These guidelines are based on the principle of median incomes for various family sizes, and the very usage of the median (the "middle point" in range of incomes) means that substantial percentages will fall below the median cut-off.

- Groups such as Native Hawaiians have a sort of "advantage" in meeting affordable-housing guidelines because of lower average incomes. But this "advantage" tends to be reversed by higher average household sizes, which means they must earn more to qualify in order to pay for larger homes. So it is in a sense true that County guidelines present more barriers to "local" qualification, but only because they reflect the underlying economic reality that larger homes cost more.

Ultimately, though, the social challenges facing West Hawai'i will probably have less to do with the fairness of "affordable housing" guidelines than with the soaring prices of market housing. The social impact of the Kaloko Makai Project will be positive to the extent that it succeeds in the goal of providing more affordable market housing to working families – a goal that would likely be achieved by greater densities consistent with the Kona Community Development Plan.

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1. THE POLICY FRAMEWORK AND THE KALOKO MAKAI PROJECT

This chapter describes both the proposed Kaloko Makai Project and the environment in which it is being developed and implemented. The County's policy framework – specifically its planning goals and objectives and the processes for meeting them – are set forth in some detail. Particular attention is paid to the Kona Community Development Plan and the accompanying Village Design Guidelines. The key conclusion from this chapter is that the Kaloko Makai Project as proposed furthers the accomplishment of these goals and objectives.

1.1 The Need for Housing in North Kona

Volume 1 of this study provides data on the general issue of lack of affordable housing and in West Hawai'i as a whole. Additionally, the Market Assessment for Kaloko Makai, prepared by Mikiko Corporation, documents the need for housing in North Kona in the time period 2010-2040.[1] Just a few highlights from that report will serve to indicate both the quantitative need for housing and the changing nature of the population to be served:

- The projected Hawai'i Island population increase between 2010 and 2040 is slightly more than100,000 people, or a 55% increase.
- As of 2010, the Competitive Residential Market Area (CRMA, defined as North Kona Census Tract 215.01and South Kohala Census Tract 217.01) provided 23% of employment positions on the island while at the same time housing only about 12% of the Island population.
- Population in the CRMA will grow at about 3.8% per year in the 2010-2040 time period.
- There will be an increasing concentration of households in the older age brackets.
- Average household size will continue to decrease.
- There will be a need for 17,600 new housing units in the CRMA during the next 30 years (2010-2040).

1.2 The Current Kaloko Makai Proposal with Respect to Housing[2]

What is being proposed is a residential mixed-use development on approximately 1,142 acres of undeveloped land in North Kona. It will include at full build-out up to 5,000

[1] Mikiko Corporation, Market Assessment for Kaloko Makai, Final Draft Report prepared for Stanford Carr Development Corporation

[2] See Wilson Okamoto Corporation, Environmental Assessment/Environmental Impact Statement preparation Notice Kaloko Makai, Kaloko and Kohanaiki, North Kona, Island of Hawai'i, Prepared for SCD-TSA Kaloko Makai, LLC, September 2010, for further details about the conceptual plans for the Kaloko Makai Project, pages 1-1 through 2-9.

residential units, both single-family and multi-family, with densities varying from three to 20 units per acre. The Project is to be developed in three phases or villages over an estimated 28 years.

This master-planned, mixed-use Project includes land devoted to centralized and neighborhood commercial and light industrial uses, two elementary schools, a middle school, a medical facility, parks, trails, open space, including a 150-acre dryland forest, and associated infrastructure.

The proposed Ane Keohokalole Highway will run through the Project. Kaloko Makai has been designated a Neighborhood Transit Oriented Development (TOD) in the Kona Community Development Plan (CDP). Kaloko Makai would become a Regional Center TOD once a hospital commits to the Project.

A major historic trail, which will be restored, runs through the Project in a mauka-makai direction.

The conceptual plans for the Project emphasize: (1) walkable villages, each with its own distinctive core; (2) pedestrian interconnectivity along pedestrian-scaled, tree-lined streets to neighborhood commercial centers and to neighboring villages; (3) front porches and rear lanais designed to facilitate neighborly interaction and indoor-outdoor living; and (4) a wide variety of housing options to provide living opportunities for a varied range of households of differing economic means. The Project will provide affordable housing that will more than adequately meet the County's affordable housing requirements in a diverse number of ways that will assure that there will be no affordable housing ghetto.

1.3 The County General Plan as Regards Housing

The County of Hawai'i General Plan[3] was adopted by ordinance in February 2005 and amended in December 2006. It "is the policy document for the long range development of the Island of Hawai'i."[4] It provides the planning framework for the community development plans, which are subsequently prepared for specific geographical districts such as Kona, as well as the Capital Improvement Program, the functional plans, e.g., sewage/drainage, and area improvement plans, e.g., downtown Hilo. The community development plans conform to the General Plan but are much more detailed and specific than the latter. In essence the community development plan implements the General Plan in a designated geographical area.

[3] See Section 9, Housing, and Sections 14, Land Use, especially Sections 14.5, Multiple Residential, and14.6, Single-Family Residential, in the County of Hawai'i, General Plan, February 2005 as amended in December 2006, online at <http://www.hawaii-county.com/la/gp/GP2005Amend%2012-2006%2005-2007%20and%20Ord%2009-161.pdf>.
[4] *Ibid.* p. 1-1.

Housing and Land Use are two of the many elements addressed in the General Plan. The other elements are: Economic, Energy, Environmental Quality, Flooding and Other Natural Hazards, Historic Sites, Natural Beauty, Natural Resources and Shoreline, Public Facilities, Public Utilities, Recreation, and Transportation.

The General Plan perceives housing as addressing much more than a person's need for shelter. "(A)dequate housing is one of the primary factors that provides a person a sense of satisfaction and well-being".[5] The Plan stresses that when the cost of land, land improvements, and home construction increase faster than personal income, many persons are prevented from purchasing homes (or, one could add, renting adequate quarters). This gives rise to one of the County's major concerns, which is affordable housing. This concern led to the establishment of the Hawai'i County Housing Agency and the Office of Housing and Community Development in the 1970s and the adoption of an affordable housing policy in 1998.[6]

The General Plan states:[7]

> In existing urban areas, the supply of readily available housing and residential zoned land is nearing a point where flexibility in choice of location and price will be limited and will contribute to rising costs of housing unless additional and alternative areas are made available for residential development.

Among the goals put forth in the General Plan that relate to the Kaloko Makai Project are the following:[8]

a. Attain safe, sanitary, and livable housing for the resident of the County of Hawai'i
b. Attain a diversity of socio-economic housing mix;
c. Maintain a housing supply that allows a variety of choices;
d. Create viable communities with affordable housing and suitable living environments;
e. Seek sufficient production of new affordable and rental and fee-simple housing in the County in a variety of sizes to satisfactorily accommodate the needs and desires of families and individuals;
f. Ensure that housing is available to all persons regardless of age, sex, marital status, ethnic background, and income;
g. Make affordable housing available in reasonable proximity to employment centers; and
h. Encourage and expand home ownership opportunities for residents.

The General Plan, after noting the rapid increase in population in the North Kona district, outlines two courses of action that relate closely to the Kaloko Makai Project, namely:[9]

[5] *Ibid.* p. 9-1.
[6] *Ibid.* pp. 9-2 and 9-3.
[7] *Ibid.* p. 9-5.
[8] *Ibid.* p. 9-10.
[9] *Ibid.* p. 9-26.

a. Encourage the use of innovative types of housing developments, such as cluster and planned unit developments, that take advantage of the steep topographic conditions; and
b. Increase affordable housing opportunities in the Kailua-Kona area.

Multiple Residential and Single-Family Residential are two sub-sections of the Land Use Section of the Hawai'i County General Plan. The goals in the multiple residential section address: (1) providing "developments that maximize convenience of its (sic) occupants"; and (2) providing "suitable environments that accommodate the physical, social and economic needs of island residents".[10] In the Standards section, the Plan specifies that "Areas shall be located in such a manner that traffic generated by high density developments will not be required to travel through traffic areas of lesser density en route to principal community facilities".[11] The Plan goes on to point out that the Kona district has over 1,000 acres for multiple residential use, but some of the areas so zoned lack basic infrastructure essential for development.[12]

The goals in the Single-Family Residential Section emphasize maximizing "choices of single-family residential lots or housing for residents of the County" and providing "single-family residential areas conveniently located to public and private services, shopping, other community activities and convenient access to employment centers that takes natural beauty into consideration".[13] In terms of courses of action, the Plan encourages: (1) concentration of residential structures to avoid strip residential development"; and (2) "the use of more innovative types of housing developments, such as zones of mix and cluster and planned unit developments".[14]

In sum, the Kaloko Makai Project is thoroughly in synch with the goals and courses of action for housing as put forth in the County of Hawai'i General Plan 2005 as amended.

1.4 The Kona Community Development Plan as Regards Housing

The Kona Community Development Plan (Kona CDP), which includes both North and South Kona, was enacted by ordinance on September 25, 2008. It was adopted pursuant to and in accordance with the Hawai'i County General Plan 2005 as amended. If a provision of the Kona CDP and a prior adopted ordinance are in conflict, the Kona CDP governs.[15] The Kona CDP includes goals, objectives, policies, and actions for transportation, land use, environmental resources, cultural resources, housing, public

[10] *Ibid.* p.14-42.
[11] *Ibid.*
[12] *Ibid.* p. 14-45.
[13] *Ibid.* p. 14-47.
[14] *Ibid.* p.14-51.
[15] See County of Hawai'i Planning Department, Kona Community Development Plan; Mapping Kona's Future. Prepared by Wilson Okamoto Corporation, September 2008; at < http://www.hawaiicountycdp.info/north-and-south-kona-cdp/cdp-final-drafts/Final%20KCDP_Sept%202008_text.pdf/view>

facilities, infrastructure, and services, energy, and economic development as well as an action plan, a monitoring plan, and introductory sections.

The three primary sections that bear on the Kaloko Makai Project, but not the only ones, are land use and housing and Attachment B, Village Design Guidelines. The Kona CDP sets forth eight guiding principles, two of which are directly applicable to Kaloko Makai:[16] (1) "provide housing choices"; and (2) "direct future growth patterns toward compact villages, preserving Kona's rural, diverse, and historical character".

With respect to housing choices, the Kona CDP states:[17]

> Future growth should offer a broad range of mixed housing choices with a variety of types and price ranges that are affordable and available in close proximity to places of work. They should also accommodate populations with special needs, including seniors, disabled persons, and the homeless.

With respect to urban villages, the Kona CDP states[18]:

> The majority of future growth should be directed north of Kailua, with some future growth in the Kailua to Keauhou area, in the form of compact villages that offer increased density and mixture of homes, shops, and places to work.

1.4.1 The Land Use Element

Kaloko Makai Village is identified in the Kona CDP as a Neighborhood TOD (Transit Oriented Development).[19] If, as anticipated, a medical center becomes part of Kaloko Makai, then the Regional Center designation would apply. A neighborhood village is defined as follows:[20]

> Neighborhood Village Core Areas are intended for predominately residential, public/civic uses, or small-scale neighborhood-oriented commercial uses. The Core's commercial uses are of a small scale and are intended to serve the needs of the Village residents. Neighborhood Village Core Areas shall be designed around a Neighborhood Center. Land uses include recreational space, small-scale public/civic uses, neighborhood oriented retail uses, and mixed-use.

A regional center is described as follows:[21]

> Regional centers are intended for mixed use and higher density residential, retail, commercial, employment, and/or regional one-of-a kind facilities, such as major civic, medical, education, and entertainment facilities. Regional centers shall be

[16] *Ibid.* p. 3-1 thru 3-3..
[17] *Ibid.*
[18] *Ibid.*
[19] *Ibid.* p4-41.
[20] *Ibid.* p. 4-40
[21] *Ibid.*

designed around a Commercial Center, which is the focus for the Village and designed to encourage pedestrian activity.

In addition to the data required for Project District Rezoning Application, the application shall include the following:[22]

a. Master Plan. To the extent practicable, the master plan shall conform with the Village Design Guidelines ... and at a minimum address:

   i. Mix of permitted uses and density;
   ii. Transportation systems including street layout and standards, transit routes and facilities, and bike and pedestrian pathways;
   iii. Village center public facilities and financing;
   iv. Infrastructure requirements, financing, and timing;
   v. Neighborhood park and public space standards;
   vi. Phasing plan;
   vii. Calculation and treatment of density transfer area; and
   viii. Planning process, including extent of consultation with the Design Center.

b. An environmental report meeting the requirements of HRS Chapter 343.

Incentives for following this process include expedited review by the Planning Director and the Planning Commission, concurrent processing of the environmental review document and the state land use boundary amendment by the County, and "the rebuttable presumption that the project furthers the intent of Chapter 25, the Zoning Code, and is consistent with goals, policies, and objectives of the County General Plan and the Kona CDP".[23] In addition, public financing shall pay for all of the costs of the major trunk transit route, a transit station, and a major park or plaza.[24]

The master plan for a TOD project is to further the intent of the Village Design Guideline, namely:[25]

1. Promote transit-oriented and pedestrian-oriented development, to increase transit use, to manage traffic congestion,
2. Encourage mixed-use, compact development that is pedestrian in scale and sensitive to environmental characteristics of the land, and facilitates the efficient use of public services;
3. Have residences, shopping, employment, and recreational uses located within close proximity with each other and efficiently organized to provide for the daily needs of the residents;
4. Provide for a range of housing types and affordability within pedestrian-oriented, human-scale neighborhoods;
5. Incorporate natural features, open space and cultural features;

[22] *Ibid.* pp.42-43.
[23] *Ibid.* p. 4-43.
[24] *Ibid.* p. 4-45.
[25] *Ibid.* p. 4-44.

6. Provide efficient circulation systems for pedestrians, non-motorized vehicles, and motorists that serve to functionally and physically integrate the various land use activities; and
7. Promote strong neighborhood identity and focus.

1.4.2 The Housing Element

The consequences of a lack of affordable housing are multiple: (1) people who want to move to a new unit are unable to do so; (2) some families are forced to live doubled-up; (3) some people become homeless; (4) young families move elsewhere where they can afford a home, leading to a shortage of workers; and (5) workers commute long distances, e.g., from Ka'ū, to their jobs in Kona. These consequences impact not only households earning less than the median income, but also families with moderate income whose members provide essential community services, such as teachers and police officers.

There are County-wide programs already in place designed to stimulate the availability of affordable housing:[26] (1) affordable rental property tax incentives; (2) density bonuses for meeting the affordable housing requirement; (3) a homebuyer education program; and (4) the Hawai'i island Housing Trust, a 501(c)(3) non-profit corporation.[27]

The Kona CDP includes several elements in its housing strategy that are of particular relevance for the Kaloko Makai Project.[28] The Plan stresses the importance of accessory or 'ohana units as a means of increasing the supply of rental housing as well as providing a source of income for the property owner. Second, the plan emphasizes the importance that some of the affordable inventory be perpetually affordable. Third, the Plan emphasizes the importance of addressing the housing needs of the elderly and the disabled. As an incentive, additional credits are provided for meeting the needs of these two groups.

The affordable housing credits in the Kona CDP – which are somewhat more liberal than those provided Chapter 11, Hawai'i County Code (HCC) – are designed to encourage workforce housing for those earning 120% to 180% of median household income, the elderly, and the disabled, as shown in Table 1.1 below.[29] Credit is also granted for affordable live/work units. Chapter 11, HCC, Housing, provides a 10% density bonus for meeting the affordable housing requirement, which is 20% of the total units as specified in Section 11-4(b)(2) of Chapter 11. The Kona CDP adds "...a 1:1

[26] Ordinance 1138, which was signed by the Mayor on April 25, 2011, has amended the affordable housing requirements by specifying that: "1. A minimum of 20% of the required affordable housing unit credits [shall be] earned at one credit per unit (100% to 120% of median household income) or higher; 2. A minimum of 30% of the required affordable housing unit credits [shall be] earned at 1.5 credits per unit (80% to 100% of median household income) or higher; and 3. A minimum of 40% of the required affordable housing unit credits [shall be] earned at two credits per unit (80% and under of median household income)."
[27] *Ibid.* p. 4-84.
[28] *Ibid.* pp. 4-85, 4-88, and 4-89.
[29] *Ibid.* p. 4-93

density bonus over and beyond the 10% bonus in HCC Section 11-8 for each affordable housing unit that exceeds the affordable housing requirements, up to a maximum 30% density bonus."[30]

Accessory or 'ohana units are encouraged with the intent of increasing the supply of rental housing, "For TODs ..., any provisions in the Project District rezoning ordinance relating to accessory units may preempt the zoning code 'ohana dwelling provisions (HCC Chapter 25, Article 6, Division 3)."[31]

Table 1.1 Affordable Housing Credits

	Percentage of Median household income	Affordable Housing Credit per HCC Section 11-5	Elderly, Disabled, or Live-Work Unit Credits
Dwelling Unit	120-180% (proposed)	0.25	0.75
	120-140%	0.5	1.0
	100-120%	1.0	1.5
	80-100%	1.5	2.0
	80%	2.0	2.5
Rental Unit	80-100%	1.0	1.5
	60-80%	1.5	2.0
	60%	2.0	2.5

The Kona CDP is designed to maintain the stock of affordable housing units for a period of 40 years. The following restrictions apply during the resale-restricted period:[32]

> **1st 20 years:** The affordable units shall have a minimum 20-year controlled appreciation restriction (cost of improvements plus appreciation based on the Honolulu Consumer Price Index;
> **After 20 years:** The owner may sell the property at market value with a shared appreciation with the County or Kona Housing Non-Profit at 50%;
> **Right of First Refusal:** After 20 years, the Kona Housing Non-Profit shall have the right of first refusal to purchase the unit;
> **Owner-occupancy:** During the resale-restricted period, affordable units must remain owner-occupied or rented out by the owner at an affordable rate as certified by the County real property tax division pursuant to the affordable rent provisions in HCC Chapter 19.

Further, the Kona Housing Non-Profit or other non-profit established pursuant to the Kona CDP has the first right of refusal on 10% of the required affordable units.[33]

The Kaloko Makai project is in a position to provide the affordable housing units required by Chapter 11, HCC, and the Kona CDP and to utilize the bonus incentives established in those two legal documents.

[30] *Ibid.*
[31] *Ibid.*
[32] *Ibid.* p. 4-94.
[33] *Ibid.*

1.4.3 Village Design Guidelines

The Village Design Guidelines provide development standards for TOD villages. The standards are based on the national SmartCode and "calibrated" to fit the Kona CDP.[34] The SmartCode is a form-based code designed to result in compact, walkable villages. With respect to TOD villages, the intent is as follows (Capitalization is as in original document):[35]

a. That Villages and REGIONAL CENTERS be compact, pedestrian-oriented and MIXED USE.
b. That ordinary activities of daily living occur within walking distance of most dwellings, allowing independence to those who do not drive.
c. That interconnected networks of transportation corridors be designed to disperse traffic and reduce the length of automobile trips.
d. That within neighborhoods, a range of housing types and price levels be provided to accommodate diverse ages and incomes.
e. That appropriate building DENSITIES and land uses be provided within walking distance of transit stops.
f. That CIVIC, institutional, and COMMERCIAL activity impart a focused town center and gathering place.
g. That schools could be sized and located to enable children to walk or bicycle to them.
h. That a range of OPEN SPACE including parks, squares, and playgrounds should be distributed within neighborhoods and villages.
i. That the growth of the village stays within a defined edge and thereby helps to establish a compact sense of place.

No attempt will be made in this volume to summarize the multiple design provisions included in the Village Design Guidelines other than to highlight a few specific provisos and to call special attention to Article 3, Village Scale Plans – New Villages, and Article 5, Building Scale Plans.

The Guidelines state that: "ACCESSORY UNITS are not included in the density calculation to encourage this residential use."[36]

In speaking of building configuration, the Guidelines state: "One PRINCIPAL Building at the FRONTAGE and one ACCESSORY UNIT to the rear of the PRINCIPAL BUILDING may be built on each LOT as shown in Table 14c, and "Rear SETBACKS for ACCESSORY UNITS shall be a minimum of 12 feet measured from the centerline of the REAR ALLEY easement."[37] Further, "ACCESSORY UNITS may be of any size, not to exceed 900 sq. ft."[38] In Article 7, Definitions, however, an Accessory unit is defined as:

[34] The SmartCode, Version 9.0, authored by Andres Duany, Sandy Sorlen, and William Wright, is available fro the New Urban News at <http://newurbannetwork.com/tools/books/smartcode-version-9-and-manual>
[35] Village Design Guidelines, Attachment B, Kona Community Development Plan, September 2008, p. 3.
[36] *Ibid.* p.8.
[37] *Ibid.*, p. 22
[38] *Ibid.* p.23.

"...an Apartment not greater than 440 square feet sharing ownership and utility connections with a Principal Building".[39]

In speaking of parking and density calculations, the Guidelines specify: "ACCESSORY UNITS do not count toward DENSITY calculations". [40]

In addressing parking location standards, the Guidelines state: "Parking shall be accessed by REAR ALLEYS when such are available on the REGULATING MAPS".[41]

The villages as planned for the Kaloko Makai Project fit the standards for TOD villages as specified in the Guidelines. Further, the Guidelines specifically encourage the inclusion of accessory or 'ohana dwelling and the use of alleys for access to parking areas.

1.5 The Hawai'i County Ordinances Relating to Housing

Three Hawai'i County Ordinances immediately relate to housing: (1) Chapter 11, Housing, Article 1, Affordable Housing (there are no other articles in this chapter); (2) Chapter 25, Zoning; and (3) Chapter 19, Real Property Taxes, particularly as it relates to two property classes: affordable rental housing and homeowner.

Most of the affordable housing requirements, the manner in which the requirements can be satisfied, the density bonuses earned by meeting the affordable housing requirement, and the resale restrictions are specified in the Housing Section (4.5) of the Kona Community Development Plan. Since the Kona CDP was adopted by ordinance, it provisions supersede those specified in Chapter 25, Zoning, of the Hawai'i County Code. The one provision in Chapter 11 that is not replaced by provisions in the Housing Section of the Kona Community Development Plan specifies that the Office of Housing and Community Development (OHCD) shall: (1) determine the rental price for units of various sized annually; and (2) enter into an agreement with the developer assuring that the rental prices will be controlled for a period of at least 20 years.[42]

The provisions of the Kona CDP amend Chapter 25, Zoning, by defining TODs, establishing TOD floating zone project districts, adopting the Village Design Guideline, and requiring mandatory Design Center review of all master plans prepared for TOD floating zones.[43]

Article 6, Division 3 of Chapter 25, Zoning, Sections 25-6-30 through 25-6-39.7 govern 'Ohana Dwellings. The provisions relate to where and when (e.g., adequate public facilities to serve the unit) 'ohana units can be constructed and where they are

[39] *Ibid.* p. 27.
[40] *Ibid.* p. 24.
[41] *Ibid.* p. 25.
[42] Section 11-11 of the Hawai'i County Code (HCC).
[43] Actions LU-2.1a, LU-2.3a, ,LU-2.4a, LU2.5a, and LU-4.2a of the Kona CDP, pp 4-42 thru 4-50.

prohibited, the height limit, the minimum building site area and yard requirements, parking requirements, and the application and appeal process. These provisions may be superseded for TODs. The Kona CDP specifies that: "For TODs..., any provision in the Project District rezoning ordinance relating to accessory units may preempt the zoning code 'ohana dwelling provisions".[44]

Chapter 19, HCC, governs the Real Property Tax System on the Island of Hawai'i. The table below shows the nine property classes and the property tax rate per $1,000 of net taxable building and land for the period July 1, 2010 to June 30, 2011.[45]

Table 1.2 Hawai'i County Tax Rates, Fiscal Year July 1, 2010 to June 30, 2011

Property Class		Tax Rate Per $1,000 Net Taxable Land	Tax Rate Per $1,000 Net Taxable Land
0	Affordable Rental Housing	$5.55	$5.55
1	Residential	$9.10	$9.10
2	Apartment	$9.85	$9.85
3	Commercial	$9.10	$9.10
4	Industrial	$9.10	$9.10
5	Agricultural and Native Forest	$8.35	$8.35
6	Conservation	$9.85	$9.85
7	Hotel/resort	$9.85	$9.85
9	Homeowner	$5.55	$5.55

Note: Chapter 19, Article 11, Section 19-90 of the Hawai'i County Code provides that the tax rates to be set on or before June 20 preceding the tax year for which property tax revenues are to be raised.

The two classes that are of particular interest are "Affordable Rental Housing" and "Homeowner". For FY 2011, the tax rates per $1000 for affordable rental housing and for homeownership were set at approximately 61% of the residential rate and 56% of the apartment rate. The County Council is to establish the rates by resolution prior to June 20 of each year. If the Council does not do so, then the rates currently in effect continue for another year.[46]

To be placed in the homeowner class, the property owner must successfully qualify for a home exemption, which will reduce the net taxable value of his/her property, as discussed below. A housing unit qualifies for the affordable rental housing class if it meets the affordable housing qualifications. A new application for inclusion in this class must be filed annually. The owner of the property must submit sufficient documentation of the monthly rent, such as a signed lease, and the rent must be such as to qualify for the entire calendar year. One benefit of having one's rental unit in the Affordable Rental Housing Program is that the assessed value will not increase by more than 3% in any

[44] Kona CDP, Policy HSG-4.6: Accessory Units, p. 4-93.
[45] Hawai'i County Real Property Tax Office at <http://www.hawaiipropertytax.com/Forms/HtmlFrame.aspx?mode=Content/2003TAXRATES.htm>
[46] Section 19-90(b), HCC.

one year as long as the owner continues to own the property and reapplies annually to remain in the Program.[47]

To qualify for a home exemption, a person must own his/her home and live in it as his/her principal residence for a minimum of 200 days in a calendar year. This means that the owner has no other home exemption in any other jurisdiction, has the intent to create or maintain a principal home in Hawai'i County, and actually occupies the property. If a person leases a property for ten years or longer, lives in the house on the property, and the lease is recorded, then the lessee can qualify for a home exemption. Persons owning a unit in a multi-unit building can qualify for a home exemption. The home exemption reduces the assessed value of the home by $40,000. For persons ages 60 through 69, the exemption is $80,000. For those 70 years of age and older, the exemption is $100,000.[48]

1.6 The Hawai'i County Rules Relating to Housing

Rule 12, County of Hawai'i Planning Department, relates to 'Ohana Dwelling Units and Rule 15 to Project Districts. In one sense this section is irrelevant because the provisions of the Kona CDP supersede those of the Department of Planning's Rules of Practice and Procedure.

The provisions of the Kona CDP relating to defining TODs (Action LU-2.3a) – establishing TOD floating zone project districts (Action LU-2.4a) and the adoption of Village Design Guidelines (Action LU-2.5a) – render Rule 15 null and void as applied to the Kaloko Makai Project. Similarly, the provisions of the Kona CDP relating to TNDs (Traditional Neighborhood Developments) supersede Rule 15 as well.

The situation with respect to Rule 12, 'Ohana Dwelling Units, is somewhat different. The Kona CDP states that:

> Accessory ('ohana dwelling) units are encouraged in order to increase the supply of rentals. For TODs and TNDs, any provisions in the Project District rezoning ordinance relating to accessory units may preempt the zoning code 'ohana dwelling provisions (HCC Chapter 25, Article 6, Division 3).[49]

The Village Design Guidelines state:

> Provisions of this Code are activated by "shall" when required; "should" when recommended; and "may" when optional.[50]

[47] See Hawai'i County Real Property Tax Division, Department of Finance, "Affordable Rental Housing Program Information" at http://www.hawaipropertytax.com/Forms/pdffiles/Affordable%20Rental%20Housing%20Program%20Information%20(Mar%202011).pdf and Sections 19-53(h) and (i), HCC.
[48] Hawai'i County Real Property Tax Office at <http://www.hawaipropertytax.com/Forms/HtmlFrame.aspx?mode=Content/2003TAXRATES.htm>
[49] Kona CDP, Policy HSG-4.6, Accessory Units. p. 4-93.
[50] Section 1.2, Village Design Guidelines, p. 2

If the Kaloko Makai Floating Zone Project District and the subsequent Project District, subsequently adapted as an ordinance, contains provisions relating to 'Ohana units, they supersede the provisos of Division 3 of Chapter 25, HCC, 'Ohana Dwellings, and those of Rule 12, Department of Planning, 'Ohana Dwelling Units. Thus, it is very important for the Kaloko Makai Project to assure that a section of the Project District address the standards and requirements for 'ohana units within the Kaloko Makai Project. Rule 12 provides guidance in so doing. Section 12-4 lists the Department's concerns in terms of adequate public facilities, Section 12-7 in terms of number of 'ohana dwelling units per lot, Section 12-8 in terms of height, lot size, setback, and off-street parking, and Section 12-9 in terms of duplex units.[51]

1.7 The Hawai'i County Design Center

The Hawai'i County Design Center is seen in the Kona CDP as an instrument of innovation stimulating exposure to new idea and encouraging a willingness to try them.[52]

The Kona CDP envisions the Design Center as a place where people will: "... collaboratively learn and apply the best available practices, ... provide an inviting venue to brainstorm ideas among applicants, government officials, and community members."[53] In addition the Design Center exists to facilitate the permitting process: "For those applicants who use the services of the Design Center, a County employee will be assigned to assist in identifying the various permit requirements, suggest a work plan to coordinate the permit requirements, and follow through with various agencies to avoid delays."[54]

The Design Center is to work with landowners to encourage Project District rezoning applications that are consistent with the Village Design Guidelines.[55]

Policy LU-4.1 lists the objectives that the Design Center is to accomplish:[56]

1. To support and expedite the translation and implementation of the Kona CDP goals, objectives, policies, actions, and design guidelines as applied to proposed development projects;
2. To be a catalyst for creative excellence and innovation;
3. To foster public-private partnerships;

[51] Sections 12-4, 12-7, 12-8, and 12-9 of the Department of Planning, Rules of Practice and Procedure, Rule 12, 'Ohana Dwelling Units.
[52] Kona CDP, pp. 3&4.
[53] *Ibid.* p. 4-33.
[54] *Ibid.*
[55] *Ibid,* Action LU-2.1c. p. 4-40.
[56] *Ibid.* pp. 4-49 & 4-50.

4. To promote coordination and collaboration among the community, government agencies, applicants, landowners, professionals, and educational institutions;
5. To provide education on best design practices to applicants, government staff, community members, educators and students; and,
6. To award and recognize exemplary projects.

Although the Design Center will be administered by the Planning Department and staffed by County employees, the department may organize a technical committee of interdisciplinary volunteers.

Action LU-4.1a raises the possibility of hiring an independent contractor to help set-up the Design Center and assist in its initial operation; Action LU-4.1b speaks to the need to fund positions to staff the Design Center; LU-4.2 makes clear that the Design Center "shall review and approve all master plans prepared for (TOD) floating zones" as well as other specified proposals; Action LU-4.2a amends Chapter 25, the Zoning Code, to require mandatory Design Center review; and Policy LU-4.3 specifies that a Design Center staff member may be assigned to coordinate and expedite the permit approval process for a project.[57]

Further, in Action HSG-e[58] developers, with assistance from the Design Center, are encouraged to:

1. Take advantage of the higher densities permitted in TODs and TNDs to financially support building at least 25% affordable units in a creative manner that results in a mix of housing types, tenures, and affordability (see Policies HSG-4.1 to HSG-4.8);
2. Take advantage of the credits recognized to provide affordable disabled, elderly projects and live-work units (Policy HSG-4.4); and
3. Although no additional credits are offered, strive to provide accessory dwelling (Policy HSG-4.6) and SRO (Policy HSG-6.3) units.

Finally, The Village Design Guidelines, Attachment B, are infused with references to the role of the Design Center. The Design Center, in a sense, is the administrator of the Village Design Guideline. As the Kona CDP makes clear: "The Village Design Guidelines (Attachment B) provide the minimum standards for TODs/TNDs, but do not rigidly constrain creativity".[59]

The Design Center as envisioned in the Village Development Guidelines (VDGs) has not yet been established. Therefore, it is not yet possible to create a TOD via the project district process.[60] The VDGs are in the process of being calibrated, that is, to be precisely adjusted to fit the Kona District. The Kona CDP Action Committee is to

[57] *Ibid.* p. 50.
[58] *Ibid.* pp. 4-96 & 4-97.List edited to include only items directly relevant to the Kaloko Makai Project;
[59] *Ibid.* p. 4-33.
[60] E-mail correspondence from Bennett Mark, Planning Program Manager, County of Hawai'i Planning Department, dated April 26, 2011.

recommend approval of the calibrated VDGs to the Planning Director. Once this occurs, then the Planning Department will be able to use the calibrated VDGs in determining whether a TOD as put forth the in a Project District application meets the VDG requirements.

There was a pre-charette informational meeting on April12, 2011, with the Kaloko Makai applicants, the Planning Department, and various State, County, and federal agencies at which potential transect zones, acreages, and agency concerns, among other topics, were discussed. The Planning Department anticipates that there will be additional charettes, first with governmental agencies and then with the public, prior to a request for approval of a TOD (or a Regional District) utilizing a project district application.

1.8 Summary: The Close Fit Between the Policy Framework and the Kaloko Makai Project

There is a close fit between the County General Plan, the Kona Community Development Plan, and the Village Design Guidelines on the one hand and the Kaloko Makai Project, as described in the Environmental Assessment/ Environmental Impact Statement Notice (September 2010), on the other.

The General Plan goals for housing are:[61]

1. Attain safe, sanitary, and livable housing for the resident of the County of Hawai'i;
2. Attain a diversity of socio-economic housing mix;
3. Maintain a housing supply that allows a variety of choices;
4. Create viable communities with affordable housing and suitable living environments;
5. Seek sufficient production of new affordable and rental and fee-simple housing in the County in a variety of sizes to satisfactorily accommodate the needs and desires of families and individuals;
6. Ensure that housing is available to all persons regardless of age, sex, marital status, ethnic background, and income;
7. Make affordable housing available in reasonable proximity to employment centers; and
8. Encourage and expand home ownership opportunities for residents.

The Kaloko Makai project is designed to meet each of these goals.

The Kona CDP makes clear that a master plan for a TOD project is to further the intent of the Village Design Guideline, namely:[62]

1. Promote transit-oriented and pedestrian-oriented development, to increase transit use, to manage traffic congestion,

[61] County of Hawai'i, General Plan, February 2005 as amended in December 2006, pp 9-10.
[62] County of Hawai'i Planning Department, Kona Community Development Plan: Mapping Kona's Future, Prepared by Wilson Okamoto Corporation, September 2008, p.4-44.

2. Encourage mixed-use, compact development that is pedestrian in scale and sensitive to environmental characteristics of the land, and facilitates the efficient use of public services;
3. Have residences, shopping, employment, and recreational uses located within close proximity with each other and efficiently organized to provide for the daily needs of the residents;
4. Provide for a range of housing types and affordability within pedestrian-oriented, human-scale neighborhoods;
5. Incorporate natural features, open space and cultural features;
6. Provide efficient circulation systems for pedestrians, non-motorized vehicles, and motorists that serve to functionally and physically integrate the various land use activities; and
7. Promote strong neighborhood identity and focus.

These objectives are applicable to a Regional Center as well as a TOD project.

The Kaloko Makai project is designed to meet each of these specific objectives. The inclusion of the Dryland Forest and the Historic Trail speak specifically to objective number 5.

The Village Community Guidelines specify:[63]

1. That Villages and REGIONAL CENTERS be compact, pedestrian-oriented and MIXED USE.
2. That ordinary activities of daily living occur within walking distance of most dwellings, allowing independence to those who do not drive.
3. That interconnected networks of transportation corridors be designed to disperse traffic and reduce the length of automobile trips.
4. That within neighborhoods, a range of housing types and price levels be provided to accommodate diverse ages and incomes.
5. That appropriate building DENSITIES and land uses be provided within walking distance of transit stops.
6. That CIVIC, institutional, and COMMERCIAL activity impart a focused town center and gathering place.
7. That schools could be sized and located to enable children to walk or bicycle to them.
8. That a range of OPEN SPACE including parks, squares, and playgrounds should be distributed within neighborhoods and villages.
9. That the growth of the village stays within a defined edge and thereby helps to establish a compact sense of place.

The requirements set forth in the Village Design Guidelines in effect do a good job of describing the plan for the Kaloko Makai Project. The schools, for example, are located so children can walk or bike to them. The walkability of the Project will vastly reduce the need for short vehicle trips. There is a range of open space in each village and all the villages have defined edges.

[63] Village Design Guidelines, Attachment B, Kona Community Development Plan, September 2008, p. 33.

2. DATA ON SOCIAL ISSUES RELATED TO AFFORDABLE HOUSING

Vol. 1 community interviews found several social issues linked to affordable housing:

1. General affordability concerns – socio-economic impacts of housing.
2. Equity issues – whether longtime local residents are less able to afford housing than are newcomers.
3. Whether HUD/County guidelines (unintentionally but effectively) discriminate against local working populations and fail to provide housing for which they can qualify – a different and more specific equity issue.

We shall address the first two in a combined fashion, and the third thereafter, by using available data from two different U.S. Census datasets:

- The 2000 Census "Summary File 3" (SF3), presenting results from the old 15% "long-form survey" that used to be part of every decennial census. Though these data are old, they provide some information not available in more recent census datasets, and also provide a benchmark to indicate housing cost increase since 2000.
- The American Community Survey (ACS) averaged 2005-09 data. The ACS replaced the old "long-form survey," which was not done for the 2010 Census – the 2010 Census contains only very limited housing or social information. This information has instead been gathered in annual ACS surveys, but with quite small samples for areas with population as low as North Kona's.

  For areas such as North Kona, the Census is only releasing five-year averaged data. The recently-released 2005-09 averaged data is the first such release, and represents the most recent available Census information on many housing topics. All dollar figures are in 2009 dollars. It should be noted that this particular five-year period is unique because the first part of it includes an economic boom period, while the last part of it includes the Great Recession. It should also be noted that the 2005-09 ACS contains most, but not all, of the detailed data from the 2000 SF3.

2.1 General Affordability and Equity

The true equity concern is more about newcomers vs. longtime residents, but what the Census actually provides are data broken down by broad "racial" (in Hawai'i, that would be interpreted more as "ethnic") categories, based on respondent self-reports:

1. White Alone
2. Black or African-American Alone
3. American Indian and Alaska Native Alone
4. Native Hawaiian or Other Pacific Islander (NHPI) Alone

5. Some Other Race Alone
6. Two or More Races (which we will call "Mixed Race")

Hawai'i County generally and North Kona in particular have very few people falling into the Black, American Indian, or Other Race categories. However, ***we will use "White Alone" as a proxy for "newcomers" to Hawai'i and the Asian, NHPI, and Mixed Race categories as proxies for "local" residents.*** This is validated by the following data from the 2005-09 ACS:

Table 2.1 Percentage Born in Hawai'i by Ethnicity, 2005-09 ACS

	Total	White	Asian	Mixed Race	NHPI	All "Local"
Hawai'i County Overall	57.9%	25.9%	69.1%	85.2%	81.8%	78.1%
North Kona Census Division	41.6%	15.3%	54.3%	82.1%	67.7%	69.3%
South Kona Census Division	51.8%	18.1%	76.2%	82.4%	70.0%	78.2%
South Kohala Census Division	47.6%	28.3%	52.8%	78.0%	83.7%	68.4%

Census data on housing "cost" are of two main types: Owner-occupied householder estimated values (and sometimes mortgage-related costs) and renter-occupied reports about gross rents, including utilities, etc. (Note that there are no Census data on second-home values/costs.) Another key housing cost measure both for owners with mortgages and for renters has to do with percentage of monthly income going to mortgage or gross rental cost – households spending more than 30% of their incomes for housing are generally viewed as facing serious affordability issues.

The 2005-09 ACS provides these data for the total population but not ethnic/racial categories. The 2000 Census SF3, however, does give such information for the major categories – as well as for some finer-grained ethnic categories not available in the ACS. Table 2.2 and Table 2.3 on the following pages show these data (adjusted to 2009 dollars) for the County as a whole and for the three districts comprising the West Hawai'i study area. The exhibits also show the more recent 2005-09 housing cost information for the total population only, giving a rough sense of change since 2000.

West Hawai'i Housing Costs Compared to Countywide Averages: Both owner- and renter-occupied costs in West Hawai'i (and particularly North Kona) far exceeded the countywide averages in 2000 and grew even more expensive over the following years.

- Overall housing values in North Kona were much higher than county averages in 2000. This was also true for South Kona and South Kohala, though not so much as North Kona. By 2005-09, housing values had increased islandwide, but even more rapidly in North Kona (essentially doubling) and South Kohala. The escalation exceeded growth in income as shown by proportion paying 30% or more for mortgage – 62% of North Kona households, up from 42% in 2000.
- Rents in North Kona also exceeded countywide averages in 2000, but not nearly as much. South Kohala was more the "high rent" area; South Kona, less so. By 2005-09, rents also increased in real terms, though nowhere near as much as values. Again, the proportion paying 30% or more for rents went up (especially in South Kona), but not as much as for values. The increase was greatest for South Kohala, again indicating a greater rental shortage there than elsewhere in West Hawai'i.

Table 2.2 Total and Ethnic-Specific Housing Costs for Owner-Occupied Units

(All values from 2000 Census except first row; all dollar values in 2009 dollars.)	Ethnic Distribution of Owner-Occupied Units[a] In County	Median Value of Owner-Occupied Units[b] In Wide	Ratio of White Median to Other Groups	Paying 30% or More of Household Income for Mortgage[c] County	Ethnic Distribution of Owner-Occupied Units[a] In North Kona	Median Value of Owner-Occupied Units[b] In North Kona	Ratio of White Median to Other Groups	Paying 30% or More of Household Income for Mortgage[c] N. Kona
Totals, Averaged 2005-09 Census[d]		$356,700		45.9%		$604,900		61.5%
Total, 2000 Census[d]	100.0%	$204,030	NA	37.2%	100.0%	$310,492	NA	42.2%
White-Alone Householder	38.1%	$170,700	1.00	40.4%	66.0%	$334,168	1.00	43.0%
Asian-Alone Householder	35.7%	$149,700	1.14	33.0%	21.1%	$268,420	1.33	37.3%
Mixed-Race Householder	17.5%	$145,800	1.17	38.7%	13.3%	$277,173	1.28	39.9%
Native Hwn/Other Pacific Island Householder[e]	7.5%	$134,800	1.27	35.4%	8.3%	$202,171	1.75	48.8%
Any Native Hawaiian Householder[e]	18.3%	$141,100	1.21	38.1%	17.0%	$234,561	1.51	39.9%
Filipino-Alone Householder[e]	8.2%	$125,900	1.36	35.7%	6.6%	$261,072	1.41	42.6%
Japanese-Alone Householder[e]	23.6%	$157,600	1.08	32.2%	13.4%	$291,244	1.22	37.6%

(All values from 2000 Census except first row; all dollar values in 2009 dollars)	Ethnic Distribution of Owner-Occupied Units[a] In South Kona	Median Value of Owner-Occupied Units[b] In South Kona	Ratio of White Median to Other Groups	Paying 30% or More of Household Income for Mortgage[c] S. Kona	Ethnic Distribution of Owner-Occupied Units[a] In South Kohala	Median Value of Owner-Occupied Units[b] In South Kohala	Ratio of White Median to Other Groups	Paying 30% or More of Household Income for Mortgage[c] S. Kohala
Totals, Averaged 2005-09 Census (ACS)		$434,400		48.0%		$515,400		48.0%
Total, 2000 Census[d]	100.0%	$292,881	NA	40.0%	100.0%	$273,456	NA	43.3%
White-Alone Householder	42.4%	$312,816	1.00	40.5%	48.0%	$302,660	1.00	47.7%
Asian-Alone Householder	33.1%	$261,609	1.20	32.8%	20.0%	$268,460	1.17	42.2%
Mixed-Race Householder	15.1%	$260,712	1.20	40.4%	21.2%	$254,340	1.19	35.6%
Native Hwn/Other Pacific Island Householder[e]	8.6%	$255,635	1.22	59.8%	10.6%	$212,658	1.42	39.1%
Any Native Hawaiian Householder[e]	20.3%	$264,429	1.18	50.5%	27.1%	$232,305	1.30	38.0%
Filipino-Alone Householder[e]	4.1%	$246,110	1.27	64.1%	6.1%	$224,507	1.35	60.0%
Japanese-Alone Householder[e]	26.2%	$263,500	1.19	29.4%	12.3%	$277,969	1.09	40.9%

[a]Smaller groups not shown but included in total: African-American, American Indian, Other Race (each "alone").
[b]Units for which estimated values are available. Values are in 2009 dollars (2000 values updated by using Honolulu CPI; ACS values given in 2009 dollars).
[c]Only units with mortgage, excluding units for which data not available.
[d]These are Pacific Islanders alone (and about 95% were "Native Hawaiian alone").
[e]Both Native Hawaiians alone and also part-Hawaiians who were included in "Two or More Races" above.
Filipino-alone and Japanese-alone were each part of "Asian-Alone" group.

Table 2.3 Total and Ethnic-Specific Housing Costs for Renter-Occupied Units

(All values from 2000 Census except first row; all dollar values in 2009 dollars.)	Ethnic Distribution of Renter-Occupied Units[b] in County	Median Gross Rent, Renter-Occupied Units[b] County-Wide	Ratio of White Median to Medians of Other Groups, County-Wide	Paying 30% or More of Household Income for Gross Rent,[c] County	Ethnic Distribution of Renter-Occupied Units[b] in North Kona	Median Gross Rent Renter-Occupied Units[b] in North Kona	Ratio of White Median to Medians of Other Groups, North Kona	Paying 30% or More of Household Income for Gross Rent,[c] N. Kona
Totals, Averaged 2005-09 Census (ACS)		**$1,011**		**47.4%**		**$1,204**		**46.1%**
Total, 2000 Census[a]	100.0%	$866	N/A	43.0%	100.0%	$989	N/A	41.8%
White-Alone Householder	41.7%	$928	1.00	42.5%	56.0%	$1,077	1.00	43.8%
Asian-Alone Householder	17.6%	$748	1.24	37.6%	10.3%	$923	1.17	34.2%
Mixed-Race Householder	25.7%	$834	1.11	43.0%	20.7%	$941	1.14	35.6%
Native Hwn/Other Pacific Island Householder[d]	11.5%	$820	1.13	50.9%	8.6%	$925	1.16	51.5%
Any Native Hawaiian Householder[e]	*25.7%*	*$826*	*1.12*	*44.4%*	*18.3%*	*$1,004*	*1.07*	*42.3%*
Filipino-Alone Householder[f]	*6.6%*	*$725*	*1.28*	*32.6%*	*2.9%*	*$864*	*1.25*	*37.2%*
Japanese-Alone Householder[f]	*8.9%*	*$701*	*1.32*	*39.4%*	*4.7%*	*$888*	*1.21*	*33.9%*

(All values from 2000 Census except first row; all dollar values in 2009 dollars.)	Ethnic Distribution of Renter-Occupied Units[b] in South Kona	Median Gross Rent, Renter-Occupied Units[b] in South Kona	Ratio of White Median to Medians of Other Groups, South Kona	Paying 30% or More of Household Income for Gross Rent,[c] S. Kona	Ethnic Distribution of Renter-Occupied Units[b] in South Kohala	Median Gross Rent, Renter-Occupied Units[b] in South Kohala	Ratio of White Median to Medians of Other Groups, South Kohala	Paying 30% or More of Household Income for Gross Rent,[c] S. Kohala
Totals, Averaged 2005-09 Census (ACS)		**$882**		**50.8%**		**$1,415**		**36.1%**
Total, 2000 Census[a]	100.0%	$769	N/A	36.0%	100.0%	$1,077	N/A	30.3%
White-Alone Householder	47.3%	$933	1.00	38.8%	47.8%	$1,200	1.00	33.6%
Asian-Alone Householder	21.1%	$625	1.49	23.0%	14.0%	$1,005	1.19	25.8%
Two-or-More Races Householder	20.4%	$656	1.42	43.9%	23.7%	$1,031	1.16	30.1%
Native Hwn/Other Pacific Island Householder[d]	10.0%	$767	1.22	39.4%	12.2%	$1,034	1.16	22.6%
Any Native Hawaiian Householder[e]	*20.8%*	*$774*	*1.21*	*40.8%*	*24.3%*	*$1,059*	*1.13*	*26.9%*
Filipino-Alone Householder[f]	*8.3%*	*$459*	*2.03*	*21.8%*	*5.0%*	*$1,005*	*1.19*	*20.5%*
Japanese-Alone Householder[f]	*11.3%*	*$609*	*1.53*	*25.0%*	*6.7%*	*$873*	*1.37*	*30.5%*

[a]Smaller groups not shown but included in total: African-American, American Indian, Other Race (each "alone").
[b]Units with cash rents. Values are in 2009 dollars (2000 values updated by using Honolulu CPI; ACS values given in 2009 dollars).
[c]Only units with mortgage, excluding units for which data not available.
[d]These are Pacific Islanders alone (and about 95% were "Native Hawaiian alone").
[e]Both Native Hawaiians alone and also part-Hawaiians who were included in "Two or More Races" above.
[f]Filipino-alone and Japanese-alone were each part of "Asian-Alone" group.

Ethnic Differences in West Hawai'i Compared to Countywide Patterns: The foregoing Table 2.2 and Table 2.3 further indicate that Whites generally pay more (and/or can afford more) for housing than do "local" groups on an islandwide basis. These islandwide patterns also exist in West Hawai'i – in some cases with even greater disparities; in other cases just reflecting islandwide patterns but at higher dollar levels.

- Whites in 2000 reported higher values than other groups, both countywide and in all three West Hawai'i districts. The gap between values reported by Whites and by other groups was particularly great in North Kona. Elsewhere in West Hawai'i, the ratios of Whites to other groups' medians were similar to countywide ones. In terms of households paying 30% or more of income for mortgages, Whites in West Hawai'i had only slightly higher than countywide average figures, and some other groups in West Hawai'i were paying even higher percentages for housing.

  Both these patterns suggest that incomes are generally higher in West Hawai'i than for the county as a whole, and even more so for Whites than for other groups. (The following analysis of 2005-09 ACS data will generally confirm this.)

- Whites in 2000 also paid higher rents than other groups, both countywide and in all three West Hawai'i districts. However, the relative differential between Whites and other groups was very similar to countywide averages for North Kona and South Kohala – only in South Kona did Whites pay *much* higher rents than did most non-White "local" groups, compared to countywide ratios. In terms of households paying 30% or more of income for rent, White proportions were close to those of other groups – it was the "NHPI alone" (mostly people saying they were Native Hawaiians alone) who were bearing the greatest burden, islandwide and in North Kona (though less heavily in the rest of West Hawai'i).

  Again, these patterns simply suggest that West Hawai'i incomes are elevated for all groups compared to countywide averages, but even more so for Whites than others.

Reasons Whites (Newcomers) Pay More: It is possible there are some social reasons (e.g., family or other social networks) allowing non-White "locals" to locate better housing "deals," and pay less. The Census data do not permit examination of that hypothesis, but they do permit examination of the other hypothesis stated above – that Whites have higher incomes and can therefore afford more. Table 2.4 indicates this hypothesis happens to be true for West Hawai'i, but is not uniformly true islandwide.[64]

[64] As previously noted, race/ethnicity is used here as a proxy for "newcomers" vs. "longtime residents." A non-Census dataset – the 2009 Hawai'i Health Surveillance Survey – permits some limited examination of countywide household median incomes by those variables. Courtesy of SMS Research, which holds rights to that data, we found that medians for people born in Hawai'i actually fell in between the values for newcomers who had been here 10 or more years and those who had moved within the last 10 years. The lower incomes for "newcomers" who had been here longer could reflect reduced incomes among retirees:

	County Total	Lifetime Resident	Moved 10+ Yr Ago	Moved in Last 10 Yr
Median Household Income	$50,176	$50,192	$45,721	$55,015
Pct. of Total Sample (N = 960)	100.0%	48.3%	35.4%	15.5%

Table 2.4 Median Incomes by Race and Census Division, 2005-09 ACS

Median Household Income	Total	White	Asian	Mixed Race	NHPI	"Local"[a]
Hawai'i County Overall	**$53,645**	***$55,845***	**$58,732**	**$54,098**	**$49,868**	**$52,738**
Hilo	$53,926	$47,048	$60,210	$57,558	$46,295	*$51,350*
Honoka'a-Kukuihaele	$59,258	$59,808	$44,609	$62,679	$62,159	$59,740
Ka'ū	$41,911	$37,917	$35,078	$49,627	$40,288	*$43,247*
Kea'au-Mountain View	$40,567	$39,731	$49,206	$37,926	$39,086	$40,872
North Hilo	$67,782	*$72,143*	$72,750	$26,111	$55,625	$51,832
North Kohala	$61,234	$56,154	$50,536	$73,315	$74,440	*$68,588*
Pa'auhau-Pa'auilo	$61,535	*$62,197*	$56,389	$71,722	$51,250	$58,998
Pāhoa-Kalapana	$36,914	$31,879	$58,155	$45,669	$56,136	*$53,142*
Pāpa'ikou-Wailea	$44,182	*$56,250*	$43,661	$43,875	$41,833	$42,523
West Hawai'i Study Area						
North Kona	$54,802	*$66,151*	$66,784	$58,440	$55,743	$58,819
South Kona	$58,849	*$65,219*	$63,500	$47,000	$39,306	$45,973
South Kohala	$75,912	*$78,826*	$70,337	$66,979	$42,349	$55,556

Median Family Income	Total	White	Asian	Mixed Race	NHPI	"Local"
Hawai'i County Overall	**$65,372**	***$67,038***	**$69,536**	**$55,969**	**$56,604**	**$62,805**
Hilo	$66,918	$57,550	$77,698	$64,079	$56,304	*$70,583*
Honoka'a-Kukuihaele	$75,583	$78,478	$74,167	$75,639	$87,578	$76,403
Ka'ū	$44,713	*$48,507*	$42,750	$37,292	$39,813	$39,706
Kea'au-Mountain View	$45,813	*$47,390*	$50,294	$35,959	$44,375	$43,997
North Hilo	$72,885	*$84,219*	$72,833	$84,167	$64,375	$72,390
North Kohala	$71,090	*$71,750*	$81,905	$71,083	$73,793	$68,356
Pa'auhau-Pa'auilo	$70,903	*$84,444*	$63,824	$47,083	$28,807	$52,700
Pāhoa-Kalapana	$46,473	$38,947	$68,482	$46,366	$60,761	*$56,003*
Pāpa'ikou-Wailea	$56,792	*$78,750*	$55,000	$44,125	$27,000	$48,626
West Hawai'i Study Area						
North Kona	$69,626	*$75,324*	$72,007	$59,789	$59,211	$65,160
South Kona	$76,354	*$82,404*	$70,266	$71,875	$60,865	$69,517
South Kohala	$77,079	*$83,125*	$74,655	$69,250	$51,954	$68,571

Median Non-Family Income	Total	White	Asian	Mixed Race	NHPI	"Local"
Hawai'i County Overall	**$32,267**	***$34,831***	**$24,878**	**$35,094**	**$24,735**	**$27,797**
Hilo	$26,794	$28,421	$25,352	$35,373	$23,285	$27,023
Honoka'a-Kukuihaele	$19,506	$27,083	$18,648	$28,816	$61,250	$28,947
Ka'ū	$23,468	$22,188	$23,500	$14,625	$27,000	$21,806
Kea'au-Mountain View	$27,103	$25,536	$31,923	$39,702	$22,500	*$33,004*
North Hilo	$14,735	$13,162	$24,500	$14,375	$33,529	*$20,520*
North Kohala	$32,629	*$35,054*	$19,688	$34,286	$25,313	$23,241
Pa'auhau-Pa'auilo	$50,160	*$52,857*	$21,818	$36,406	N/A	$23,832
Pāhoa-Kalapana	$24,542	$21,855	$19,375	$27,000	$50,125	*$29,901*
Pāpa'ikou-Wailea	$16,923	$13,289	$16,481	$37,143	$42,833	*$24,286*
West Hawai'i Study Area						
North Kona	$44,429	*$48,840*	$31,618	$38,182	$25,463	$32,882
South Kona	$27,736	*$32,813*	$21,250	$16,429	$14,861	$17,888
South Kohala	$47,377	*$53,117*	$45,607	$38,177	$14,342	$39,056

Italicized numbers in yellow *$XX,XXX* show "White" or "Local" with higher median for the area. Those pairs with no italics are so close as to be essentially equal.

[a]Median Income for "Local" estimated from Census data on numbers in different age categories.

Note in Table 2.4 that – especially in West Hawai'i – Asian incomes tend to be very close to, and sometimes a little greater than, White incomes. The "Local" household and median incomes are lower than Asian incomes because of the effects of Mixed Race and NHPI (Native Hawaiian and Pacific Islander) lower incomes. The ACS does not permit analysis by "Any Native Hawaiian" (alone or mixed), but numbers from the 2000 Census indicate that ***people who are at least part-Hawaiian accounted for between 70% and 80% of the combined NHPI and Mixed-Race categories*** in the overall county or the three West Hawai'i districts. Thus, again, it would appear to be Native Hawaiians who are having a particularly difficult time economically in West Hawai'i compared to Whites or even to Asians.

These income disparities reflect overall group differences shown below in:

- Education – better educated workers earn more throughout the nation;
- Age – older and more experienced workers usually earn more, and incomes are greater in the prime 25-64 working years (the 2005-09 ACS indicates householders in those years had median incomes about 50% greater than younger or older ones);
- Family Structure – female single-parent households face particularly economic challenges (the 2005-09 ACS found a countywide median of just $23,950 for single mothers, vs. $36,600 for single fathers and $78,900 for couples with children).

Table 2.5 Factors Related to Income, by Race, 2005-09 ACS

	Hawai'i County						North Kona					
	Total	White	Asian	Mixed Race	NHPI	All "Local"	Total	White	Asian	Mixed Race	NHPI	All "Local"
Education for Population 25+												
% Lacking High School Diploma	9.0%	6.4%	13.9%	6.4%	13.0%	12.0%	8.7%	4.0%	10.5%	12.1%	16.8%	12.3%
% Bachelor's Degree or More	26.2%	35.4%	25.7%	14.4%	13.3%	20.0%	27.5%	37.8%	24.4%	9.4%	15.7%	17.2%
Age												
Median Age[a]	39.4	46.9	49.0	22.4	32.1	34.8	40.3	50.2	41.6	25.8	31.6	32.8
% Population in 25-64 Age Group	54.1%	62.4%	55.4%	42.1%	61.3%	49.0%	57.6%	65.2%	59.6%	45.6%	61.9%	51.8%
% Population in 65+ Age Group	13.7%	15.1%	24.1%	4.6%	9.2%	13.3%	13.0%	16.9%	18.2%	5.9%	4.4%	10.6%
Composition of Family Households												
Female Householder, Children Under 18	12.3%	9.2%	8.9%	20.3%	18.7%	14.6%	9.9%	8.8%	9.4%	9.6%	22.6%	11.9%

	South Kona						South Kohala					
	Total	White	Asian	Mixed Race	NHPI	All "Local"	Total	White	Asian	Mixed Race	NHPI	All "Local"
Education for Population 25+												
% Lacking High School Diploma	9.7%	6.2%	10.3%	15.2%	9.8%	13.4%	7.0%	4.7%	12.1%	2.9%	17.0%	10.1%
% Bachelor's Degree or More	24.8%	33.8%	24.8%	9.1%	5.5%	16.2%	31.1%	41.0%	24.1%	19.2%	6.2%	19.4%
Age												
Median Age[a]	45.1	48.5	53.3	21.3	43.7	38.0	38.7	42.4	38.3	22.4	32.8	30.4
% Population in 25-64 Age Group	55.7%	58.0%	53.3%	36.8%	54.3%	46.6%	60.5%	61.2%	68.2%	45.7%	40.6%	50.0%
% Population in 65+ Age Group	15.6%	13.0%	26.9%	8.8%	17.5%	17.8%	10.3%	13.1%	11.2%	2.5%	14.1%	8.3%
Composition of Family Households												
Female Householder, Children Under 18	9.0%	9.3%	10.0%	14.0%	0.0%	10.0%	12.0%	8.9%	12.7%	25.8%	29.8%	20.2%

[a]Median Age for "Local" estimated by JMK Associates from Census information about numbers in different age categories.

Table 2.6 HUD Guidelines for Hawai'i County as of Mid 2009

AFFORDABLE HOUSING GUIDELINES FOR THE COUNTY OF HAWAI'I

FOR-SALE UNITS GUIDELINES *(Effective 07/02/09)*

This information is based on 2009 median income established by the U.S. Department of Housing and Urban Development (HUD) for various family sizes. Adjustments to the very low- (50%) and low-income (80%) limits are made by HUD for areas with unusually high or low family income or housing costs. Most income limits are proportionately based on very low-income limits. Thus, the four-person (60%) income limit is 120% (6/5ths) of the four-person very low-income limit.

The figures consider (1) a 30-year conventional fixed mortgage; (2) a fixed interest rate of 6.06%*; (3) housing expenses equal to 28% of gross annual income; and (4) a down payment equal to 5% of the sales price. *The interest rate used is the annual average interest rate for a 30-year conventional fixed mortgage, for the twelve months ending in the previous year, as published by the Federal Home Loan Mortgage Corp (http://www.freddiemac.com/pmms/docs/30yr_pmms_mth.txt). The rate is rounded to the nearest half percent.

% of Median	50%	60%	70%	80%	90%	100%	110%	120%	130%	140%
FAMILY SIZE: 1										
Income	$ 23,850	$ 28,980	$ 33,110	$ 37,800	$ 42,570	$ 45,570	$ 50,130	$ 54,660	$ 59,240	$ 63,800
Sales price	$ 99,900	$ 116,300	$ 135,800	$ 154,900	$ 174,400	$ 188,700	$ 205,400	$ 224,000	$ 242,700	$ 261,400
FAMILY SIZE: 2										
Income	$ 27,000	$ 32,400	$ 37,800	$ 43,200	$ 48,600	$ 52,080	$ 57,290	$ 62,500	$ 67,700	$ 72,913
Sales price	$ 119,600	$ 132,700	$ 154,800	$ 177,000	$ 199,100	$ 213,400	$ 234,700	$ 256,000	$ 277,300	$ 298,700
FAMILY SIZE: 3										
Income	$ 30,400	$ 36,480	$ 42,560	$ 48,600	$ 54,720	$ 58,590	$ 64,450	$ 70,310	$ 76,170	$ 82,033
Sales price	$ 124,500	$ 149,400	$ 174,400	$ 199,100	$ 224,200	$ 240,000	$ 264,000	$ 288,000	$ 312,000	$ 336,000
FAMILY SIZE: 4										
Income	$ 33,750	$ 40,500	$ 47,250	$ 54,000	$ 60,750	$ 65,100	$ 71,610	$ 78,120	$ 84,630	$ 91,143
Sales price	$ 138,300	$ 165,900	$ 193,600	$ 221,200	$ 248,900	$ 266,700	$ 293,400	$ 320,000	$ 346,700	$ 373,400
FAMILY SIZE: 5										
Income	$ 36,450	$ 43,740	$ 51,030	$ 58,300	$ 65,610	$ 70,310	$ 77,340	$ 84,370	$ 91,400	$ 98,430
Sales price	$ 149,300	$ 179,200	$ 209,100	$ 238,800	$ 268,800	$ 288,000	$ 316,800	$ 345,600	$ 374,400	$ 403,200
FAMILY SIZE: 6										
Income	$ 38,150	$ 46,980	$ 54,810	$ 62,650	$ 70,479	$ 75,520	$ 83,070	$ 90,620	$ 98,170	$ 105,722
Sales price	$ 160,400	$ 192,500	$ 224,500	$ 256,200	$ 288,700	$ 309,400	$ 340,300	$ 371,200	$ 402,200	$ 433,100

FOR-SALE FINISHED LOTS GUIDELINES *(Effective 07/02/09)*

This information is based on the affordable sales price for a completed unit for a household, earning one hundred percent of the median income in the County of Hawai'i, less the cost to build a single-family home of 1,100 square feet. *$150 per square foot cost is based on estimates by The County of Hawai'i, Department of Public Works, Building Division.

% of Median Income	Affordable Home Price	-	Cost/Unit	=	Affordable Lot Price
50%	$ 221,200	-	$ 165,000	=	$ 56,200
100%	$ 266,700	-	$ 165,000	=	$ 101,700

FOR-RENT GUIDELINES *(Effective 07/02/09)*

Affordable rents are based on 30% of gross monthly income, including utilities (water, sanitary sewage service, electricity and/or gas). Please refer to form HUD-52667(Allowances for Tenant-Furnished Utilities and Other Services) for utilities for either single- and/or multi-family units.

Bedroom Size		Studio	One	Two	Three	Four
	30%	$ 355	$ 380	$ 456	$ 526	$ 587
	50%	$ 591	$ 633	$ 760	$ 877	$ 978
	60%	$ 709	$ 759	$ 912	$ 1,053	$ 1,174
% of Median Income	80%	$ 945	$ 1,012	$ 1,216	$ 1,403	$ 1,566
	100%	$ 1,139	$ 1,220	$ 1,464	$ 1,692	$ 1,888
	120%	$ 1,367	$ 1,464	$ 1,757	$ 2,031	$ 2,265
	140%	$ 1,595	$ 1,708	$ 2,050	$ 2,369	$ 2,643

Summary: General conclusions to be drawn from all the previous analyses would be –

- All groups – newcomer/longtime residents or ethnic/racial groups – face serious affordability issues in regard to housing in West Hawai'i (especially North Kona).
- Whites (viewed as a proxy for newcomers) pay more on average for housing in West Hawai'i, but it is not clear whether that means they are bidding up housing costs or just less able to find better housing "deals" than longtime residents. Higher housing costs for Whites is part of an islandwide pattern, even though Whites don't always have higher incomes than other groups outside West Hawai'i.
- Native Hawaiians (and perhaps Filipinos) are particularly challenged in West Hawai'i due to lower overall incomes that reflect differences in overall education, age, and family structure. In the future, they will likely comprise a greater proportion of the "local" population, because the Asian population is aging (Table 2.5).

2.2 Effect of Median Income Guidelines on "Local" Qualification for Housing

The question here – raised by a number of community interviewees – is whether "affordable housing" projects provided in response to County guidelines are truly affordable, especially for "local" working families.

The federal Department of Housing and Urban Development (HUD) sets guidelines for any for-sale or rental "affordable housing" projects in all U.S. areas, including Hawai'i County. Because this analysis considers data in 2009 dollars, HUD guidelines for Hawai'i County effective July 2009 are reproduced on the following page (provided courtesy of the County's Office of Housing and Community Development) as Table 2.6. To derive these guidelines, HUD uses a complex procedure that still begins with 2000 Census figures but also integrates updated data from various sources, including recent ACS data for both County and State (but not the most recent ACS, as that is still being collected during or after the period the guidelines are issued).

Thus, the 2009 income figures in the 2005-09 ACS provides an indication of factors that affect (future) County guidelines, but not a direct analysis of the guidelines themselves.

Comparing HUD Assumed Medians with Census Medians: Following the HUD guideline information, Table 2.7 compares HUD's assumed 100% median figure for the County (effective mid-2009) with "actual" medians from the ACS. However, it should be remembered the ACS is still a survey, and so has sampling error. Also, the comparison is imperfect because the averaged ACS median incomes include pre-recession figures.

- Subject to these caveats, Table 2.7 indicates Hawai'i County residents probably had higher medians than assumed by HUD, making it easier to qualify for affordable housing projects.
- West Hawai'i residents had even higher incomes than countywide averages, meaning it was even easier to qualify there, compared to the rest of the island.

Table 2.7 Median Family Incomes, HUD Guidelines Versus 2005-09 ACS Values

	HUD	ACS 2005-09 (2009 dollars)			
	Hawai'i County	Hawai'i County	North Kona	South Kona	South Kohala
Total:		$65,372	$69,626	$76,354	$77,079
1-person families	$45,570	N/A	N/A	N/A	N/A
2-person families	$52,080	$57,186	$67,072	$65,739	$71,442
3-person families	$58,590	$64,217	$65,965	$78,500	$77,468
4-person families	$65,100	$75,513	$70,823	$91,131	$86,591
5-person families	$70,310	$71,497	$84,154	$89,938	$86,472
6-person families	$75,520	$94,267	$115,017	$80,500	$148,686
7+-person families	N/A	$83,099	$82,813	$133,750	$74,495

Note: Census definition of "family" includes mostly couples or people with own children under 18. If there is only one person – or unrelated people – in a unit, the Census considers that a "non-family household." The ACS provides data on overall household (families and non-families combined) median income, but does not break this out by household size. As previously noted, the 2005-09 ACS median household income for Hawai'i County was $55,645.

The reason that areas (or groups) with higher median incomes have a somewhat harder time qualifying under a median-based system is that the higher median indicates proportionately more people make "too much money" to qualify. For example, HUD's 100% median qualification point for a two-person household in mid-2009 was a little over $50,000. Table 2.8 switches to household incomes to show varying percentages falling under a $50,000 median point (ignoring household size for the moment):

Table 2.8 Percentages Exceeding $50,000 Household Income, by Race and District, 2005-09 ACS

	Hawai'i County						North Kona					
	Total	White	Asian	Mixed Race	NHPI	All "Local"	Total	White	Asian	Mixed Race	NHPI	All "Local"
% Households Earning Under $50,000												
All Households	44.9%	44.9%	42.4%	46.7%	50.1%	46.1%	36.7%	34.7%	35.6%	42.0%	45.6%	39.8%
- Householders Under 25	59.2%	58.6%	64.6%	50.6%	68.7%	64.3%	41.6%	42.6%	52.2%	10.0%	92.6%	45.6%
- Householders 25-44	39.4%	39.0%	34.6%	42.7%	44.2%	40.3%	34.2%	20.6%	30.7%	42.1%	39.7%	30.6%
- Householders 45-64	39.2%	41.2%	20.0%	45.7%	43.6%	38.7%	31.3%	31.3%	22.4%	38.5%	37.4%	31.3%
- Householders 65+	60.8%	58.0%	61.6%	62.6%	66.2%	62.3%	51.1%	46.6%	52.9%	66.0%	58.3%	57.0%

	South Kona						South Kohala					
	Total	White	Asian	Mixed Race	NHPI	All "Local"	Total	White	Asian	Mixed Race	NHPI	All "Local"
% Households Earning Under $50,000												
All Households	44.7%	42.6%	42.2%	62.1%	53.0%	47.7%	28.4%	24.6%	28.8%	38.6%	50.0%	35.9%
- Householders Under 25	91.3%	XXX	XXX	XXX	XXX	XXX	45.6%	XXX	60.0%	44.0%	XXX	38.8%
- Householders 25-44	41.7%	50.7%	46.1%	32.6%	61.1%	32.3%	17.7%	11.0%	27.0%	28.4%	23.8%	27.3%
- Householders 45-64	37.2%	36.1%	16.9%	58.1%	63.6%	40.1%	23.8%	19.5%	27.8%	47.1%	38.8%	32.5%
- Householders 65+	58.8%	43.3%	65.0%	69.6%	68.4%	68.7%	58.2%	54.0%	46.3%	84.0%	79.7%	63.1%

Shaded cells with "XXX" looking like this [illegible] had numbers too small to be reported at all. Shaded cells with % [illegible] = "Caution, small N's"

If $50,000 were actually the sole median point for qualification, 50% should qualify. The Hawai'i County total figure of 45% is in that ballpark, but people in the prime 25-64 working years had just 39% in the hypothetical "qualifying" pool. In North Kona and other West Hawai'i districts (especially South Kohala), the "qualifying" percentages were even lower.

Further Specifying These Conclusions for "Local" Residents: The Census does not provide ethnic/racial breakdowns for the sort of income-by-family-size information shown above in Table 2.7. However, Table 2.8 shows available race-specific numbers by householder age, if not the more ideal family size breakdown. For the great majority of cells in this matrix, the West Hawai'i percentages are smaller than countywide ones, suggesting less ability to qualify for people who live in North Kona, South Kona, or South Kohala than people who live elsewhere on the island. There is no clear or consistent pattern as to whether, for example, Whites throughout West Hawai'i had greater differences from their countywide percentage than any other group.

But qualifying is not just a matter of income but also of family/household size. Although the 2005-09 ACS does not provide household size by ethnic/racial categories, it is generally known that "local" family sizes (especially for Hawaiian or part-Hawaiian households, as well as for Filipinos) tend to be larger. This perception is borne out by data from the 2000 Census (Table 2.9). As of that year, average household sizes for Native Hawaiians were actually less than for Filipinos, although this is likely because of the younger average age among Hawaiians and therefore more households occupied by people who have yet to have all the children they may eventually have.

Still, on average, even Filipino and Native Hawaiian householders were reporting household sizes between 3.4 and 4.1 in 2000, and these household sizes have likely been declining along with those of other groups as time has gone by. That means the 100% median reference point for the typical Native Hawaiian or Filipino household in 2009 still was likely closer to $58,590 or $65,100 (Table 2.9), whereas the 100% median qualifying point would often be lower for Whites due to smaller average household sizes. Basically, households with the same number of income earners but more dependents must earn more to qualify for "affordable housing" projects, but the groups with average lower incomes have historically tended to have larger family sizes.

Table 2.9 Total and Ethnic-Specific Average Household Sizes

(All values from 2000 Census except first row, from 2005-09 ACS.)	Hawai'i County	North Kona	South Kona	South Kohala
Totals, Averaged 2005-09 Census (ACS)	2.67	2.65	2.79	2.58
Total, 2000 Census[a]	2.75	2.70	2.81	2.76
White-Alone Householder	2.38	2.36	2.42	2.38
Asian-Alone Householder	2.74	2.98	2.91	2.58
Mixed-Race Householder	3.21	3.22	3.35	3.58
Native Hwn/Other Pacific Island Householder[b]	3.45	3.49	3.48	3.67
Any Native Hawaiian Householder[c]	3.42	3.43	3.78	3.79
Filipino-Alone Householder[d]	3.55	4.07	3.73	2.88
Japanese-Alone Householder[d]	2.38	2.50	2.26	2.36

[a]Smaller groups not shown but included in total: African-American, American Indian, Other Race (each "alone").
[b]These are Pacific Islanders alone (and about 95% were "Native Hawaiian alone").
[c]Both Native Hawaiians alone and also part-Hawaiians who were included in "Two or More Races" above.
[d]Filipino-alone and Japanese-alone were each part of "Asian-Alone" group.

Closing Comment on the Nature of "Median Income": Something that is taken for granted by housing specialists and other people who work with numbers – but may not be intuitive for others in the public – is that the "median income" is the figure at which 50% of the specified population earns more and 50% earns less. In other words, ***housing that is affordable to a household making exactly the median income for some group is by definition not affordable to half that group's population.***

Thus, the idea that guidelines based on a median-income definition do not help many people qualify for housing is absolutely accurate. This, however, is exactly why the guidelines extend down to 50% of median in the case of for-sale housing and to 30% of housing in the case of rental housing. The question of why relatively little housing gets provided for those very low-end households in Hawai'i is more a matter of land use economics, and a question for a very different type of analysis than can be done with the sort of Census data considered here.

Summary: Housing affordability is a serious concern in West Hawai'i in regard to market housing, and even the HUD-based County guidelines to qualify for subsidized "affordable housing" projects pose more of a challenge to West Hawai'i residents than others on the island – for the ironic reason that West Hawai'i residents earn more and thus have a harder time qualifying.

Some "local" groups – Native Hawaiians and probably Filipinos, whose combined share of the "local" population will probably increase over time – now tend to have lower incomes than newcomers, which arguably increases their "advantage" in qualifying for affordable housing projects. But this "advantage" tends to be reversed by higher average household sizes that mean they must earn more to qualify. The HUD guidelines requiring higher incomes for larger families are logical, based on the assumption that larger housing space must be purchased to accommodate larger families. But there is further irony in the fact that guidelines for "affordable housing" tend to preclude sacrifices that many people have voluntarily decided to make for market housing – e.g., accepting more people in the same space, sub-letting to unrelated tenants, etc.

Ultimately, though, the social challenges facing West Hawai'i will probably have less to do with the fairness of "affordable housing" guidelines than with the soaring prices of market housing. The social impact of the Kaloko Makai project will be positive to the extent that it succeeds in the goal of providing more affordable market housing to working families – a goal that would likely be achieved by greater densities consistent with the Kona Community Development Plan.

J•M•K JOHN M. KNOX & ASSOCIATES, INC.

KALOKO MAKAI SOCIAL IMPACT ASSESSMENT

Volume 3: North Kona Community Planning Survey, 2009

April 6, 2009
(Foreword Added May 2011)

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FOREWORD (May 2011)

John M. Knox & Associates was engaged to prepare a social impact assessment of the proposed Kaloko Makai mixed-use commercial and residential development in Kona. In accord with Kona Community Plan principles of providing housing choices, recreation opportunities, directing growth patterns towards compact villages and encouraging a diverse and vibrant economy, Stanford Carr Development proposes a 1,142-acre development with a strong emphasis on residential development.

The work is presented in three volumes:

1. Volume 1 (prepared in 2011) presents background socio-economic conditions and results of a community interview process to surface key issues.
2. Volume 2 (also 2011) is a more extensive analysis of housing issues, prepared by subcontractor Tom Dinell (Dinell Associates). Mr. Dinell is Emeritus Professor in the University of Hawai'i Mānoa's Dept. of Urban and Regional Planning, teaching courses on housing there.
3. The current Volume 3 contains results of a 2009 "North Kona Community Planning Survey" that focused on awareness of the new Kona Community Development Plan (CDP) and extent of agreement with key element relevant to the proposed project. This survey was commissioned by Stanford Carr Development as part of the social impact assessment during the early stages of project planning and Environmental Impact Statement preparation work.

SUMMARY AND ANALYSIS OF VOLUME 3 RESULTS

SCD Kaloko Makai, LLC is seeking development approvals for its proposed Kaloko Makai mixed-use community in North Kona. To explore the social impact of the project, the company retained John M. Knox & Associates, Inc. ("JMK Associates") to conduct a telephone survey of 400 North Kona residents. This sample size permits a precision of ±5% for most results.

Key survey purposes and results are summarized below:

Purpose	Results
1. Importance of various possible North Kona community needs – including but not limited to certain elements of the Kaloko Makai project;	When asked to rate importance for a list of 12 possible needs, those related to health and medicine – more doctors and a new hospital – topped the list. Various transportation-related needs (especially mauka-makai connectors), affordable housing, and preserving open space between development were all rated "very important" by majorities of respondents.
2. Awareness of the new Kona CDP, including (for those aware) beliefs about its best and worst parts, extent of community participation, and whether respondents personally provided any response or input to the plan;	• 28% said they read or heard about the plan; • Those aware of the plan gave a wide variety of answers regarding "best" and worst" parts, but 40% to 50% indicated they needed more information; • Of the 28%, 25% said there had been a "great deal" of community input; 37% said "moderate amount;" and the remainder said "very little" or were unsure. Also, 31% (or about 9% of the overall sample) said they had some form of personal input.
3. Agreement with selected key elements of the CDP – particularly those broad planning principles about new transit-oriented developments (TODs) on the future Mid-Level road north of Kailua (as the Kaloko Makai community would be one of these); and	Majorities agreed with eight key principles relevant to planning growth north of Kailua. There was particularly strong agreement that a new hospital should be located on the Mid-Level Road and that some developments should be permitted higher densities around job centers.
4. Awareness of, and reaction to, the Kaloko Makai proposal itself.	• 56% said they had heard of the project. • 71% found the project either "very" or "somewhat" acceptable, with younger people particularly likely to favor it. • The majority who found the project acceptable tended to cite the hospital, housing, schools, and overall "good plan," while the minority who found it unacceptable focused on scale and density.

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PURPOSE

SCD Kaloko Makai, LLC is seeking development approvals for its proposed Kaloko Makai mixed-use community in North Kona. To explore the social impact of the project, the company retained John M. Knox & Associates, Inc. ("JMK Associates") to conduct a telephone survey of North Kona residents. JMK Associates, in conjunction with the client, designed the survey, specified the analyses, and wrote this report, while subcontract FAQ Hawai'i, Inc. did the telephone interviewing and computerized analysis.

Social impact assessment is a diverse and multi-dimensional discipline. Surveys provide one technique for understanding community needs and perceptions, so that policy makers can decide how well a proposed project meshes with community priorities and attitudes.

The proposed Kaloko Makai project will be one of the first to be evaluated following the September 2008 enactment of the new Kona Community Development Plan (CDP). SCD Kaloko Makai believes its project is consistent with the Kona CDP. However, while the CDP was developed over many years with substantial community input, there has never been a public opinion survey about the extent of agreement with the new plan.

Therefore, the purposes of this survey were to determine:

1. The importance of various possible North Kona community needs – including but not limited to certain elements of the Kaloko Makai project;
2. Awareness of the new Kona CDP, including (for those aware) beliefs about its best and worst parts, extent of community participation, and whether respondents personally provided any response or input to the plan;
3. Agreement with selected key elements of the CDP – particularly those broad planning principles about new transit-oriented developments (TODs) on the future Mid-Level road north of Kailua (as the Kaloko Makai community would be one of these); and
4. Awareness of, and reaction to, the Kaloko Makai proposal itself.

METHODS

Timeframe: Interviews were conducted between March 18 and 25, 2009. Calls were made between the hours of 5 and 9 p.m. Mondays through Fridays, and between 10 a.m. and 2 p.m. on Saturdays and 12 noon and 9 p.m. on Sundays.

Sample Size and Precision: The total sample **N of 400** permits a North Kona District precision ("sampling error") of **±5.0%**. There would be less precision (more error) for sub-samples, such as for particular demographic groups in the cross-tabulations at the end of the report.

Sampling Frame: The sampling frame consisted of a Random Digit Dialing (RDD) sample, ordered from Scientific Telephone Samples, a national sampling company that specializes in providing sample to market research companies. The RDD sampling frame consisted of the North Kona telephone prefixes of 322, 324, 325, 326, 327, 329, 331, and 334.

Interviewing Procedures: A training session was held in which the interviewers role-played and practiced the interviews before conducting the surveys with the actual respondents. FAQ Hawai'i's call center interviewers are well-versed in the nuances of a multi-cultural and multi-ethnic population of Hawaii. The interviewers are trained and experienced in conducting telephone surveys. FAQ Hawai'i has a ten-station CATI-equipped call center in downtown Honolulu. ("CATI" stands for Computer-Assisted Telephone Interviewing, a software program that permits interviewers to record answers directly into the overall survey database.)

The call center has a silent monitoring system used for quality control purposes. The supervisor constantly monitors both the respondent (person answering the questions) and the interviewer without being detected by either party.

Information Provided to Respondents on Request: Survey questions about planning issues can be confusing to the average person. On the other hand, lengthy explanations in a survey can be deadly – it is hard to absorb a great deal of new information over the phone, and respondents may simply terminate the call or else respond based on (possible misunderstandings of) snatches of the explanations.

In this case, it seemed appropriate to provide interviewers with limited answers to very basic questions that respondents might ask before they could in turn answer the questions posed to them – e.g., definitions of basic terms used in the questions about the Kona Community Development Plan.

However, interviewers reported that respondents rarely asked them for any such definitions. The most frequent question that interviewers received was, "Who is paying

for this survey?" (Interviewers are almost never told the identity of a client and so could honestly respond they did not know.)

Data Processing and Cross-Tabulations: FAQ Hawai'i processed the data, performing basic cross-tabulations, using SPSS, a statistical program. These cross-tabulations are shown in Appendix B, immediately following Appendix A, which is a print version of the actual computerized questionnaire shows overall results.

Survey Representativeness: Although the last U.S. Census of North Kona was conducted in the year 2000, which makes it difficult to compare with 2009 results, the results for demographic variables shown in Appendix A suggest some bias in the survey:

- Age is likely the most important concern. The proportion of people aged 55 or greater in this sample was about twice what it was for the adult North Kona population in 2000. FAQ Hawai'i reported that people who answered the phones were even more willing to take and complete the survey than is typically the case, and the rates of people not answering phone calls were typical of most surveys. Therefore, the most likely explanation is the growing tendency of young people to have only cell phones, which are usually not in sampling frames.
- The age bias likely accounts for all or most of a number of other disproportionate elements – e.g., likely oversampling of respondents who are highly educated, homeowners, and/or affluent (though the income results look less out of line than the other variables). Older people tend to be more educated, to own homes, and to have higher incomes.
- The sample was also slightly biased toward females (typical for surveys) and Caucasians. The female bias proved unimportant because females and males answered almost every survey question in a similar manner. The Caucasian percentage of 62% is higher than the 2000 Census figure of 46%, but the 46% applies to the entire population, including children, and Caucasians tend to have fewer children than other groups in Hawai'i.

It is possible to adjust for bias by weighting the results to some known population parameter. However, this was not done for the present survey because (1) the Census provides these parameters, and the Census is now out of date; and (2) more importantly, weighting the results by age would actually make the results more favorable to the client. As will be later noted, younger people were much more likely than older ones to find the proposed project "acceptable."

Therefore, the survey results reported here are conservative in that they understate the likely actual percentage of people who would have said the Kaloko Makai is acceptable if the sample had been weighted to correct for the critical age bias.

RESULTS

This section provides an overview of results. For a complete listing, Appendix A contains a paper copy of the computerized questionnaire with percentage results for closed-ended questions. ("Closed-ended" questions have predetermined choices of answers – e.g., yes or no. "Open-ended" questions are those which respondents answer in their own words, and those answers are later coded into categories. Those responses were too numerous to fit into the Appendix A questionnaire format, but are summarized in this section.) The subsequent Appendix B shows survey results cross-tabulated by demographic variables.

1. Importance of North Kona Community Needs

The survey's Question 1 ("Q1") stated: "*First, I'm going to read a list of possible needs for North Kona. For each one, please tell me if you think it is a very important need, fairly important, somewhat important, or not important at all.*" Twelve different items were listed (Q1a to Q1l).To prevent bias due to question ordering, the starting point for the 12 specific items was randomly rotated.

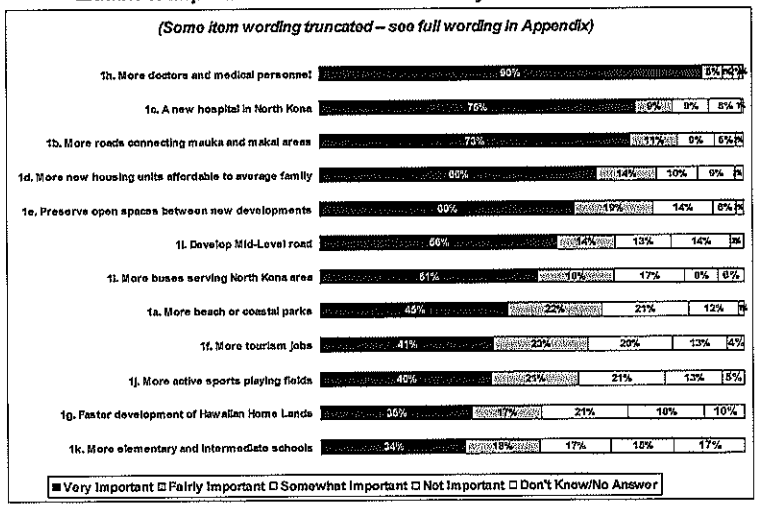
Exhibit 1 presents overall results, ordered by percentage "Very Important." This exhibit shows:

- Of the listed "possible needs," those related to health and medicine – more doctors and a new hospital – topped the list.
- Various transportation-related needs (especially mauka-makai connectors), affordable housing, and preserving open space between development were all rated "very important" by majorities of respondents.
- Relatively lower ratings were accorded the need for more schools, active playing fields, faster development of Hawaiian Home Lands, and more tourism jobs.

The lengthy Appendix B shows all demographic cross-tabulations for the items in Exhibit 1. Some of the more noteworthy patterns from those tables include –

- The strong desire for more doctors and a new hospital was present for all groups. The Mid-Level Road was also generally supported by all demographic groups.
- However, there were some variations for the lower-rated items. "*Faster development of Hawaiian Home Lands areas*" was "very important" to 61% of Native Hawaiians, vs. 30% to 35% of other groups. Both "*More elementary and intermediate schools*" and "*More active sports playing fields*" were of much more importance to younger and/or less educated resident than to older and/or highly-educated ones.

Exhibit 1: Importance of Various Community Needs in North Kona



2. Awareness of, and Beliefs about, Overall Kona CDP

After Q1, immediately following survey questions were:

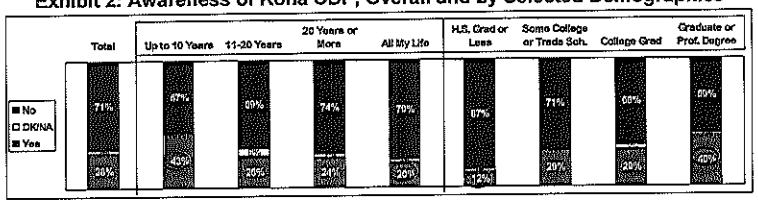
- Q2: "*Have you read or heard that the County just approved a new Kona Community Development Plan?*" (Closed-ended: Yes or no?)
- Q3 [asked only if "yes" to Q2]: "*From what you have read or heard, what do you think are the best parts of this new plan?*" (Open-ended)
- Q4 [asked only if "yes" to Q2]: "*From what you have read or heard, what are the worst parts of the plan, or what worries you about it?*" (Open-ended)
- Q5 [asked only if "yes" to Q2]: "*Do you believe this plan was based on what you would call a great deal of community input, a moderate amount of community input, or very little community input?*" (Closed-ended: great deal, moderate, or very little?)
- Q5a [asked only if "yes" to Q2]: "*Did you personally go to any meetings or have any input to this plan?*" (Closed-ended: Yes or no?)

a. Awareness of New Kona CDP

Exhibit 2 shows overall awareness, as well as several of the more notable demographic differences (length of residence and education).

Overall, 28% said they read or heard about the plan; 71% said they had not; and 1% was unsure. Newcomers (up to 10 years in Hawai'i) were more than twice as likely as lifetime residents to report awareness, and people with the highest possible levels of education were more than three times as likely as the least educated to say they were aware of the plan. These differences were statistically significant.

Exhibit 2: Awareness of Kona CDP, Overall and by Selected Demographics



In addition, residents with very high household incomes ($100,000+) were nearly three times as likely as those with incomes under $35,000 to report awareness, although there was no difference among the various intermediate income categories.

b. Perceived Best and Worst Parts of Plan

The 111 respondents aware of the plan replied in their own words to the questions about best and worst parts, and the original responses were coded into the categories shown in Exhibit 3.

Responses were very scattered. The most frequent response – more than 40% each for "best" and "worst" aspects of plan – was admission that respondents did not know or needed more information.

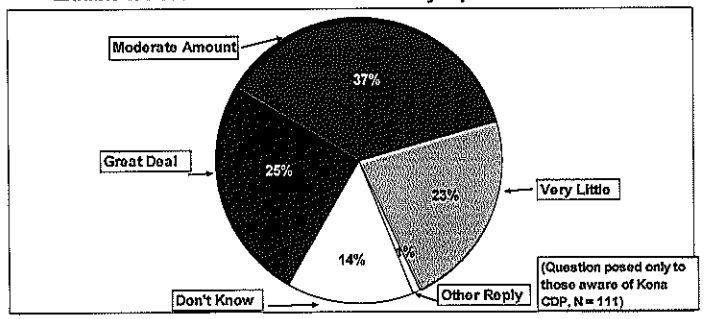
Exhibit 3: "Best Parts" and "Worst Parts" of Kona CDP

Best Parts		Worst Parts	
more roads/traffic alleviation	14%	no action will really be taken	10%
good plan/like the plan	13%	too much development	5%
puts everything in one area	7%	poor road plans	5%
more recreational facilities	6%	high cost of development	5%
hospital is needed	5%	increase traffic	4%
preservation of land	5%	will take too long to complete	4%
good location for growth	5%	not enough emphasis on schools	4%
plans for more affordable housing	3%	not enough community input	4%
UH will be there	3%	not a long-term solution	2%
infrastructure included in plan	3%	other	10%
community input	3%	no answer	11%
considers cultural values	2%	DK/Need more info	46%
dev. thoughtfully considered	1%		
creates new jobs	1%		
other	7%		
DK/Need more info	41%		

c. Perceived Extent of Community Input

The 111 respondents aware of the plan were also asked whether they thought there had been a great deal of, moderate amount of, or very little community input to the plan. Exhibit 4 shows overall results. Overall, 25% said "great deal;" 37% said "moderate amount;" 23% said "very little;" and 15% were unsure or gave some other reply.

Exhibit 4: Perceived Extent of Community Input to the Kona CDP



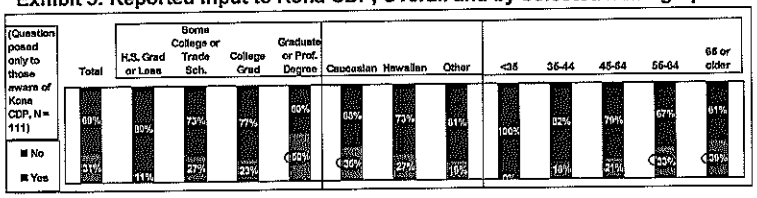
Data in Appendix B show that groups more likely to perceive a "great" amount of input included the more affluent (32%) and/or most educated (40%) respondents. However, due to the small sub-sample sizes, these differences would not technically be statistically significant.

d. Reported Personal Input to the Kona CDP

Finally, the 111 respondents aware of the plan were asked if they had personally gone to any meetings or had any input to the Kona CDP. Exhibit 5 shows overall responses as well as several of the more notable demographic differences (education, ethnicity, and age).

Overall, 31% said they had some input to the plan, and 69% said they had not. (The 31% is based only on those responding to this question; for the overall sample, this would translate to about 9%.) Input was reported by the most educated, Caucasians, and/or older residents, although the small sub-sample sizes meant such differences did not attain statistical significance.

Exhibit 5: Reported Input to Kona CDP, Overall and by Selected Demographics



3. Agreement/Disagreement with Selected Key Kona CDP Planning Principles

The Kona CDP is approximately 275 pages long, and filled with numerous very specific recommendations and requirements. The selected broad principles used in the survey were those which applied to the area specified in the plan as being targeted for most future growth – i.e., the region between Kailua and the airport, including the proposed future side of the Kaloko Makai development.

Interviewers reading Q6 asked: "*I'm going to mention certain things that are part of the new Kona Community Development Plan. For each one, please tell me if you personally strongly agree, somewhat agree, somewhat disagree, or strongly disagree that this should be Kona's plan.*"

Eight key principles were posed for agreement or disagreement. (Because the logic of the principles was sequential in nature, these items did not have a rotating start point but were always asked in the same order.) The questionnaire wording for these items inevitably was boiled down and somewhat simplified from the wording in the CDP, but every effort was made to remain true to the underlying principles.

Exhibit 6 shows the overall results for these eight items (though it should be noted the item wording in Exhibit 6 had been further truncated for simplicity in presentation, and the reader should refer to full original wording Appendix A).

Exhibit 6: Agreement with Selected Key CDP Planning Principles

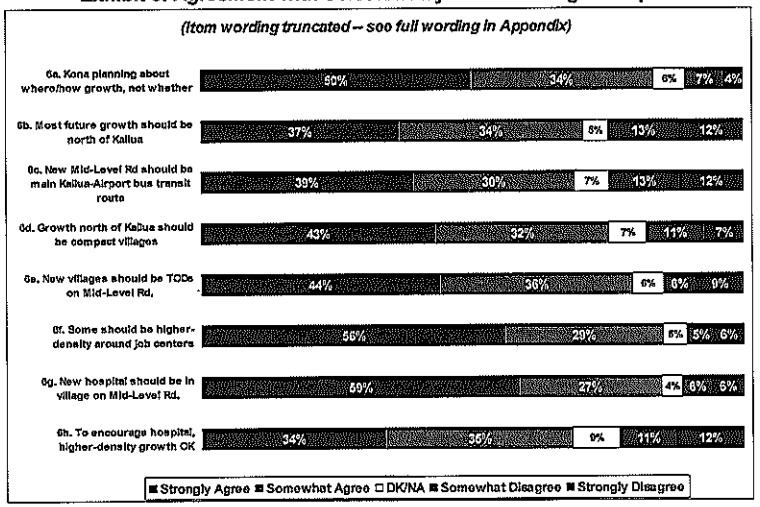


Exhibit 6 shows:

- Strong majorities agreed – either "strongly" or "somewhat" – with all stated Kona CDP planning principles. Disagreement never exceeded 25%.
- The very strongest agreement was with the propositions that (1) at least some new developments should provide higher-density housing and commercial development to support major job centers; and (2) there should be a new hospital along the Mid-Level Road in one of the villages between Kailua and the airport.

Some of the more noteworthy demographic differences of patterns to be observed for this series of items in Appendix B include:

- Although demographic differences could be found for particular items, there was no consistent pattern of differences – e.g., younger people did not usually agree or disagree more often than did older people on the great majority of questions.
- Smaller percentages "strongly agreed" that "*Planning for Kona is mostly about where and how growth happens, not trying to make growth happen faster or slower*" among younger residents, the least educated, Native Hawaiians, and/or lifetime residents. However, most of these groups were simply down-shifting to "somewhat agree," not actively disagreeing.

- There were no significant and/or meaningful differences in regard to agreement with the last two items in Exhibit 6 – i.e., that a new hospital should be built on the Mid-Level Road, and that higher densities should be allowed to attract a hospital site.

4. Awareness of, and Reaction to, Proposed Kaloko Makai Project

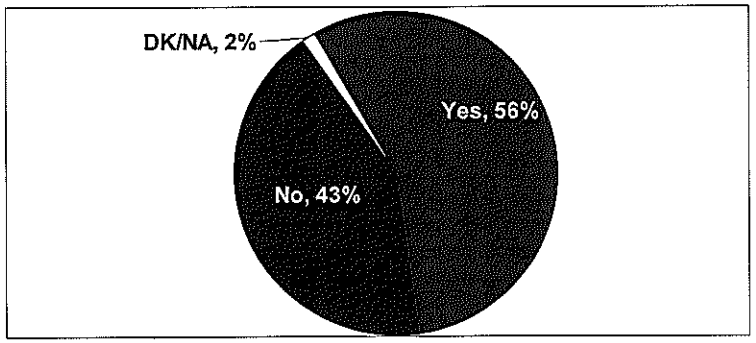
After Q6, immediately following survey questions were:

- Q7: "*Have you heard that a new development is being proposed for the Kaloko Makai area, north and mauka of Costco along Hina Lani Street?*" (Closed-ended: Yes or no?)
- Q8: *"Here's a summary of the proposal, to be developed over 30 years: 5,000 housing units of various types spread over 1,150 acres, one intermediate and two elementary schools, mauka and makai commercial areas, 150-acre dryland forest preserve, and a new regional hospital on the Mid-Level Road. Does this overall package sound like a very acceptable, somewhat acceptable, somewhat unacceptable, or very unacceptable idea?"* (Closed-ended: very acceptable, somewhat acceptable, somewhat unacceptable, or very unacceptable?)
- Q9 [asked only if "acceptable" to Q8]: *"What is the most important reason you think this is an acceptable development?"* (Open-ended?)
- Q10 [asked only if "unacceptable" to Q8]: *"What is the most important reason you think this is an unacceptable development?"* (Open-ended?)

a. Awareness of Kaloko Makai Project

Exhibit 7 shows overall responses to the question about whether the respondent has heard about the project. Overall, 56% said they had heard about the plan; 43% said they had not; and 2% were unsure.

Exhibit 7: Awareness of Kaloko Makai Project

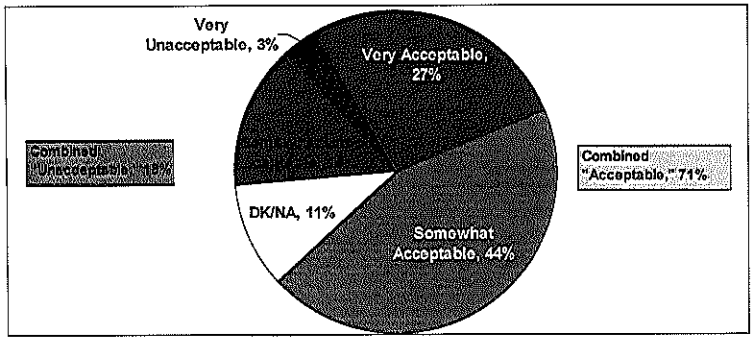


The cross-tabulations in Appendix B show very little difference among demographic groups in response to this question. Young people, homeowners, and higher-income residents were slightly more likely to have heard of the project, but these differences did not pass tests of statistical significance.

b. Acceptability of Proposed Project

As with the question about the Kona CDP, it was necessary to boil down a complex project proposal into a relatively short question (as stated above or in Appendix A). It should be acknowledged that attitudes may change with time and with media attention to specific project aspects. However, Exhibit 8 shows results for this question as of the interview timeframe in spring 2009.

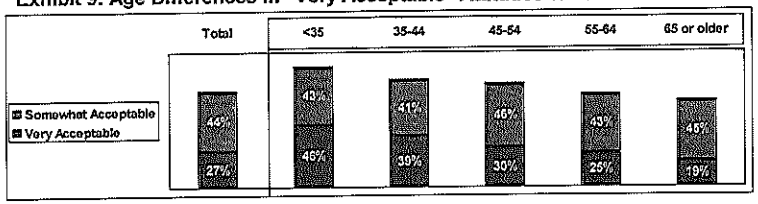
Exhibit 8: Acceptability of Proposed Kaloko Makai Development



Overall, 71% found the project as described to be "acceptable," and 18% found it "unacceptable," with the remainder unsure. Not surprisingly, given the historic mixed feelings over growth in Kona and the Neighbor Islands in general, there were more "somewhat acceptable" than "very acceptable" responses, and also more "somewhat" than "very unacceptable" responses as well.

Detailed cross-tabulations in Appendix B show various small demographic differences, but only one achieved statistical significance – the much greater tendency of people aged 35 or less to find the project "acceptable" as compared to older people, especially senior citizens. Since the sample was biased in a way that under-represented young people, this suggests the true "acceptable" proportion for all North Kona residents would exceed the combined 71% indicated in Exhibits 8 and 9.

Exhibit 9: Age Differences in "Very Acceptable" Attitudes toward Kaloko Makai



c. Reported Reasons for "Acceptable" or "Unacceptable" Responses

Exhibits 10 and 11 show the reasons given by the 185 respondents who had said "acceptable," as well as the 102 respondents who had said "unacceptable." (Note that different respondents answered the different questions. Also, no follow-up question was asked of those who were not sure of the project's acceptability.)

The majority group who found the proposed project acceptable either tended to focus on specific project elements – particularly the hospital site, but also housing, schools, and traffic alleviation via the Mid-Level Road – or just found it a good plan overall. The minority who found the project unacceptable primarily focused on its scale ("too big") or said the available amount of land was not enough for all proposed development elements ("density too high").

The cross-tabulations in Appendix B indicate only minor demographic differences in these responses – e.g., younger residents who found the project "acceptable" tended to talk a little more on the hospital, schools, and job potentials, while older ones talked a little more about housing or the overall sense of it being a good plan.

Exhibit 10: Reasons Kaloko Makai Is "Acceptable" or "Unacceptable"

"Acceptable"		"Unacceptable"	
hospital is needed	36%	too big / don't need	46%
good plan/ meets future needs	26%	density too high	21%
more housing / affordable housing	18%	too much traffic	12%
more schools	15%	not enough infrastructure	12%
alleviate traffic	11%	poor location	8%
increase in jobs	8%	need to preserve land	7%
everything is close proximity	7%	finish other projects first	7%
good location	7%	poor plan	6%
infrastructure for growing population	4%	not enough water	5%
long-term plan	4%	too long to complete	5%
good use of unused land	4%	not enough schools	4%
preservation of land considered	2%	other	11%
other	8%	DK/Need more info	1%
DK/Need more info	2%		

Appendix A:

Survey Questionnaire and Overall Results

2009 North Kona Community Survey

Reference No._____
Time Ended _____
Time Started_____
Total Minutes_____
Interviewer ID_____
Telephone_____

Date:_____
Interviewer Name_____
Respondent Name_____

Hello, good morning/afternoon/evening, I'm _____ from FAQ Hawai'i, a professional survey research center in Honolulu. Today we're conducting a short survey on residents' attitudes on public issues in North Kona. Let me assure you this survey is to get your opinions only, and we're not selling anything. Let me also assure you that all of your answers will be kept completely confidential.

A. Are you a full-time Kona resident who is 18 years of age or older?
YES ← CONTINUE
NO ← TERMINATE

1. First, I'm going to read a list of possible needs for North Kona. For each one, please tell me if you think it is a very important need, fairly important, somewhat important, or not important at all. **[ROTATE]**:

		Very Important	Fairly Important	Somewhat Important	Not Important at All	DK/NA
a.	more beach or coastal parks	44.50%	22.00%	20.50%	11.75%	1.25%
b.	more roads connecting mauka and makai areas	73.25%	11.25%	8.75%	5.00%	1.75%
c.	a new hospital in North Kona	74.75%	8.75%	8.50%	7.50%	0.50%
d.	more new housing units affordable to the average Kona family	65.50%	14.00%	9.75%	8.75%	2.00%
e.	preservation of open spaces between new urban developments	60.00%	18.75%	14.00%	5.50%	1.75%
f.	more tourism jobs	40.75%	22.50%	20.00%	12.75%	4.00%
g.	faster development of Hawaiian Home Lands areas	35.75%	16.50%	20.50%	17.75%	9.50%
h.	more doctors and medical personnel	90.25%	5.00%	2.25%	1.50%	1.00%
i.	more buses serving the North Kona area	51.25%	18.25%	16.50%	8.00%	6.00%
j.	more active sports playing fields	40.25%	20.75%	20.50%	13.25%	5.25%
k.	more elementary and intermediate schools	34.00%	17.75%	16.75%	15.00%	16.50%
l.	developing a Mid-Level road mauka of Queen Ka'ahumanu Highway and makai of Mamalahoa Highway, in between and parallel to both of them	56.00%	13.75%	13.25%	13.75%	3.25%

2. Have you read or heard that the County just approved a new Kona Community Development Plan?

Yes.....27.75%
No.....70.75% → GO TO Q6
(Don't know/no answer).....1.50%

3. From what you have read or heard, what do you think are the best parts of this new plan? **[RECORD ANSWERS VERBATIM.]**

[See summary of coded results in Exhibit 3 of foregoing report.]

4. From what you have read or heard, what are the worst parts of the plan, or what worries you about it? **[RECORD ANSWERS VERBATIM.]**

[See summary of coded results in Exhibit 3 of foregoing report.]

5. Do you believe this plan was based on what you would call a great deal of community input, a moderate amount of community input, or very little community input?

Great deal of community	25.23%
Moderate amount of community input	36.94%
Very little community input	22.52%
(Other reply)	0.90%
(Don't know/no answer)	14.41%

5a. Did you personally go to any meetings or have any input to this plan?

Yes	30.63%
No	69.37%
(Don't know/no answer)	0.00%

6. I'm going to mention certain things that are part of the new Kona Community Development Plan. For each one, please tell me if you personally strongly agree, somewhat agree, somewhat disagree, or strongly disagree that this should be Kona's plan. **[READ IN ORDER]**

		Strongly Agree	Somewhat Agree	Somewhat Disagree	Strongly Disagree	DK/NA
a.	Planning for Kona is mostly about where and how growth happens, not trying to make growth happen faster or slower.	49.75%	33.75%	7.00%	3.50%	6.00%
b.	Most future growth should be located north of Kailua, toward the airport.	36.50%	34.00%	13.25%	11.50%	4.75%
c.	The new Mid-Level Road should be developed as the main route for buses or other future mass transit connecting Kailua to the Airport.	39.00%	30.00%	13.00%	11.50%	6.50%
d.	Growth north of Kona should be directed mostly into compact mixed-use villages, with open space in between them.	43.00%	32.25%	10.75%	7.00%	7.00%
e.	The new villages should be centered around bus transit stops on the new Mid-Level Road.	44.00%	35.75%	5.75%	8.75%	5.75%
f.	Some villages should provide higher-density housing and commercial to support major job areas like the civic center, new hospital, and new university.	56.00%	29.25%	4.75%	5.50%	4.50%
g.	There should be a new hospital along the Mid-Level Road in one of the villages between Kailua and the airport.	58.50%	26.50%	5.50%	5.75%	3.75%
h.	To encourage a private landowner to attract a new hospital site, higher densities should be allowed in that village.	33.75%	34.75%	10.50%	12.25%	8.75%

7. Have you heard that a new development is being proposed for the Kaloko Makai area, north and mauka of Costco along Hina Lani Street?

Yes	56.00%
No	42.50%
(Don't know/no answer)	1.50%

8. Here's a summary of the proposal, to be developed over 30 years: 5,000 housing units of various types spread over 1,150 acres, one intermediate and two elementary schools, mauka and makai commercial areas, 150-acre dryland forest preserve, and a new regional hospital on the Mid-Level Road. Does this overall package sound like a very acceptable, somewhat acceptable, somewhat unacceptable, or very unacceptable idea?

Very acceptable	27.25%	→ ASK Q9
Somewhat acceptable	44.00%	
Somewhat unacceptable	10.75%	→ ASK Q10
Very unacceptable	14.75%	
(Don't know/no answer)	3.25%	→ GO TO Q11

9. What is the most important reason you think this is an acceptable development? **[RECORD ANSWERS VERBATIM, THEN GO TO Q 11.]**

[See summary of coded results in Exhibit 10 of foregoing report.]

10. What is the most important reason you think this is an unacceptable development? **[RECORD ANSWERS VERBATIM.]**

[See summary of coded results in Exhibit 10 of foregoing report.]

11. The rest of our questions are for statistical purposes only.

In which age category are you?	Under 25	2.75%
	25 to 34	4.25%
	35 to 44	11.00%
	45 to 54	20.00%
	55 to 64	31.75%
	65 or older	30.25%
	[Refused]	0.00%
12. What is your ethnic identification? [IF MORE THAN ONE:] With which do you identify the most?	Caucasian	61.50%
	Filipino	4.50%
	Hawaiian or part-Hawaiian	14.00%
	Japanese	7.50%
	Mixed, non-Hawaiian	3.50%
	Other (specify:) _____	6.75%
	[Refused]	2.25%
13. How long have you lived in Hawai'i?	Less than 5 years	9.00%
	5 to 10 years	16.00%
	11 to 20 years	13.00%
	20 years or more	32.25%
	All your life	29.75%
	[Refused]	0.00%
14. Do you own or rent the place where you're living? [COUNT LEASEHOLD AS OWNERSHIP]	Own	78.50%
	Rent	17.75%
	[Refused]	3.75%

15.	Which of the following categories describes your current level of education?	Less than high school ..... 2.50% High school graduate ..... 16.75% Some college or trade school .....32.25% College graduate .....29.75% Graduate or professional degree .....18.75% [Refused] 0.00%
16.	Which of the following categories includes your total annual family income before taxes for 2008? Just stop me when I reach the correct category.	Less than $25,000 .....10.25% $25,000 but less than $35,000 .....9.50% $35,000 but less than $50,000 .....14.50% $50,000 but less than $75,000 .....17.75% $75,000 but less than $100,000 .....16.00% $100,000 and over .....16.25% [Refused] 15.75%
17.	Gender [RECORD, DO NOT ASK]	Male .....41.50% Female 58.50%

In case my supervisor would like to verify this survey, may I have just your first name please? [RECORD RESPONDENT NAME ON COVER.] And that was my last question. Thank you very much for your time and cooperation in completing this survey!

Appendix B:

Demographic Cross-Tabulations

Q1c. First, I'm going to read a list of possible needs for North Kona. For each one, please tell me if you think it is a very important need, fairly important, somewhat important, or not important at all.
A NEW HOSPITAL IN NORTH KONA.

			AGE					ETHNICITY			LENGTH OF RESIDENCY			
		Total	<35 years	35-44	45-54	55-64	65+	Caucasian	Hawaiian	other	up to 10 years	11-20 years	20 years or more	all my life
NEW HOSPITAL	very important	75%	65%	77%	76%	77%	71%	72%	82%	78%	71%	85%	72%	76%
	fairly important	9%	11%	9%	10%	5%	12%	10%	4%	10%	11%	4%	10%	8%
	somewhat important	9%	11%	7%	9%	7%	10%	9%	4%	9%	6%	6%	11%	7%
	not at all important	6%	11%	7%	4%	10%	7%	9%	11%	3%	9%	4%	7%	6%
	DK/NA	1%	0%	0%	0%	1%	1%	0%	0%	1%	1%	0%	0%	1%
Total		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
BASE		400	28	44	80	127	121	246	56	89	100	52	129	119

FAQ Hawaii, Inc. (2009)

Q1d. First, I'm going to read a list of possible needs for North Kona. For each one, please tell me if you think it is a very important need, fairly important, somewhat important, or not important at all.
MORE NEW HOUSING UNITS AFFORDABLE TO THE AVERAGE KONA FAMILY.

			AGE					ETHNICITY			LENGTH OF RESIDENCY			
		Total	<35 years	35-44	45-54	55-64	65+	Caucasian	Hawaiian	other	up to 10 years	11-20 years	20 years or more	all my life
MORE NEW AFFORDABLE HSNG	very important	66%	71%	61%	74%	65%	60%	61%	64%	66%	60%	71%	61%	72%
	fairly important	14%	18%	14%	9%	13%	17%	16%	4%	17%	16%	12%	14%	13%
	somewhat important	10%	4%	14%	10%	11%	8%	13%	4%	7%	11%	6%	16%	3%
	not at all important	9%	4%	9%	8%	9%	11%	8%	9%	9%	10%	6%	9%	9%
	DK/NA	2%	4%	2%	0%	2%	3%	3%	0%	1%	3%	4%	1%	2%
Total		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
BASE		400	28	44	80	127	121	246	56	89	100	52	129	119

FAQ Hawaii, Inc. (2009)

Q1a. First, I'm going to read a list of possible needs for North Kona. For each one, please tell me if you think it is a very important need, fairly important, somewhat important, or not important at all.
MORE BEACH OR COASTAL PARKS.

			AGE					ETHNICITY			LENGTH OF RESIDENCY			
		Total	<35 years	35-44	45-54	55-64	65+	Caucasian	Hawaiian	other	up to 10 years	11-20 years	20 years or more	all my life
MORE BEACHES/ COASTAL PARKS	very important	45%	43%	50%	53%	44%	36%	44%	46%	44%	34%	37%	53%	48%
	fairly important	22%	29%	15%	25%	21%	21%	21%	36%	16%	22%	23%	19%	25%
	somewhat important	21%	14%	20%	15%	24%	22%	22%	13%	21%	30%	23%	16%	16%
	not at all important	12%	14%	11%	6%	10%	16%	11%	6%	16%	14%	13%	11%	10%
	DK/NA	1%	0%	0%	0%	1%	3%	2%	0%	1%	0%	4%	2%	1%
Total		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
BASE		400	28	44	80	127	121	246	56	89	100	52	129	119

FAQ Hawaii, Inc. (2009)

Q1b. First, I'm going to read a list of possible needs for North Kona. For each one, please tell me if you think it is a very important need, fairly important, somewhat important, or not important at all.
MORE ROADS CONNECTING MAUKA AND MAKAI AREAS.

			AGE					ETHNICITY			LENGTH OF RESIDENCY			
		Total	<35 years	35-44	45-54	55-64	65+	Caucasian	Hawaiian	other	up to 10 years	11-20 years	20 years or more	all my life
MORE ROADS CONNECTING MAUKA & MAKAI	very important	73%	57%	66%	80%	72%	76%	73%	73%	74%	70%	75%	74%	74%
	fairly important	11%	21%	14%	13%	6%	11%	11%	7%	15%	16%	15%	10%	7%
	somewhat important	9%	7%	11%	6%	11%	7%	10%	7%	4%	9%	6%	10%	8%
	not at all important	5%	11%	7%	1%	7%	3%	4%	9%	6%	3%	2%	4%	9%
	DK/NA	2%	4%	2%	0%	2%	2%	2%	4%	1%	2%	0%	2%	3%
Total		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
BASE		400	28	44	80	127	121	246	56	89	100	52	129	119

FAQ Hawaii, Inc. (2009)

Q1g. First, I'm going to read a list of possible needs for North Kona. For each one, please tell me if you think it is a very important need, fairly important, somewhat important, or not important at all.
FASTER DEVELOPMENT OF HAWAIIAN HOME LANDS AREAS.

			AGE					ETHNICITY			LENGTH OF RESIDENCY			
		Total	<35 years	35-44	45-54	55-64	65+	Caucasian	Hawaiian	other	up to 10 years	11-20 years	20 years or more	all my life
FASTER DEV. OF HAWN HOME LANDS	very important	36%	39%	52%	36%	34%	31%	31%	61%	35%	29%	25%	33%	43%
	fairly important	17%	36%	11%	18%	17%	13%	15%	21%	19%	7%	17%	22%	18%
	somewhat important	21%	18%	25%	28%	18%	17%	22%	11%	22%	25%	33%	18%	14%
	not at all important	18%	4%	9%	16%	20%	23%	22%	7%	11%	26%	17%	18%	12%
	DK/NA	10%	4%	2%	3%	12%	16%	10%	0%	12%	11%	8%	12%	7%
Total		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
BASE		400	28	44	80	127	121	246	56	89	100	52	129	119

FAQ Hawaii, Inc. (2009)

Q1h. First, I'm going to read a list of possible needs for North Kona. For each one, please tell me if you think it is a very important need, fairly important, somewhat important, or not important at all.
MORE DOCTORS AND MEDICAL PERSONNEL.

			AGE					ETHNICITY			LENGTH OF RESIDENCY			
		Total	<35 years	35-44	45-54	55-64	65+	Caucasian	Hawaiian	other	up to 10 years	11-20 years	20 years or more	all my life
MORE DOCTORS/MED. STAFF	very important	90%	82%	86%	95%	90%	91%	90%	91%	89%	90%	94%	88%	91%
	fairly important	5%	7%	11%	4%	6%	2%	4%	5%	7%	6%	4%	4%	6%
	somewhat important	2%	7%	2%	1%	3%	1%	2%	4%	1%	1%	2%	4%	2%
	not at all important	2%	0%	0%	0%	2%	3%	2%	0%	2%	1%	0%	4%	0%
	DK/NA	1%	4%	0%	0%	0%	2%	1%	0%	1%	2%	0%	0%	2%
Total		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
BASE		400	28	44	80	127	121	246	56	89	100	52	129	119

FAQ Hawaii, Inc. (2009)

Q1e. First, I'm going to read a list of possible needs for North Kona. For each one, please tell me if you think it is a very important need, fairly important, somewhat important, or not important at all.
PRESERVATION OF OPEN SPACES BETWEEN NEW URBAN DEVELOPMENTS.

			AGE					ETHNICITY			LENGTH OF RESIDENCY			
		Total	<35 years	35-44	45-54	55-64	65+	Caucasian	Hawaiian	other	up to 10 years	11-20 years	20 years or more	all my life
PRESERVATION OF OPEN SPACES	very important	60%	43%	64%	65%	63%	56%	64%	61%	47%	50%	60%	69%	59%
	fairly important	19%	29%	14%	21%	16%	20%	16%	21%	25%	21%	23%	15%	19%
	somewhat important	14%	14%	16%	11%	13%	16%	13%	11%	21%	17%	15%	12%	13%
	not at all important	6%	7%	7%	3%	6%	6%	7%	2%	4%	11%	0%	4%	5%
	DK/NA	2%	7%	0%	0%	2%	2%	1%	5%	2%	1%	2%	1%	3%
Total		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
BASE		400	28	44	80	127	121	246	56	89	100	52	129	119

FAQ Hawaii, Inc. (2009)

Q1f. First, I'm going to read a list of possible needs for North Kona. For each one, please tell me if you think it is a very important need, fairly important, somewhat important, or not important at all.
MORE TOURISM JOBS.

			AGE					ETHNICITY			LENGTH OF RESIDENCY			
		Total	<35 years	35-44	45-54	55-64	65+	Caucasian	Hawaiian	other	up to 10 years	11-20 years	20 years or more	all my life
MORE TOURISM JOBS	very important	41%	43%	45%	48%	35%	40%	37%	45%	49%	47%	29%	38%	44%
	fairly important	23%	21%	25%	23%	20%	25%	23%	18%	26%	21%	29%	21%	23%
	somewhat important	20%	14%	20%	19%	24%	17%	22%	18%	16%	23%	27%	19%	18%
	not at all important	13%	14%	7%	10%	17%	12%	15%	16%	4%	7%	13%	18%	12%
	DK/NA	4%	7%	2%	1%	4%	6%	4%	4%	4%	2%	2%	5%	6%
Total		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
BASE		400	28	44	80	127	121	246	56	89	100	52	129	119

FAQ Hawaii, Inc. (2009)

Q1k. First, I'm going to read a list of possible needs for North Kona. For each one, please tell me if you think it is a very important need, fairly important, somewhat important, or not important at all.
MORE ELEMENTARY AND INTERMEDIATE SCHOOLS.

		Total	AGE					ETHNICITY			LENGTH OF RESIDENCY			
			<35 years	35-44	45-54	55-64	65+	Caucasian	Hawaiian	other	up to 10 years	11-20 years	20 years or more	all my life
MORE ELE. & MIDDLE SCHOOLS	very important	34%	50%	48%	44%	25%	28%	30%	34%	44%	36%	37%	29%	38%
	fairly important	18%	14%	16%	16%	20%	17%	18%	16%	18%	16%	10%	22%	18%
	somewhat important	17%	11%	23%	14%	23%	12%	16%	20%	17%	12%	17%	18%	19%
	not at all important	15%	25%	9%	15%	15%	15%	13%	27%	10%	11%	13%	15%	19%
	DK/NA	17%	0%	5%	11%	17%	28%	22%	4%	11%	25%	23%	16%	7%
Total		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
BASE		400	28	44	80	127	121	245	56	89	100	52	129	119

FAQ Hawaii, Inc. (2009)

Q1l. First, I'm going to read a list of possible needs for North Kona. For each one, please tell me if you think it is a very important need, fairly important, somewhat important, or not important at all.
DEVELOPING A MID-LEVEL ROAD MAUKA OR QUEEN KA'AHUMANU HIGHWAY AND MAKAI OF MAMALAHOA HIGHWAY, IN BETWEEN AND PARALLEL TO BOTH OF THEM.

		Total	AGE					ETHNICITY			LENGTH OF RESIDENCY			
			<35 years	35-44	45-54	55-64	65+	Caucasian	Hawaiian	other	up to 10 years	11-20 years	20 years or more	all my life
DEVELOPING MID-LEVEL ROAD	very important	56%	50%	43%	65%	50%	62%	56%	54%	57%	60%	52%	66%	55%
	fairly important	14%	21%	20%	14%	10%	13%	13%	16%	17%	16%	23%	9%	13%
	somewhat important	13%	11%	16%	10%	18%	10%	12%	14%	16%	10%	13%	16%	13%
	not at all important	14%	16%	16%	9%	18%	11%	16%	13%	6%	7%	10%	18%	17%
	DK/NA	3%	0%	5%	3%	3%	4%	4%	4%	2%	7%	2%	2%	3%
Total		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
BASE		400	28	44	80	127	121	245	56	89	100	52	129	119

FAQ Hawaii, Inc. (2009)

Q1i. First, I'm going to read a list of possible needs for North Kona. For each one, please tell me if you think it is a very important need, fairly important, somewhat important, or not important at all.
MORE BUSES SERVING THE NORTH KONA AREA.

		Total	AGE					ETHNICITY			LENGTH OF RESIDENCY			
			<35 years	35-44	45-54	55-64	65+	Caucasian	Hawaiian	other	up to 10 years	11-20 years	20 years or more	all my life
MORE BUSES	very important	51%	36%	52%	58%	49%	53%	50%	45%	61%	45%	60%	49%	55%
	fairly important	18%	21%	20%	19%	17%	18%	20%	20%	13%	13%	25%	22%	16%
	somewhat important	17%	21%	11%	15%	22%	12%	18%	15%	12%	16%	10%	19%	15%
	not at all important	8%	14%	14%	5%	6%	6%	7%	11%	6%	13%	4%	5%	8%
	DK/NA	6%	7%	2%	4%	6%	6%	7%	4%	6%	11%	2%	5%	5%
Total		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
BASE		400	28	44	80	127	121	245	56	89	100	52	129	119

FAQ Hawaii, Inc. (2009)

Q1j. First, I'm going to read a list of possible needs for North Kona. For each one, please tell me if you think it is a very important need, fairly important, somewhat important, or not important at all.
MORE ACTIVE SPORTS PLAYING FIELDS.

		Total	AGE					ETHNICITY			LENGTH OF RESIDENCY			
			<35 years	35-44	45-54	55-64	65+	Caucasian	Hawaiian	other	up to 10 years	11-20 years	20 years or more	all my life
MORE ACTIVE SPORTS FIELDS	very important	40%	57%	52%	51%	31%	35%	34%	54%	51%	29%	35%	40%	53%
	fairly important	21%	11%	23%	20%	22%	21%	24%	16%	15%	22%	25%	23%	15%
	somewhat important	21%	14%	18%	20%	25%	18%	22%	14%	21%	23%	21%	19%	19%
	not at all important	13%	16%	5%	6%	17%	17%	14%	13%	10%	16%	8%	16%	10%
	DK/NA	5%	0%	2%	3%	6%	9%	7%	2%	3%	10%	12%	2%	3%
Total		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
BASE		400	28	44	80	127	121	245	56	89	100	52	129	119

FAQ Hawaii, Inc. (2009)

Q4. From what you have read or heard, what are the worst parts of the plan, or what worries you about it?

		Total	AGE					ETHNICITY			LENGTH OF RESIDENCY			
			<35 years	35-44	45-54	55-64	65+	Caucasian	Hawaiian	other	up to 10 years	11-20 years	20 years or more	all my life
Q4: Worst Parts of this Plan	DK/Need more info	46%	75%	27%	42%	45%	50%	49%	36%	38%	47%	45%	55%	33%
	No answer	11%	0%	0%	16%	10%	13%	8%	27%	10%	12%	0%	10%	17%
	no action will be taken	10%	0%	9%	16%	10%	8%	13%	0%	5%	7%	23%	13%	4%
	other	9%	0%	36%	0%	10%	5%	12%	0%	5%	12%	15%	6%	4%
	too much development	5%	0%	0%	5%	8%	3%	4%	9%	5%	2%	0%	3%	13%
	poor road plans	5%	25%	0%	5%	8%	0%	4%	9%	5%	7%	0%	3%	4%
	high cost of development	5%	0%	9%	5%	3%	5%	6%	0%	0%	9%	0%	3%	0%
	increase traffic	4%	0%	9%	11%	3%	0%	1%	9%	10%	5%	0%	3%	4%
	will take too long to complete	4%	0%	0%	5%	0%	8%	3%	9%	5%	2%	8%	0%	8%
	not enough emphasis on schools	4%	0%	9%	0%	3%	5%	4%	0%	5%	5%	8%	3%	0%
	not enough community input	4%	0%	0%	0%	5%	5%	3%	0%	10%	0%	0%	6%	8%
	not a long-term solution	2%	0%	0%	0%	3%	3%	0%	9%	5%	0%	0%	0%	8%
BASE		111	4	11	19	39	38	77	11	21	43	13	31	24

FAQ Hawaii, Inc. (2009)

Q5. Do you believe this plan was based on what you would call a great deal of community input, a moderate amount of community input, or very little community input?

		Total	AGE					ETHNICITY			LENGTH OF RESIDENCY			
			<35 years	35-44	45-54	55-64	65+	Caucasian	Hawaiian	other	up to 10 years	11-20 years	20 years or more	all my life
AMOUNT OF COMMUNITY INPUT ON PLAN	great deal of community input	25%	0%	27%	16%	36%	21%	26%	9%	33%	30%	23%	23%	21%
	moderate amount of community input	37%	25%	36%	32%	31%	47%	38%	18%	43%	30%	38%	52%	29%
	very little community input	23%	75%	18%	21%	28%	13%	23%	36%	14%	28%	31%	10%	25%
	other	1%	0%	0%	0%	0%	3%	0%	9%	0%	0%	0%	0%	4%
	DK/NA	14%	0%	18%	32%	5%	16%	13%	27%	10%	12%	8%	16%	21%
Total		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
BASE		111	4	11	19	39	38	77	11	21	43	13	31	24

FAQ Hawaii, Inc. (2009)

Q2. Have you read or heard that the County just approved a new Kona Community Development Plan?

		Total	AGE					ETHNICITY			LENGTH OF RESIDENCY			
			<35 years	35-44	45-54	55-64	65+	Caucasian	Hawaiian	other	up to 10 years	11-20 years	20 years or more	all my life
HEARD THAT COUNTY APPROVED NEW KONA COMM. DEV. PLAN	yes	28%	14%	25%	24%	31%	31%	31%	20%	24%	43%	25%	24%	20%
	no	71%	86%	75%	74%	68%	67%	67%	80%	74%	57%	69%	74%	79%
	DK/NA	2%	0%	0%	3%	2%	2%	2%	0%	2%	0%	6%	2%	1%
Total		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
BASE		400	28	44	80	127	121	246	56	83	100	52	129	119

FAQ Hawaii, Inc. (2009)

Q3. From what you have read or heard, what do you think are the best parts of this new plan?

		Total	AGE					ETHNICITY			LENGTH OF RESIDENCY			
			<35 years	35-44	45-54	55-64	65+	Caucasian	Hawaiian	other	up to 10 years	11-20 years	20 years or more	all my life
Q3: Best Parts of this Plan	DK/Need more info	41%	75%	27%	42%	49%	34%	33%	45%	62%	35%	31%	48%	50%
	more roads / traffic alleviation	14%	0%	9%	5%	10%	24%	14%	9%	14%	16%	15%	10%	13%
	good plan/like the plan	13%	0%	18%	21%	10%	11%	12%	18%	10%	21%	8%	3%	13%
	puts everything in one area	7%	0%	18%	11%	8%	3%	9%	0%	5%	7%	8%	13%	0%
	other	7%	0%	0%	11%	8%	8%	5%	27%	5%	7%	8%	3%	13%
	more recreational facilities	6%	0%	9%	0%	5%	11%	8%	0%	5%	7%	8%	10%	0%
	hospital is needed	5%	0%	9%	0%	0%	13%	3%	0%	19%	5%	0%	10%	4%
	preservation of land	5%	0%	9%	0%	5%	5%	5%	0%	5%	5%	0%	6%	4%
	good location	5%	0%	9%	0%	3%	8%	5%	9%	0%	2%	23%	0%	4%
	more affordable hsng	3%	0%	0%	0%	0%	8%	3%	9%	0%	2%	0%	3%	4%
	UH will be there	3%	25%	0%	0%	5%	0%	3%	0%	5%	5%	8%	0%	0%
	infrastructure included in plan	3%	0%	0%	11%	3%	0%	4%	0%	0%	2%	0%	6%	0%
	community input	3%	0%	0%	5%	3%	3%	4%	0%	0%	0%	15%	3%	0%
	considers cultural values	2%	0%	0%	5%	3%	0%	3%	0%	0%	0%	0%	6%	0%
	dev. thoughtfully considered	1%	0%	0%	0%	3%	0%	1%	0%	0%	0%	0%	3%	0%
	creates new jobs	1%	0%	9%	0%	0%	0%	1%	0%	0%	0%	0%	0%	4%
	don't like new developments	1%	0%	0%	0%	0%	3%	1%	0%	0%	0%	0%	0%	4%
BASE		111	4	11	19	39	38	77	11	21	43	13	31	24

FAQ Hawaii, Inc. (2009)

Q6b. I'm going to mention certain things that are part of the new Kona Community Development Plan. For each one, please tell me if you personally strongly agree, somewhat agree, somewhat disagree, or strongly disagree that this should be Kona's plan.
MOST FUTURE GROWTH SHOULD BE LOCATED NORTH OF KAILUA, TOWARD THE AIRPORT.

			AGE					ETHNICITY			LENGTH OF RESIDENCY			
		Total	<35 years	35-44	45-54	55-64	65+	Caucasian	Hawaiian	other	up to 10 years	11-20 years	20 years or more	all my life
MOST FUTURE GROWTH SHOULD BE NORTH OF KAILUA	strongly agree	37%	43%	39%	38%	33%	34%	36%	34%	42%	39%	40%	35%	34%
	somewhat agree	34%	32%	45%	36%	30%	33%	31%	43%	36%	31%	42%	29%	39%
	somewhat disagree	13%	14%	7%	13%	13%	16%	14%	13%	10%	16%	8%	14%	13%
	strongly disagree	12%	4%	9%	9%	15%	12%	13%	11%	7%	7%	4%	18%	12%
	DK/NA	5%	7%	0%	5%	6%	5%	6%	0%	6%	7%	6%	5%	3%
Total		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
BASE		400	28	44	80	127	121	246	56	88	100	52	129	119

FAQ Hawaii, Inc. (2009)

Q6c. I'm going to mention certain things that are part of the new Kona Community Development Plan. For each one, please tell me if you personally strongly agree, somewhat agree, somewhat disagree, or strongly disagree that this should be Kona's plan.
THE NEW MID-LEVEL ROAD SHOULD BE DEVELOPED AS THE MAIN ROUTE FOR BUSES OR OTHER FUTURE MASS TRANSIT CONNECTING KAILUA TO THE AIRPORT.

			AGE					ETHNICITY			LENGTH OF RESIDENCY			
		Total	<35 years	35-44	45-54	55-64	65+	Caucasian	Hawaiian	other	up to 10 years	11-20 years	20 years or more	all my life
MID-LEVEL ROAD SHOULD BE MAIN KAILUA-AIRPORT BUS TRANSIT ROUTE	strongly agree	39%	32%	36%	53%	32%	40%	37%	32%	51%	40%	52%	36%	35%
	somewhat agree	30%	36%	36%	20%	29%	34%	29%	41%	26%	28%	33%	26%	35%
	somewhat disagree	13%	18%	9%	15%	13%	12%	15%	14%	9%	12%	6%	16%	14%
	strongly disagree	12%	11%	16%	8%	17%	7%	11%	13%	8%	13%	4%	16%	9%
	DK/NA	7%	4%	2%	5%	9%	7%	8%	0%	7%	7%	6%	7%	6%
Total		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
BASE		400	28	44	80	127	121	246	56	88	100	52	129	119

FAQ Hawaii, Inc. (2009)

Q5a. Did you personally go to any meetings or have any input to this plan?

			AGE					ETHNICITY			LENGTH OF RESIDENCY			
		Total	<35 years	35-44	45-54	55-64	65+	Caucasian	Hawaiian	other	up to 10 years	11-20 years	20 years or more	all my life
PERSONALLY GO TO MEETINGS ABOUT PLAN	yes	31%	0%	18%	21%	33%	39%	35%	27%	19%	30%	31%	32%	29%
	no	69%	100%	82%	79%	67%	61%	65%	73%	81%	70%	69%	68%	71%
Total		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
BASE		111	4	11	19	33	38	77	11	21	43	13	31	24

FAQ Hawaii, Inc. (2009)

Q6a. I'm going to mention certain things that are part of the new Kona Community Development Plan. For each one, please tell me if you personally strongly agree, somewhat agree, somewhat disagree, or strongly disagree that this should be Kona's plan.
PLANNING FOR KONA IS MOSTLY ABOUT WHERE AND HOW GROWTH HAPPENS, NOT TRYING TO MAKE GROWTH HAPPEN FASTER OR SLOWER.

			AGE					ETHNICITY			LENGTH OF RESIDENCY			
		Total	<35 years	35-44	45-54	55-64	65+	Caucasian	Hawaiian	other	up to 10 years	11-20 years	20 years or more	all my life
PLANNING FOR KONA IS MOSTLY WHERE/HOW GROWTH HAPPENS	strongly agree	50%	29%	52%	53%	50%	51%	54%	32%	51%	60%	45%	52%	35%
	somewhat agree	34%	57%	32%	23%	38%	32%	34%	34%	33%	29%	37%	35%	35%
	somewhat disagree	7%	11%	7%	14%	4%	5%	4%	20%	6%	5%	6%	3%	13%
	strongly disagree	4%	0%	5%	3%	4%	4%	4%	7%	0%	2%	4%	5%	3%
	DK/NA	6%	4%	5%	9%	4%	7%	4%	7%	11%	4%	6%	5%	8%
Total		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
BASE		400	28	44	80	127	121	246	56	88	100	52	129	119

FAQ Hawaii, Inc. (2009)

Q6f. I'm going to mention certain things that are part of the new Kona Community Development Plan. For each one, please tell me if you personally strongly agree, somewhat agree, somewhat disagree, or strongly disagree that this should be Kona's plan.
SOME VILLAGES SHOULD PROVIDE HIGHER-DENSITY HOUSING AND COMMERCIAL TO SUPPORT MAJOR JOB AREAS LIKE THE CIVIC CENTER, NEW HOSPITAL, AND NEW UNIVERSITY.

			AGE					ETHNICITY			LENGTH OF RESIDENCY			
		Total	<35 years	35-44	45-54	55-64	65+	Caucasian	Hawaiian	other	up to 10 years	11-20 years	20 years or more	all my life
SOME VILLAGES SHOULD PROVIDE HIGH DENSITY HOUSING	strongly agree	56%	64%	57%	56%	51%	59%	57%	45%	63%	63%	69%	50%	50%
	somewhat agree	29%	25%	34%	29%	35%	23%	28%	43%	22%	23%	25%	33%	33%
	somewhat disagree	5%	4%	7%	5%	5%	4%	5%	2%	3%	4%	2%	7%	4%
	strongly disagree	6%	4%	0%	4%	7%	7%	7%	7%	1%	7%	2%	5%	6%
	DK/NA	5%	4%	2%	6%	2%	7%	3%	2%	10%	3%	2%	5%	7%
Total		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
BASE		400	28	44	80	127	121	246	56	89	100	52	129	119

FAQ Hawaii, Inc. (2009)

Q6g. I'm going to mention certain things that are part of the new Kona Community Development Plan. For each one, please tell me if you personally strongly agree, somewhat agree, somewhat disagree, or strongly disagree that this should be Kona's plan.
THERE SHOULD BE A NEW HOSPITAL ALONG THE MID-LEVEL ROAD IN ONE OF THE VILLAGES BETWEEN KAILUA AND THE AIRPORT.

			AGE					ETHNICITY			LENGTH OF RESIDENCY			
		Total	<35 years	35-44	45-54	55-64	65+	Caucasian	Hawaiian	other	up to 10 years	11-20 years	20 years or more	all my life
SHOULD BE NEW HOSPITAL AROUND MID-LEVEL ROAD	strongly agree	58%	71%	64%	63%	53%	57%	57%	57%	65%	58%	65%	57%	57%
	somewhat agree	27%	18%	23%	28%	30%	26%	25%	27%	27%	24%	21%	28%	29%
	somewhat disagree	6%	0%	9%	6%	6%	4%	6%	11%	1%	4%	8%	6%	5%
	strongly disagree	6%	7%	0%	3%	8%	7%	6%	4%	2%	7%	4%	6%	5%
	DK/NA	4%	4%	5%	1%	3%	6%	4%	2%	4%	7%	2%	2%	3%
Total		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
BASE		400	28	44	80	127	121	246	56	89	100	52	129	119

FAQ Hawaii, Inc. (2009)

Q6d. I'm going to mention certain things that are part of the new Kona Community Development Plan. For each one, please tell me if you personally strongly agree, somewhat agree, somewhat disagree, or strongly disagree that this should be Kona's plan.
GROWTH NORTH OF KONA SHOULD BE DIRECTED MOSTLY INTO COMPACT MIXED-USE VILLAGES, WITH OPEN SPACE IN BETWEEN THEM.

			AGE					ETHNICITY			LENGTH OF RESIDENCY			
		Total	<35 years	35-44	45-54	55-64	65+	Caucasian	Hawaiian	other	up to 10 years	11-20 years	20 years or more	all my life
GROWTH N. OF KONA SHOULD BE INTO COMPACT MIXED-USE	strongly agree	43%	36%	36%	50%	40%	45%	45%	36%	42%	45%	44%	45%	39%
	somewhat agree	32%	43%	39%	28%	34%	29%	31%	30%	39%	30%	42%	35%	27%
	somewhat disagree	11%	7%	18%	10%	10%	11%	10%	21%	6%	13%	6%	5%	17%
	strongly disagree	7%	7%	5%	6%	11%	4%	7%	9%	2%	6%	6%	9%	7%
	DK/NA	7%	7%	5%	6%	5%	11%	7%	4%	11%	6%	2%	6%	11%
Total		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
BASE		400	28	44	80	127	121	246	56	89	100	52	129	119

FAQ Hawaii, Inc. (2009)

Q6a. I'm going to mention certain things that are part of the new Kona Community Development Plan. For each one, please tell me if you personally strongly agree, somewhat agree, somewhat disagree, or strongly disagree that this should be Kona's plan.
THE NEW VILLAGES SHOULD BE CENTERED AROUND BUS TRANSIT STOPS ON THE NEW MID-LEVEL ROAD.

			AGE					ETHNICITY			LENGTH OF RESIDENCY			
		Total	<35 years	35-44	45-54	55-64	65+	Caucasian	Hawaiian	other	up to 10 years	11-20 years	20 years or more	all my life
NEW VILLAGES SHOULD BE CENTERED AROUND TRANSIT STOPS	strongly agree	44%	29%	43%	45%	45%	46%	45%	33%	46%	44%	67%	42%	36%
	somewhat agree	36%	50%	36%	39%	31%	36%	35%	39%	36%	40%	23%	36%	37%
	somewhat disagree	6%	4%	11%	3%	6%	6%	7%	6%	4%	4%	2%	7%	8%
	strongly disagree	9%	4%	7%	10%	14%	4%	8%	11%	7%	8%	4%	10%	10%
	DK/NA	6%	14%	2%	4%	4%	8%	6%	5%	7%	4%	4%	5%	9%
Total		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
BASE		400	28	44	80	127	121	246	56	89	100	52	129	119

FAQ Hawaii, Inc. (2009)

Q8. Here's a summary of the proposal, to be developed over 30 years: 5,000 housing units of various types spread over 1,150 acres, one intermediate and two elementry schools, mauka and makai commercial areas, 150-acre dryland forest preserve, and a new regional hospital on the Mid-Level Road. Does this overall package sound like a very acceptable, somewhat acceptable, somewhat unacceptable, or very unacceptable idea?

			AGE					ETHNICITY			LENGTH OF RESIDENCY			
		Total	<35 years	35-44	45-54	55-64	65+	Caucasian	Hawaiian	other	up to 10 years	11-20 years	20 years or more	all my life
PACKAGE SOUND GOOD?	very acceptable	27%	46%	39%	30%	25%	19%	24%	29%	36%	32%	29%	22%	28%
	somewhat acceptable	44%	43%	41%	46%	43%	45%	43%	52%	42%	41%	52%	40%	43%
	somewhat unacceptable	11%	4%	14%	10%	9%	14%	14%	4%	7%	9%	12%	16%	7%
	very unacceptable	15%	4%	7%	9%	22%	17%	17%	13%	8%	16%	6%	19%	13%
	DK/NA	3%	4%	0%	5%	1%	6%	2%	4%	8%	2%	2%	3%	5%
Total		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
BASE		400	28	44	80	127	121	246	56	89	100	52	129	119

FAQ Hawaii, Inc. (2009)

Q9. What is the most important reason you think this is an acceptable development?

			AGE					ETHNICITY			LENGTH OF RESIDENCY			
		Total	<35 years	35-44	45-54	55-64	65+	Caucasian	Hawaiian	other	up to 10 years	11-20 years	20 years or more	all my life
Q9. Most important reason you think development is acceptable.	hospital is needed	36%	43%	40%	33%	37%	32%	35%	44%	38%	34%	43%	34%	37%
	good plan/ meets future needs	26%	16%	29%	25%	24%	30%	25%	16%	30%	25%	24%	33%	21%
	more housing / affordable housing	16%	12%	9%	13%	14%	25%	15%	24%	14%	16%	14%	9%	21%
	more schools	15%	26%	23%	16%	11%	12%	11%	16%	25%	14%	19%	14%	17%
	alleviate traffic	11%	4%	11%	11%	13%	12%	12%	9%	13%	12%	14%	14%	7%
	increase in jobs	8%	26%	3%	10%	6%	6%	6%	16%	10%	7%	5%	5%	14%
	other	8%	8%	6%	7%	7%	10%	7%	13%	7%	5%	5%	6%	12%
	everything is close proximity	7%	8%	3%	11%	5%	4%	7%	11%	6%	7%	7%	5%	10%
	good location	7%	0%	6%	7%	13%	3%	6%	4%	6%	5%	2%	13%	4%
	infrastructure for growing pop.	4%	4%	3%	3%	5%	3%	5%	0%	1%	3%	12%	3%	1%
	long-term plan	4%	4%	3%	7%	1%	4%	2%	4%	6%	3%	6%	3%	4%
	good use of unused land	4%	0%	6%	3%	3%	4%	4%	2%	3%	4%	2%	5%	2%
	preservation of land considered	2%	0%	0%	10%	1%	0%	4%	0%	1%	3%	7%	3%	0%
	DK/Need more info	2%	4%	0%	2%	2%	1%	3%	0%	0%	4%	2%	1%	0%
BASE		285	25	35	61	87	77	164	45	65	73	42	80	90

FAQ Hawaii, Inc. (2009)

Q6h. I'm going to mention certain things that are part of the new Kona Community Development Plan. For each one, please tell me if you personally strongly agree, somewhat agree, somewhat disagree, or strongly disagree that this should be Kona's plan.
TO ENCOURAGE A PRIVATE LANDOWNER TO ATTRACT A NEW HOSPITAL SITE, HIGHER DENSITIES SHOULD BE ALLOWED IN THAT VILLAGE.

			AGE					ETHNICITY			LENGTH OF RESIDENCY			
		Total	<35 years	35-44	45-54	55-64	65+	Caucasian	Hawaiian	other	up to 10 years	11-20 years	20 years or more	all my life
HIGHER DENSITIES TO ATTRACT NEW HOSPITAL/LANDOWNER	strongly agree	34%	36%	27%	43%	36%	27%	33%	25%	44%	39%	29%	36%	29%
	somewhat agree	35%	43%	57%	30%	28%	35%	35%	41%	31%	28%	50%	33%	36%
	somewhat disagree	11%	4%	9%	8%	13%	12%	10%	11%	9%	12%	10%	11%	9%
	strongly disagree	12%	7%	5%	11%	15%	14%	15%	13%	6%	12%	6%	14%	13%
	DK/NA	9%	11%	2%	9%	6%	12%	8%	11%	10%	9%	6%	7%	12%
Total		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
BASE		400	28	44	80	127	121	246	56	89	100	52	129	119

FAQ Hawaii, Inc. (2009)

Q7. Have you heard that a new development is being proposed for the Kaloko Makai area, north and mauka of Costco along Hina Lani street?

			AGE					ETHNICITY			LENGTH OF RESIDENCY			
		Total	<35 years	35-44	45-54	55-64	65+	Caucasian	Hawaiian	other	up to 10 years	11-20 years	20 years or more	all my life
HEARD OF NEW DEVELOPMENT IN KALOKO MAKAI AREA	yes	56%	56%	45%	55%	57%	56%	57%	54%	53%	57%	60%	52%	58%
	no	43%	25%	50%	45%	41%	44%	41%	46%	45%	41%	33%	47%	40%
	DK/NA	2%	7%	5%	0%	2%	0%	2%	0%	2%	2%	2%	1%	2%
Total		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
BASE		400	28	44	80	127	121	246	56	89	100	52	129	119

FAQ Hawaii, Inc. (2009)

Q1a. First, I'm going to read a list of possible needs for North Kona. For each one, please tell me if you think it is a very important need, fairly important, somewhat important, or not important at all.
MORE BEACH OR COASTAL PARKS.

		Total	EDUCATION LEVEL				INCOME					HOME OWNERSHIP STATUS		GENDER	
			up to HS grad	some college	college grad	graduate/ prof. degree	<$35k	$35k <$50k	$50k <$75k	$75k <$100k	$100k+	own	rent	male	female
MORE BEACHES/ COASTAL PARKS	very important	45%	52%	50%	41%	33%	47%	52%	46%	39%	42%	43%	49%	44%	45%
	fairly important	22%	17%	26%	24%	19%	19%	17%	25%	33%	12%	23%	18%	22%	22%
	somewhat important	21%	16%	16%	23%	29%	18%	16%	23%	19%	29%	21%	17%	23%	19%
	not at all important	12%	16%	7%	11%	17%	15%	14%	4%	9%	14%	11%	14%	10%	13%
	DK/NA	1%	0%	2%	2%	1%	1%	2%	1%	0%	3%	1%	1%	1%	2%
Total		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
BASE		400	77	123	119	79	79	68	71	64	65	314	71	166	234

FAQ Hawaii, Inc. (2009)

Q1b. First, I'm going to read a list of possible needs for North Kona. For each one, please tell me if you think it is a very important need, fairly important, somewhat important, or not important at all.
MORE ROADS CONNECTING MAUKA AND MAKAI AREAS.

		Total	EDUCATION LEVEL				INCOME					HOME OWNERSHIP STATUS		GENDER	
			up to HS grad	some college	college grad	graduate/ prof. degree	<$35k	$35k <$50k	$50k <$75k	$75k <$100k	$100k+	own	rent	male	female
MORE ROADS CONNECTING MAUKA & MAKAI	very important	73%	75%	75%	71%	71%	75%	66%	70%	84%	66%	75%	72%	76%	71%
	fairly important	11%	10%	9%	13%	13%	8%	16%	13%	6%	15%	11%	7%	10%	12%
	somewhat important	9%	3%	12%	9%	9%	9%	9%	11%	5%	14%	8%	10%	7%	10%
	not at all important	5%	9%	4%	4%	4%	8%	9%	4%	5%	3%	4%	8%	5%	5%
	DK/NA	2%	3%	0%	3%	3%	1%	2%	1%	0%	0%	1%	3%	2%	2%
Total		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
BASE		400	77	123	119	79	79	68	71	64	65	314	71	166	234

FAQ Hawaii, Inc. (2009)

Q10. What is the most important reason you think this is an unacceptable development?

		Total	AGE					ETHNICITY			LENGTH OF RESIDENCY			
			<35 years	35-44	45-54	55-64	65+	Caucasian	Hawaiian	other	up to 10 years	11-20 years	20 years or more	all my life
Q10: Most important reason you think development is unacceptable.	too big / don't need	46%	50%	33%	53%	44%	43%	43%	56%	62%	24%	44%	53%	57%
	density too high	21%	50%	44%	13%	26%	11%	16%	33%	23%	16%	0%	22%	30%
	too much traffic	12%	0%	0%	7%	15%	14%	10%	22%	15%	16%	0%	11%	13%
	not enough infrastructure	12%	0%	11%	13%	15%	8%	12%	11%	8%	20%	22%	7%	9%
	other	11%	0%	0%	13%	10%	14%	12%	0%	15%	8%	44%	7%	9%
	poor location	6%	0%	0%	0%	10%	11%	10%	0%	0%	8%	0%	13%	0%
	need to preserve land	7%	50%	11%	7%	5%	5%	6%	11%	8%	12%	22%	0%	9%
	finish other projects first	7%	0%	0%	13%	10%	3%	6%	11%	8%	4%	11%	7%	9%
	poor plan	6%	50%	0%	7%	5%	5%	8%	0%	0%	4%	0%	9%	4%
	not enough water	5%	0%	11%	0%	5%	5%	3%	22%	8%	0%	11%	2%	13%
	too long to complete	5%	0%	0%	0%	8%	5%	5%	0%	0%	8%	11%	4%	0%
	not enough schools	4%	0%	22%	7%	3%	0%	4%	11%	0%	8%	11%	2%	0%
	DK/Need more info	1%	0%	0%	0%	0%	3%	1%	0%	0%	4%	0%	0%	0%
BASE		102	2	9	15	39	37	77	9	13	25	9	45	23

FAQ Hawaii, Inc. (2009)

Q1e. First, I'm going to read a list of possible needs for North Kona. For each one, please tell me if you think it is a very important need, fairly important, somewhat important, or not important at all.
PRESERVATION OF OPEN SPACES BETWEEN NEW URBAN DEVELOPMENTS.

			EDUCATION LEVEL				INCOME					HOME OWNERSHIP STATUS		GENDER	
		Total	up to HS grad	some college	college grad	graduate/ prof. degree	<$35k	$35k <$50k	$50k <$75k	$75k <$100k	$100k+	own	rent	male	female
PRESERVATION OF OPEN SPACES	very important	60%	51%	65%	61%	60%	63%	74%	51%	58%	69%	59%	63%	56%	63%
	fairly important	19%	25%	15%	18%	20%	14%	10%	25%	23%	14%	18%	21%	20%	18%
	somewhat important	14%	14%	15%	13%	15%	14%	12%	18%	14%	12%	15%	10%	16%	12%
	not at all important	6%	6%	3%	8%	5%	5%	0%	4%	5%	5%	6%	1%	6%	5%
	DK/NA	2%	4%	2%	1%	0%	4%	3%	1%	0%	0%	1%	4%	1%	2%
Total		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
BASE		400	77	129	119	75	79	58	71	64	65	314	71	166	234

FAQ Hawaii, Inc. (2009).

Q1f. First, I'm going to read a list of possible needs for North Kona. For each one, please tell me if you think it is a very important need, fairly important, somewhat important, or not important at all.
MORE TOURISM JOBS.

			EDUCATION LEVEL				INCOME					HOME OWNERSHIP STATUS		GENDER	
		Total	up to HS grad	some college	college grad	graduate/ prof. degree	<$35k	$35k <$50k	$50k <$75k	$75k <$100k	$100k+	own	rent	male	female
MOER TOURISM JOBS	very important	41%	53%	39%	33%	36%	53%	34%	39%	42%	34%	40%	45%	39%	42%
	fairly important	23%	17%	25%	24%	23%	19%	19%	27%	22%	23%	24%	18%	21%	24%
	somewhat important	20%	13%	18%	24%	24%	13%	28%	17%	23%	23%	19%	21%	23%	18%
	not at all important	13%	9%	15%	12%	15%	9%	17%	15%	11%	18%	13%	10%	13%	12%
	DK/NA	4%	8%	4%	3%	3%	6%	2%	1%	2%	2%	4%	6%	3%	5%
Total		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
BASE		400	77	129	119	75	79	58	71	64	65	314	71	166	234

FAQ Hawaii, Inc. (2009)

Q1c. First, I'm going to read a list of possible needs for North Kona. For each one, please tell me if you think it is a very important need, fairly important, somewhat important, or not important at all.
A NEW HOSPITAL IN NORTH KONA.

			EDUCATION LEVEL				INCOME					HOME OWNERSHIP STATUS		GENDER	
		Total	up to HS grad	some college	college grad	graduate/ prof. degree	<$35k	$35k <$50k	$50k <$75k	$75k <$100k	$100k+	own	rent	male	female
NEW HOSPITAL	very important	75%	86%	70%	76%	71%	81%	71%	75%	64%	78%	76%	72%	75%	75%
	fairly important	9%	5%	10%	10%	8%	5%	10%	8%	11%	11%	9%	8%	10%	8%
	somewhat important	9%	4%	10%	5%	9%	4%	12%	11%	14%	5%	8%	13%	9%	8%
	not at all important	6%	4%	10%	5%	11%	8%	7%	6%	11%	6%	7%	6%	6%	9%
	DK/NA	1%	1%	0%	0%	1%	3%	0%	0%	0%	0%	0%	1%	1%	0%
Total		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
BASE		400	77	129	119	75	79	58	71	64	65	314	71	166	234

FAQ Hawaii, Inc. (2009)

Q1d. First, I'm going to read a list of possible needs for North Kona. For each one, please tell me if you think it is a very important need, fairly important, somewhat important, or not important at all.
MORE NEW HOUSING UNITS AFFORDABLE TO THE AVERAGE KONA FAMILY.

			EDUCATION LEVEL				INCOME					HOME OWNERSHIP STATUS		GENDER	
		Total	up to HS grad	some college	college grad	graduate/ prof. degree	<$35k	$35k <$50k	$50k <$75k	$75k <$100k	$100k+	own	rent	male	female
MORE NEW AFFORDABLE HSNG	very important	66%	69%	65%	62%	58%	73%	67%	65%	63%	62%	61%	85%	67%	64%
	fairly important	14%	14%	12%	15%	15%	8%	10%	17%	11%	20%	16%	6%	13%	15%
	somewhat important	10%	6%	11%	11%	9%	6%	14%	8%	14%	11%	11%	7%	9%	10%
	not at all important	9%	9%	10%	9%	5%	9%	9%	10%	9%	6%	10%	3%	10%	8%
	DK/NA	2%	1%	2%	3%	3%	4%	0%	0%	3%	2%	2%	0%	1%	3%
Total		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
BASE		400	77	129	119	75	79	58	71	64	65	314	71	166	234

FAQ Hawaii, Inc. (2009)

Q1f. First, I'm going to read a list of possible needs for North Kona. For each one, please tell me if you think it is a very important need, fairly important, somewhat important, or not important at all.
MORE BUSES SERVING THE NORTH KONA AREA.

		Total	EDUCATION LEVEL: up to HS grad	some college	college grad	graduate/ prof. degree	INCOME: <$35k	$35k <$50k	$50k <$75k	$75k <$100k	$100k+	HOME OWNERSHIP STATUS: own	rent	GENDER: male	female
MORE BUSES	very important	51%	62%	50%	49%	47%	63%	43%	54%	52%	32%	49%	62%	42%	56%
	fairly important	18%	14%	18%	19%	21%	15%	22%	17%	16%	26%	19%	14%	19%	18%
	somewhat important	17%	9%	16%	21%	15%	8%	10%	17%	19%	29%	17%	13%	23%	12%
	not at all important	8%	8%	9%	9%	4%	6%	9%	10%	6%	11%	6%	6%	10%	6%
	DKNA	6%	6%	6%	2%	9%	8%	10%	3%	6%	2%	6%	6%	5%	6%
Total		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
BASE		400	77	129	119	75	79	58	71	64	65	314	71	166	234

FAQ Hawaii, Inc. (2009)

Q1j. First, I'm going to read a list of possible needs for North Kona. For each one, please tell me if you think it is a very important need, fairly important, somewhat important, or not important at all.
MORE ACTIVE SPORTS PLAYING FIELDS.

		Total	EDUCATION LEVEL: up to HS grad	some college	college grad	graduate/ prof. degree	INCOME: <$35k	$35k <$50k	$50k <$75k	$75k <$100k	$100k+	HOME OWNERSHIP STATUS: own	rent	GENDER: male	female
MORE ACTIVE SPORTS FIELDS	very important	40%	48%	42%	45%	21%	48%	38%	44%	48%	29%	38%	54%	38%	42%
	fairly important	21%	18%	24%	18%	23%	20%	14%	17%	19%	31%	21%	18%	17%	24%
	somewhat important	21%	14%	19%	19%	31%	18%	14%	25%	22%	23%	22%	15%	25%	17%
	not at all important	13%	13%	12%	13%	17%	9%	26%	11%	8%	14%	14%	10%	17%	10%
	DKNA	5%	6%	3%	5%	8%	5%	9%	3%	3%	3%	6%	3%	2%	7%
Total		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
BASE		400	77	129	119	75	79	58	71	64	65	314	71	166	234

FAQ Hawaii, Inc. (2009)

Q1g. First, I'm going to read a list of possible needs for North Kona. For each one, please tell me if you think it is a very important need, fairly important, somewhat important, or not important at all.
FASTER DEVELOPMENT OF HAWAIIAN HOME LANDS AREAS.

		Total	EDUCATION LEVEL: up to HS grad	some college	college grad	graduate/ prof. degree	INCOME: <$35k	$35k <$50k	$50k <$75k	$75k <$100k	$100k+	HOME OWNERSHIP STATUS: own	rent	GENDER: male	female
FASTER DEV. OF HAWN HOME LANDS	very important	36%	46%	39%	29%	25%	44%	40%	35%	33%	29%	26%	9%	33%	38%
	fairly important	17%	19%	17%	16%	13%	20%	17%	15%	14%	20%	13%	3%	18%	15%
	somewhat important	21%	10%	21%	25%	23%	11%	19%	21%	23%	28%	18%	3%	23%	19%
	not at all important	18%	14%	15%	20%	23%	15%	16%	23%	14%	18%	16%	2%	20%	16%
	DKNA	10%	6%	9%	10%	12%	9%	5%	6%	11%	5%	5%	2%	7%	12%
Total		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	82%	18%	100%	100%
BASE		400	77	129	119	75	79	58	71	64	65	314	71	166	234

FAQ Hawaii, Inc. (2009)

Q1h. First, I'm going to read a list of possible needs for North Kona. For each one, please tell me if you think it is a very important need, fairly important, somewhat important, or not important at all.
MORE DOCTORS AND MEDICAL PERSONNEL.

		Total	EDUCATION LEVEL: up to HS grad	some college	college grad	graduate/ prof. degree	INCOME: <$35k	$35k <$50k	$50k <$75k	$75k <$100k	$100k+	HOME OWNERSHIP STATUS: own	rent	GENDER: male	female
MORE DOCTORS/MED. STAFF	very important	90%	91%	90%	95%	91%	91%	84%	90%	88%	95%	91%	90%	87%	93%
	fairly important	5%	5%	6%	5%	3%	3%	7%	6%	6%	3%	5%	4%	5%	5%
	somewhat important	2%	1%	2%	3%	1%	0%	5%	3%	5%	2%	2%	3%	4%	1%
	not at all important	2%	1%	2%	2%	1%	5%	2%	1%	0%	0%	2%	1%	2%	1%
	DKNA	1%	1%	0%	0%	4%	1%	2%	0%	2%	0%	1%	1%	2%	0%
Total		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
BASE		400	77	129	119	75	79	58	71	64	65	314	71	166	234

FAQ Hawaii, Inc. (2009)

Q2. Have you read or heard that the County just approved a new Kona Community Development Plan?

		Total	EDUCATION LEVEL: up to HS grad	some college	college grad	graduate/ prof. degree	INCOME: <$35k	$35k <$50k	$50k <$75k	$75k <$100k	$100k+	HOME OWNERSHIP STATUS: own	rent	GENDER: male	female
HEARD THAT COUNTY APPROVED NEW KONA COMM. DEV. PLAN	yes	28%	12%	29%	29%	40%	14%	31%	30%	34%	38%	30%	20%	29%	27%
	no	71%	87%	71%	68%	59%	85%	67%	69%	66%	60%	68%	80%	70%	71%
	DKNA	2%	1%	1%	3%	1%	1%	2%	1%	0%	2%	2%	0%	1%	2%
Total		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
BASE		400	77	129	119	75	79	58	71	64	65	314	71	166	234

FAQ Hawaii, Inc. (2009)

Q3. From what you have read or heard, what do you think are the best parts of this new plan?

		Total	EDUCATION LEVEL: up to HS grad	some college	college grad	graduate/ prof. degree	INCOME: <$35k	$35k <$50k	$50k <$75k	$75k <$100k	$100k+	HOME OWNERSHIP STATUS: own	rent	GENDER: male	female
Q3: Best Parts of this Plan	DK/Need more info	41%	67%	46%	40%	30%	36%	39%	38%	41%	43%	41%	50%	43%	37%
	more roads / traffic alleviation	14%	11%	14%	11%	17%	18%	11%	10%	16%	16%	15%	0%	15%	13%
	good plan/like the plan	13%	22%	11%	11%	13%	18%	22%	10%	14%	4%	10%	29%	6%	17%
	puts everything in one area	7%	0%	8%	6%	10%	9%	0%	14%	5%	8%	9%	0%	4%	10%
	other	7%	11%	6%	9%	3%	18%	0%	10%	5%	6%	6%	7%	6%	6%
	more recreational facilities	6%	0%	11%	3%	7%	9%	11%	5%	14%	0%	6%	0%	6%	11%
	hospital is needed	5%	0%	5%	6%	7%	9%	11%	5%	9%	0%	5%	7%	4%	6%
	good location	5%	0%	0%	6%	10%	0%	6%	0%	9%	4%	5%	0%	6%	3%
	preservation of land	5%	0%	5%	0%	10%	0%	17%	5%	0%	0%	4%	0%	2%	6%
	more affordable hsng	3%	0%	0%	6%	3%	0%	11%	0%	5%	0%	2%	7%	2%	3%
	UH will be there	3%	0%	3%	3%	3%	0%	6%	5%	0%	4%	3%	0%	6%	0%
	Infrastructure included in plan	3%	0%	3%	3%	3%	0%	0%	0%	9%	4%	3%	0%	0%	5%
	community input	3%	0%	0%	3%	7%	0%	0%	5%	0%	8%	2%	7%	6%	0%
	considers cultural values	2%	0%	3%	3%	0%	0%	0%	0%	5%	0%	2%	0%	0%	3%
	dev. thoughtfully considered	1%	0%	3%	0%	0%	0%	0%	0%	5%	0%	1%	0%	0%	2%
	don't like new developments	1%	0%	0%	3%	0%	0%	0%	5%	0%	0%	1%	0%	2%	0%
	creates new jobs	1%	0%	0%	3%	0%	0%	0%	0%	0%	0%	1%	0%	0%	2%
BASE		111	9	37	35	30	11	18	21	22	25	93	14	48	63

FAQ Hawaii, Inc. (2009)

Q1k. First, I'm going to read a list of possible needs for North Kona. For each one, please tell me if you think it is a very important need, fairly important, somewhat important, or not important at all.
MORE ELEMENTARY AND INTERMEDIATE SCHOOLS.

		Total	EDUCATION LEVEL: up to HS grad	some college	college grad	graduate/ prof. degree	INCOME: <$35k	$35k <$50k	$50k <$75k	$75k <$100k	$100k+	HOME OWNERSHIP STATUS: own	rent	GENDER: male	female
MORE ELE. & MIDDLE SCHOOLS	very important	34%	48%	32%	32%	27%	43%	26%	35%	33%	35%	32%	44%	31%	36%
	fairly important	18%	16%	14%	23%	19%	19%	14%	14%	22%	18%	19%	13%	21%	15%
	somewhat important	17%	10%	20%	13%	24%	10%	17%	21%	17%	17%	17%	17%	16%	18%
	not at all important	15%	14%	15%	16%	15%	10%	22%	15%	13%	17%	16%	6%	17%	14%
	DKNA	17%	12%	19%	17%	16%	18%	21%	11%	16%	12%	17%	18%	15%	18%
Total		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
BASE		400	77	129	119	75	79	58	71	64	65	314	71	166	234

FAQ Hawaii, Inc. (2009)

Q1L First, I'm going to read a list of possible needs for North Kona. For each one, please tell me if you think it is a very important need, fairly important, somewhat important, or not important at all.
DEVELOPING A MID-LEVEL ROAD MAUKA OR QUEEN KA'AHUMANU HIGHWAY AND MAKAI OF MAMALAHOA HIGHWAY, IN BETWEEN AND PARALLEL TO BOTH OF THEM.

		Total	EDUCATION LEVEL: up to HS grad	some college	college grad	graduate/ prof. degree	INCOME: <$35k	$35k <$50k	$50k <$75k	$75k <$100k	$100k+	HOME OWNERSHIP STATUS: own	rent	GENDER: male	female
DEVELOPING MID-LEVEL ROAD	very important	56%	61%	55%	57%	51%	53%	47%	65%	62%	57%	59%	45%	55%	57%
	fairly important	14%	14%	13%	16%	11%	20%	12%	14%	17%	8%	13%	18%	16%	12%
	somewhat important	13%	12%	14%	11%	17%	10%	17%	10%	16%	15%	12%	17%	11%	15%
	not at all important	14%	10%	16%	13%	15%	14%	21%	10%	13%	18%	13%	14%	14%	14%
	DKNA	3%	3%	2%	3%	7%	3%	3%	1%	3%	2%	3%	6%	4%	3%
Total		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
BASE		400	77	129	119	75	79	58	71	64	65	314	71	166	234

FAQ Hawaii, Inc. (2009)

Q5a. Did you personally go to any meetings or have any input to this plan?

		Total	EDUCATION LEVEL: up to HS grad	some college	college grad	graduate/ prof. degree	INCOME: <$35k	$35k <$50k	$50k <$75k	$75k <$100k	$100k+	HOME OWNERSHIP STATUS: own	rent	GENDER: male	female
PERSONALLY GO TO MEETINGS ABOUT PLAN	yes	31%	11%	27%	23%	50%	18%	33%	24%	32%	24%	32%	21%	29%	32%
	no	69%	89%	73%	77%	50%	82%	67%	76%	68%	76%	68%	79%	71%	68%
Total		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
BASE		111	9	37	35	30	11	18	21	22	25	93	14	48	63

FAQ Hawaii, Inc. (2009)

Q6a. I'm going to mention certain things that are part of the new Kona Community Development Plan. For each one, please tell me if you personally strongly agree, somewhat agree, somewhat disagree, or strongly disagree that this should be Kona's plan.
PLANNING FOR KONA IS MOSTLY ABOUT WHERE AND HOW GROWTH HAPPENS, NOT TRYING TO MAKE GROWTH HAPPEN FASTER OR SLOWER.

		Total	EDUCATION LEVEL: up to HS grad	some college	college grad	graduate/ prof. degree	INCOME: <$35k	$35k <$50k	$50k <$75k	$75k <$100k	$100k+	HOME OWNERSHIP STATUS: own	rent	GENDER: male	female
PLANNING FOR KONA IS MOSTLY WHERE/HOW GROWTH HAPPENS	strongly agree	50%	40%	47%	56%	55%	43%	50%	64%	48%	55%	52%	45%	51%	49%
	somewhat agree	34%	32%	40%	29%	31%	35%	34%	35%	38%	34%	34%	30%	34%	33%
	somewhat disagree	7%	14%	5%	5%	5%	10%	9%	6%	6%	5%	4%	17%	6%	6%
	strongly disagree	4%	3%	5%	3%	3%	3%	5%	3%	2%	2%	4%	1%	1%	5%
	DK/NA	6%	10%	3%	6%	7%	9%	2%	3%	6%	5%	6%	7%	5%	6%
Total		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
BASE		403	77	129	119	78	79	58	71	64	65	314	71	169	234

FAQ Hawaii, Inc. (2009)

Q4. From what you have read or heard, what are the worst parts of the plan, or what worries you about it?

		Total	EDUCATION LEVEL: up to HS grad	some college	college grad	graduate/ prof. degree	INCOME: <$35k	$35k <$50k	$50k <$75k	$75k <$100k	$100k+	HOME OWNERSHIP STATUS: own	rent	GENDER: male	female
Q4: Worst Parts of this Plan	DK/Need more info	46%	78%	43%	46%	40%	45%	56%	43%	41%	52%	45%	50%	46%	44%
	No answer	11%	11%	14%	11%	7%	16%	11%	10%	14%	12%	12%	7%	13%	10%
	no action will be taken	10%	0%	3%	9%	23%	0%	6%	14%	6%	12%	9%	21%	6%	13%
	other	9%	0%	5%	14%	10%	9%	11%	19%	0%	4%	10%	0%	8%	11%
	too much development	5%	0%	5%	6%	3%	9%	6%	5%	5%	0%	5%	0%	6%	2%
	poor road plans	5%	11%	8%	3%	0%	9%	0%	5%	5%	4%	3%	7%	4%	5%
	high cost of development	5%	0%	5%	6%	3%	9%	0%	0%	9%	0%	5%	0%	4%	5%
	will take too long to complete	4%	0%	3%	3%	7%	0%	0%	0%	5%	8%	4%	0%	4%	3%
	not enough emphasis on schools	4%	0%	5%	6%	0%	0%	0%	0%	14%	0%	4%	0%	0%	6%
	not enough community input	4%	0%	11%	0%	0%	0%	0%	0%	5%	8%	4%	0%	2%	5%
	increase traffic	4%	11%	3%	3%	3%	9%	6%	5%	0%	0%	2%	7%	4%	3%
	not a long-term solution	2%	0%	0%	3%	3%	0%	6%	0%	5%	0%	1%	7%	0%	3%
BASE		111	9	37	35	30	11	18	21	22	25	93	14	48	63

FAQ Hawaii, Inc. (2009)

Q5. Do you believe this plan was based on what you would call a great deal of community input, a moderate amount of community input, or very little community input?

		Total	EDUCATION LEVEL: up to HS grad	some college	college grad	graduate/ prof. degree	INCOME: <$35k	$35k <$50k	$50k <$75k	$75k <$100k	$100k+	HOME OWNERSHIP STATUS: own	rent	GENDER: male	female
AMOUNT OF COMMUNITY INPUT ON PLAN	great deal of community input	25%	22%	14%	26%	40%	18%	6%	29%	32%	32%	27%	14%	21%	29%
	moderate amount of community input	37%	22%	33%	43%	33%	45%	50%	38%	27%	36%	40%	21%	40%	35%
	very little community input	23%	33%	22%	29%	13%	18%	17%	19%	27%	24%	20%	29%	25%	21%
	other	1%	0%	3%	0%	0%	9%	0%	0%	0%	0%	1%	0%	2%	0%
	DK/NA	14%	22%	24%	3%	13%	9%	28%	14%	14%	8%	12%	36%	13%	16%
Total		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
BASE		111	9	37	35	30	11	18	21	22	25	93	14	48	63

FAQ Hawaii, Inc. (2009)

Q6d. I'm going to mention certain things that are part of the new Kona Community Development Plan. For each one, please tell me if you personally strongly agree, somewhat agree, somewhat disagree, or strongly disagree that this should be Kona's plan.
GROWTH NORTH OF KONA SHOULD BE DIRECTED MOSTLY INTO COMPACT MIXED-USE VILLAGES, WITH OPEN SPACE IN BETWEEN THEM.

			EDUCATION LEVEL				INCOME					HOME OWNERSHIP STATUS		GENDER	
		Total	up to HS grad	some college	college grad	graduate/ prof. degree	<$35k	$35k <$50k	$50k <$75k	$75k <$100k	$100k+	own	rent	male	female
GROWTH N. OF KONA SHOULD BE INTO COMPACT MIXED-USE	strongly agree	43%	36%	44%	39%	56%	38%	48%	39%	45%	62%	45%	37%	41%	44%
	somewhat agree	32%	29%	32%	39%	27%	34%	31%	32%	39%	29%	31%	42%	32%	32%
	somewhat disagree	11%	17%	12%	6%	6%	11%	9%	13%	11%	6%	10%	13%	14%	9%
	strongly disagree	7%	6%	6%	6%	7%	6%	9%	10%	0%	9%	6%	6%	8%	6%
	DKNA	7%	10%	6%	6%	3%	10%	3%	6%	5%	3%	8%	3%	5%	9%
Total		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
BASE		400	77	129	119	75	79	58	71	64	65	314	71	166	234

FAQ Hawaii, Inc. (2009)

Q6e. I'm going to mention certain things that are part of the new Kona Community Development Plan. For each one, please tell me if you personally strongly agree, somewhat agree, somewhat disagree, or strongly disagree that this should be Kona's plan.
THE NEW VILLAGES SHOULD BE CENTERED AROUND BUS TRANSIT STOPS ON THE NEW MID-LEVEL ROAD.

			EDUCATION LEVEL				INCOME					HOME OWNERSHIP STATUS		GENDER	
		Total	up to HS grad	some college	college grad	graduate/ prof. degree	<$35k	$35k <$50k	$50k <$75k	$75k <$100k	$100k+	own	rent	male	female
NEW VILLAGES SHOULD BE CENTERED AROUND TRANSIT STOPS	strongly agree	44%	42%	47%	39%	49%	47%	36%	44%	47%	46%	45%	45%	37%	49%
	somewhat agree	36%	33%	30%	41%	35%	37%	48%	31%	41%	29%	35%	37%	42%	32%
	somewhat disagree	6%	3%	6%	8%	3%	0%	7%	7%	6%	9%	7%	3%	7%	5%
	strongly disagree	9%	9%	9%	7%	11%	6%	7%	11%	5%	11%	8%	10%	11%	7%
	DKNA	6%	9%	5%	6%	3%	10%	2%	7%	2%	5%	6%	6%	4%	7%
Total		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
BASE		400	77	129	119	75	79	58	71	64	65	314	71	166	234

FAQ Hawaii, Inc. (2009)

Q6b. I'm going to mention certain things that are part of the new Kona Community Development Plan. For each one, please tell me if you personally strongly agree, somewhat agree, somewhat disagree, or strongly disagree that this should be Kona's plan.
MOST FUTURE GROWTH SHOULD BE LOCATED NORTH OF KAILUA, TOWARD THE AIRPORT.

			EDUCATION LEVEL				INCOME					HOME OWNERSHIP STATUS		GENDER	
		Total	up to HS grad	some college	college grad	graduate/ prof. degree	<$35k	$35k <$50k	$50k <$75k	$75k <$100k	$100k+	own	rent	male	female
MOST FUTURE GROWTH SHOULD BE NORTH OF KAILUA	strongly agree	37%	38%	35%	34%	43%	29%	33%	37%	43%	38%	37%	35%	40%	34%
	somewhat agree	34%	35%	33%	36%	31%	41%	31%	35%	27%	38%	33%	42%	31%	36%
	somewhat disagree	13%	12%	14%	15%	11%	14%	17%	14%	11%	11%	14%	13%	14%	13%
	strongly disagree	12%	9%	13%	11%	12%	11%	12%	10%	13%	11%	12%	6%	13%	11%
	DKNA	5%	6%	5%	4%	4%	5%	7%	1%	2%	2%	4%	4%	2%	7%
Total		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
BASE		400	77	129	119	75	79	58	71	64	65	314	71	166	234

FAQ Hawaii, Inc. (2009)

Q6c. I'm going to mention certain things that are part of the new Kona Community Development Plan. For each one, please tell me if you personally strongly agree, somewhat agree, somewhat disagree, or strongly disagree that this should be Kona's plan.
THE NEW MID-LEVEL ROAD SHOULD BE DEVELOPED AS THE MAIN ROUTE FOR BUSES OR OTHER FUTURE MASS TRANSIT CONNECTING KAILUA TO THE AIRPORT.

			EDUCATION LEVEL				INCOME					HOME OWNERSHIP STATUS		GENDER	
		Total	up to HS grad	some college	college grad	graduate/ prof. degree	<$35k	$35k <$50k	$50k <$75k	$75k <$100k	$100k+	own	rent	male	female
MID-LEVEL ROAD SHOULD BE MAIN KAILUA-AIRPORT BUS TRANSIT ROUTE	strongly agree	39%	49%	36%	33%	35%	45%	40%	37%	38%	40%	40%	37%	33%	39%
	somewhat agree	30%	25%	29%	33%	33%	25%	29%	32%	41%	25%	28%	33%	30%	30%
	somewhat disagree	13%	14%	16%	9%	13%	16%	16%	14%	8%	12%	13%	10%	16%	11%
	strongly disagree	12%	6%	14%	12%	12%	4%	16%	14%	8%	14%	12%	7%	11%	12%
	DKNA	7%	5%	5%	8%	7%	9%	0%	3%	6%	9%	7%	7%	8%	7%
Total		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
BASE		400	77	129	119	75	79	58	71	64	65	314	71	166	234

FAQ Hawaii, Inc. (2009)

Q6h. I'm going to mention certain things that are part of the new Kona Community Development Plan. For each one, please tell me if you personally strongly agree, somewhat agree, somewhat disagree, or strongly disagree that this should be Kona's plan.
TO ENCOURAGE A PRIVATE LANDOWNER TO ATTRACT A NEW HOSPITAL SITE, HIGHER DENSITIES SHOULD BE ALLOWED IN THAT VILLAGE.

			EDUCATION LEVEL				INCOME					HOME OWNERSHIP STATUS		GENDER	
		Total	up to HS grad	some college	college grad	graduate/ prof. degree	<$35k	$35k <$50k	$50k <$75k	$75k <$100k	$100k+	own	rent	male	female
HIGHER DENSITIES TO ATTRACT NEW HOSPITAL/LANDOWNER	strongly agree	34%	40%	29%	32%	37%	32%	24%	35%	27%	45%	35%	31%	38%	31%
	somewhat agree	35%	27%	35%	41%	32%	39%	43%	34%	36%	32%	35%	34%	31%	38%
	somewhat disagree	11%	13%	16%	7%	5%	8%	5%	8%	23%	9%	11%	10%	13%	9%
	strongly disagree	12%	5%	14%	10%	20%	9%	19%	17%	9%	9%	11%	14%	15%	10%
	DKNA	9%	14%	6%	10%	5%	13%	9%	6%	5%	5%	8%	11%	4%	12%
Total		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
BASE		400	77	129	119	75	79	58	71	64	65	314	71	166	234

FAQ Hawaii, Inc. (2009)

Q7. Have you heard that a new development is being proposed for the Kaloko Makai area, north end mauka of Costco along Hina Lani street?

			EDUCATION LEVEL				INCOME					HOME OWNERSHIP STATUS		GENDER	
		Total	up to HS grad	some college	college grad	graduate/ prof. degree	<$35k	$35k <$50k	$50k <$75k	$75k <$100k	$100k+	own	rent	male	female
HEARD OF NEW DEVELOPMENT IN KALOKO MAKAI AREA	yes	56%	57%	50%	61%	56%	49%	45%	63%	66%	65%	58%	44%	62%	52%
	no	43%	42%	47%	38%	43%	47%	55%	34%	34%	34%	40%	54%	37%	47%
	DKNA	2%	1%	2%	1%	1%	4%	0%	3%	0%	2%	1%	3%	1%	2%
Total		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
BASE		400	77	129	119	75	79	58	71	64	65	314	71	166	234

FAQ Hawaii, Inc. (2009)

Q6f. I'm going to mention certain things that are part of the new Kona Community Development Plan. For each one, please tell me if you personally strongly agree, somewhat agree, somewhat disagree, or strongly disagree that this should be Kona's plan.
SOME VILLAGES SHOULD PROVIDE HIGHER-DENSITY HOUSING AND COMMERCIAL TO SUPPORT MAJOR JOB AREAS LIKE THE CIVIC CENTER, NEW HOSPITAL, AND NEW UNIVERSITY.

			EDUCATION LEVEL				INCOME					HOME OWNERSHIP STATUS		GENDER	
		Total	up to HS grad	some college	college grad	graduate/ prof. degree	<$35k	$35k <$50k	$50k <$75k	$75k <$100k	$100k+	own	rent	male	female
SOME VILLAGES SHOULD PROVIDE HIGH DENSITY HOUSING	strongly agree	56%	62%	50%	53%	64%	52%	55%	59%	53%	62%	57%	54%	54%	57%
	somewhat agree	29%	26%	34%	32%	20%	33%	24%	27%	36%	23%	27%	38%	31%	28%
	somewhat disagree	5%	1%	7%	6%	3%	3%	5%	4%	9%	5%	6%	0%	5%	5%
	strongly disagree	6%	4%	5%	6%	6%	5%	12%	6%	0%	3%	6%	1%	7%	4%
	DKNA	5%	6%	4%	3%	5%	8%	3%	4%	2%	2%	4%	7%	2%	6%
Total		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
BASE		400	77	129	119	75	79	58	71	64	65	314	71	166	234

FAQ Hawaii, Inc. (2009)

Q6g. I'm going to mention certain things that are part of the new Kona Community Development Plan. For each one, please tell me if you personally strongly agree, somewhat agree, somewhat disagree, or strongly disagree that this should be Kona's plan.
THERE SHOULD BE A NEW HOSPITAL ALONG THE MID-LEVEL ROAD IN ONE OF THE VILLAGES BETWEEN KAILUA AND THE AIRPORT.

			EDUCATION LEVEL				INCOME					HOME OWNERSHIP STATUS		GENDER	
		Total	up to HS grad	some college	college grad	graduate/ prof. degree	<$35k	$35k <$50k	$50k <$75k	$75k <$100k	$100k+	own	rent	male	female
SHOULD BE NEW HOSPITAL AROUND MID-LEVEL ROAD	strongly agree	59%	61%	61%	55%	57%	54%	67%	56%	55%	65%	60%	51%	56%	59%
	somewhat agree	27%	29%	22%	32%	23%	34%	21%	26%	25%	25%	26%	32%	28%	26%
	somewhat disagree	6%	5%	7%	4%	5%	5%	3%	4%	11%	2%	5%	10%	5%	6%
	strongly disagree	6%	0%	7%	5%	9%	1%	2%	7%	8%	5%	5%	3%	5%	6%
	DKNA	4%	5%	2%	3%	5%	5%	7%	3%	2%	2%	4%	4%	4%	4%
Total		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
BASE		400	77	129	119	75	79	58	71	64	65	314	71	166	234

FAQ Hawaii, Inc. (2009)

Q10. What is the most important reason you think this is an unacceptable development?

		Total	EDUCATION LEVEL: up to HS grad	some college	college grad	graduate/ prof. degree	INCOME: <$35k	$35k <$50k	$50k <$75k	$75k <$100k	$100k+	HOME OWNERSHIP STATUS: own	rent	GENDER: male	female
Q10: Most important reason you think development is unacceptable.	too big / don't need	45%	64%	41%	43%	45%	64%	55%	43%	50%	22%	43%	23%	40%	51%
	density too high	21%	36%	12%	27%	17%	29%	29%	17%	13%	21%	19%	31%	22%	19%
	too much traffic	12%	21%	15%	7%	6%	14%	6%	13%	0%	29%	13%	8%	7%	16%
	not enough infrastructure	12%	7%	15%	17%	4%	7%	0%	13%	13%	0%	11%	23%	16%	9%
	other	11%	7%	6%	17%	13%	7%	12%	4%	13%	29%	13%	0%	18%	5%
	poor location	8%	0%	6%	10%	13%	7%	0%	22%	13%	0%	7%	8%	7%	9%
	finish other projects first	7%	14%	9%	7%	0%	0%	12%	9%	19%	0%	7%	8%	9%	5%
	need to preserve land	7%	7%	9%	3%	8%	7%	12%	9%	0%	14%	5%	15%	9%	5%
	poor plan	6%	7%	9%	7%	0%	7%	6%	9%	0%	14%	5%	15%	11%	2%
	too long to complete	5%	0%	9%	3%	4%	0%	6%	0%	13%	7%	5%	8%	4%	5%
	not enough water	5%	14%	3%	3%	4%	7%	0%	4%	0%	7%	5%	8%	4%	5%
	not enough schools	4%	0%	9%	3%	0%	0%	6%	4%	13%	0%	5%	0%	2%	5%
	DK/Need more info	1%	0%	0%	0%	4%	0%	0%	0%	6%	0%	1%	0%	0%	2%
REDUCED BASE		102	14	34	30	24	14	17	23	16	14	85	13	45	57

FAQ Hawaii, Inc. (2009)

Q8. Here's a summary of the proposal, to be developed over 30 years: 5,000 housing units of various types spread over 1,150 acres, one intermediate and two elementry schools, mauka and makai commercial areas, 150-acre dryland forest preserve, and a new regional hospital on the Mid-Level Road. Does this overall package sound like a very acceptable, somewhat acceptable, somewhat unacceptable, or very unacceptable idea?

		Total	EDUCATION LEVEL: up to HS grad	some college	college grad	graduate/ prof. degree	INCOME: <$35k	$35k <$50k	$50k <$75k	$75k <$100k	$100k+	HOME OWNERSHIP STATUS: own	rent	GENDER: male	female
PACKAGE SOUND GOOD?	very acceptable	27%	35%	22%	25%	29%	25%	21%	31%	23%	45%	26%	32%	30%	25%
	somewhat acceptable	44%	38%	43%	48%	36%	43%	43%	35%	50%	34%	43%	46%	41%	46%
	somewhat unacceptable	11%	6%	9%	11%	17%	4%	14%	21%	6%	6%	11%	6%	13%	9%
	very unacceptable	15%	10%	16%	14%	15%	14%	16%	11%	17%	15%	16%	10%	14%	15%
	DK/NA	3%	6%	2%	2%	3%	6%	2%	1%	2%	0%	4%	3%	2%	4%
Total		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
BASE		400	77	129	119	75	79	58	71	64	65	314	71	166	234

FAQ Hawaii, Inc. (2009)

Q9. What is the most important reason you think this is an acceptable development?

		Total	EDUCATION LEVEL: up to HS grad	some college	college grad	graduate/ prof. degree	INCOME: <$35k	$35k <$50k	$50k <$75k	$75k <$100k	$100k+	HOME OWNERSHIP STATUS: own	rent	GENDER: male	female
Q9: Most important reason you think development is acceptable.	hospital is needed	36%	44%	41%	29%	31%	34%	40%	36%	43%	37%	34%	41%	39%	34%
	good plan/ meets future needs	26%	21%	24%	30%	27%	31%	25%	17%	23%	25%	26%	27%	27%	25%
	more housing / affordable housing	16%	21%	10%	16%	20%	10%	28%	21%	17%	8%	15%	18%	11%	19%
	more schools	15%	14%	18%	14%	14%	15%	15%	23%	19%	12%	13%	21%	13%	17%
	alleviate traffic	11%	7%	12%	11%	14%	14%	8%	13%	9%	10%	13%	7%	12%	11%
	increase in jobs	8%	12%	12%	6%	2%	7%	13%	13%	9%	6%	7%	11%	11%	7%
	other	8%	12%	4%	7%	10%	12%	10%	6%	4%	4%	9%	4%	8%	8%
	everything is close proximity	7%	7%	6%	7%	8%	7%	13%	9%	2%	6%	7%	6%	3%	10%
	good location	7%	2%	11%	2%	12%	7%	3%	6%	9%	12%	7%	6%	7%	7%
	long-term plan	4%	0%	4%	3%	6%	0%	5%	4%	4%	8%	5%	0%	5%	2%
	infrastructure for growing pop.	4%	2%	1%	7%	4%	7%	0%	4%	2%	4%	3%	4%	3%	4%
	good use of unused land	4%	0%	5%	3%	4%	0%	3%	4%	6%	4%	4%	2%	4%	3%
	preservation of land considered	2%	0%	2%	6%	0%	7%	3%	0%	2%	0%	2%	4%	3%	2%
	DK/Need more info	2%	2%	2%	2%	0%	2%	5%	0%	0%	0%	1%	4%	0%	3%
BASE		285	57	92	87	49	59	40	47	47	51	218	68	118	167

FAQ Hawaii, Inc. (2009)

Appendix P

Preliminary Engineering Report for
Kaloko Makai
Wilson Okamoto Corporation
July 2013

Preliminary Engineering Report

Kaloko Makai Infrastructure

Kaloko, North Kona, Hawaii
TMK: 7-3-009: 17, 19, 25, 26, 28, 62 and 63

Prepared For:

SCD-TSA Kaloko Makai, LLC
1100 Alakea Street, 27th Floor
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Prepared By:

Wilson Okamoto Corporation
Engineers and Planners
1907 South Beretania Street, Suite 400
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WOC Job No. 7469-04

July 2013

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  Dated: July 20, 2007

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EXECUTIVE SUMMARY

A preliminary engineering report for the proposed Kaloko Makai development was conducted to: (1) review the site infrastructure and utility systems, (2) determine project demands, (3) identify possible constraints, and (4) conceptualize proposed improvements to sanitary sewer, potable water, storm drainage, parking, roadway, electrical, telephone, cable, and data communications systems to support the development.

Sanitary Sewer System: An average dry weather wastewater flow of 2.34 million gallons per day and a design peak wastewater flow of 11.80 million gallons per day are projected for the development. Since the Kaloko Makai property is undeveloped, a wastewater collection system is not available to service the Project site. Proposed wastewater improvements include an on-site wastewater treatment plant (WWTP). The WWTP would provide treatment for wastewater effluent from the Project site to produce R-1 quality water for reuse as irrigation water. An irrigation storage and distribution system will service parks and open space landscaping within the development. Excess R-1 quality water will be disposed of via injection wells located adjacent to the on-site WWTP.

Potable Water System: An average daily potable water demand of 2.18 million gallons per day and a maximum daily storage volume of 3.28 million gallons are projected for the development. Water service and improvements, in the North Kona area are not available to support any new developments. Proposed improvements include new groundwater source development, desalination plant, transmission, and distribution system.

Drainage System: Existing topography within the Project site is characterized by moderate mauka to makai slopes. Site elevations range from about 80 feet above mean sea level to about 700 feet above mean sea level. Drainage of storm runoff can be accommodated through culverts, drainpipes and catch basins, connected to drywells and/or detention basins. Permanent Best Management Practices will be developed and implemented in coordination with the regulatory agencies.

Roadway and Parking System: Primary access to the Project site is proposed along Hina Lani Street off the Queen Kaahumanu Highway and the new Ane Keohokalole Highway. Street parking will be allowed in residential areas, and off-street parking will be developed for commercial areas.

Electrical, Telephone, Cable, and Data Systems: Electrical, telephone, cable TV service, and data line access to the information system for the Project will be provided by Hawaii Electric Light Company, Hawaiian Telcom and Time Warner Cable.

1. INTRODUCTION

Based on the Conceptual Land Use Plan dated June 2012 prepared by SCD-TSA Kaloko Makai, LLC, this Preliminary Engineering Report presents the preliminary engineering assessment of the Project's infrastructure and utility requirements. The objective of the report is to review the existing infrastructure systems, determine the Project demands, identify possible opportunities and constraints based on the projected demands, and conceptualize the improvements relative to wastewater, irrigation, potable water, drainage, roadway, parking, electrical, telephone, cable, and data communication systems. The proposed improvements will be reviewed and revised based on further development of the Project plans and availability of more detailed information. This report is a general summary of the engineering aspects of the Kaloko Makai Project.

SCD-TSA Kaloko Makai, LLC, plans to develop a 1,100-acre property located within the Kaloko-Honokohau area of North Kona, Island of Hawaii (See Figure 1-1). The Tax Map Keys for the Project site are (3)7-3-009: 17, 25, 26, 28, and 63 (See Figure 1-2). In addition, the Project continues to investigate the potential for a potable water source. The current conceptual land use plan for the Project identifies components of the development as follows (See Figure 1-3):

Natural Zone	Natural Landscape
Sub-Urban Zone	Detached Homes with Landscaped yards
General Urban Zone	Mix Single Family and Small Multi-Family Homes with scattered commercial use
Urban Center Zone	Shops and offices mixed with Town Homes and Large Multi-Family
Industrial Mixed Use	Light Industrial and Mixed Use
School	Elementary (2) and Middle (1) school
Hospital	West Hawaii Hospital
Fire Station	Fire and Emergency Response Unit
Dryland Forest	Wildlife Preserve
Park	Recreational Parks
Open Space/Buffer	Screened Buffer Setback
WWTP	Wastewater Treatment Plant
Kohanaiki Trail	Multi-use pedestrian and bicycle path representing a historical land to sea trail.
Preservation/Buffer Area	Historic sites recommended for preservation

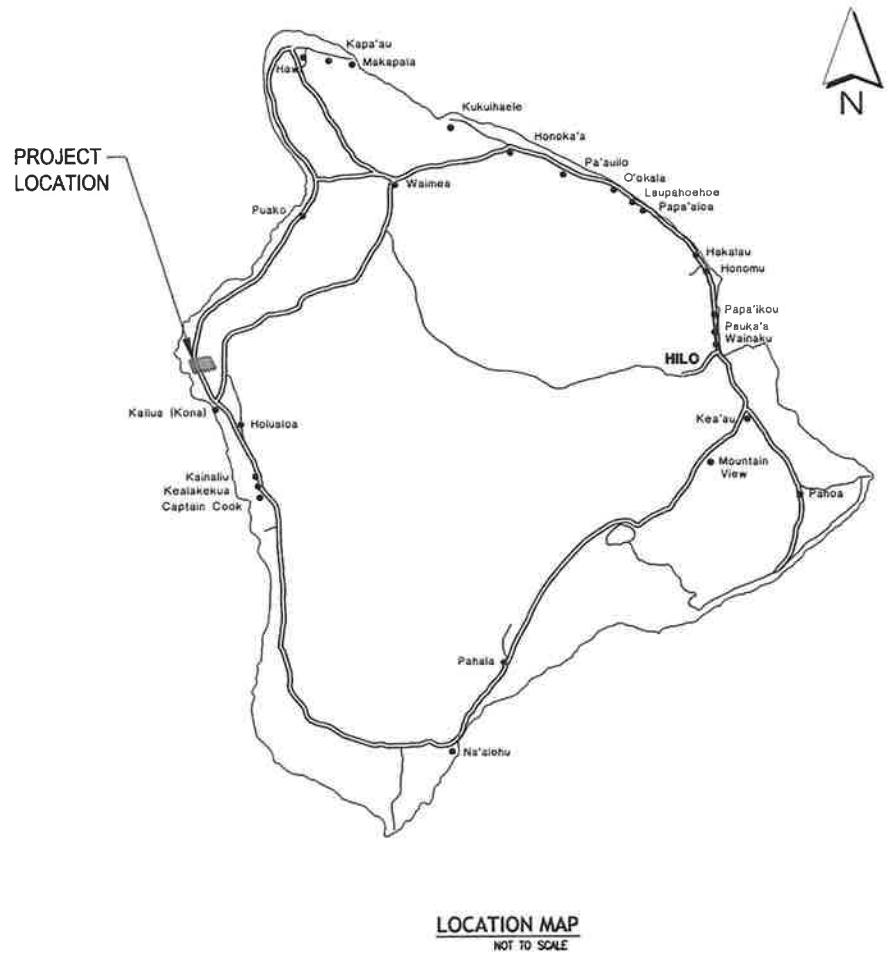
Residential, urban, and mixed-use zones are anticipated to consist of approximately 5,000 residential units, up to 600,000 square feet of retail/commercial space and 42 acres dedicated for school use. Associated amenities include recreational parks and expansion of Ane Keohokalole Highway (also known as Mid Level Road) through the Project. The entire Project will be separated into 3 total phases that are described as followed (See Figure 1-4):

- **Phase 1 –** Phase 1 developments will consist of multi, single, and affordable housing, as well as parks, a school, and a light industrial area. An on-site wastewater treatment plant and electrical substation will also be built during this phase.

- **Phase 2 –** Phase 2 developments will consist of multi, single, senior, and affordable housing. There will also be a school, park, and a light industrial area built during this phase.

- **Phase 3 –** Phase 3 developments will consist of multi, single, affordable and large lot single family units. There will also be a park, school, and industrial area built during this phase, as well as an on-site fire station and desalinization plant.

The Project site is bordered by Queen Kaahumanu Highway to the west and the Kaloko Light Industrial Subdivision to the southwest. The Project site is surrounded by undeveloped lands or other private properties in various stages of developments to the north, south, and east. The curvilinear east-west alignment of Hina Lani Street bisects the Project site. The north-south alignment of the future Ane Keohokalole Highway also bisects the Project site.



LOCATION MAP
NOT TO SCALE

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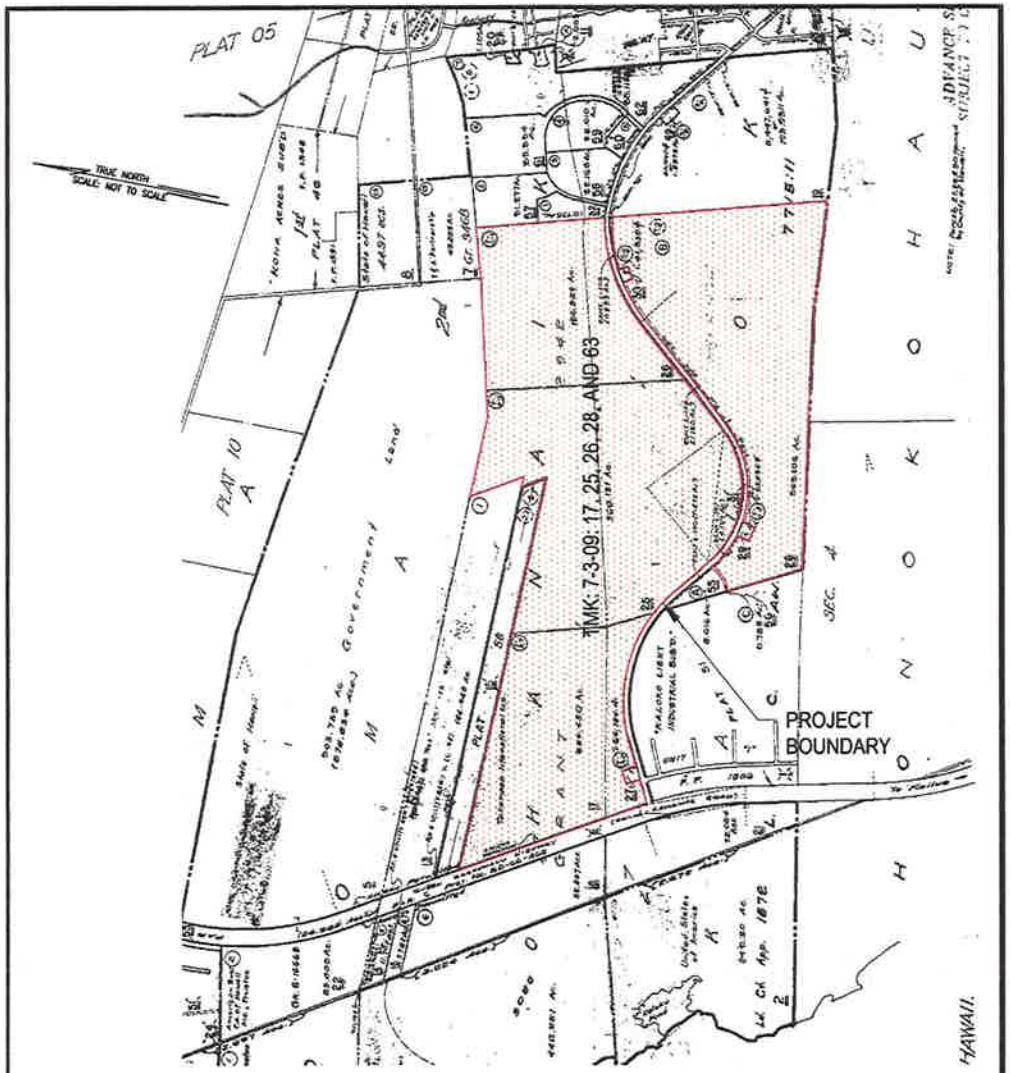
Wilson Okamoto Corporation
Engineers • Planners

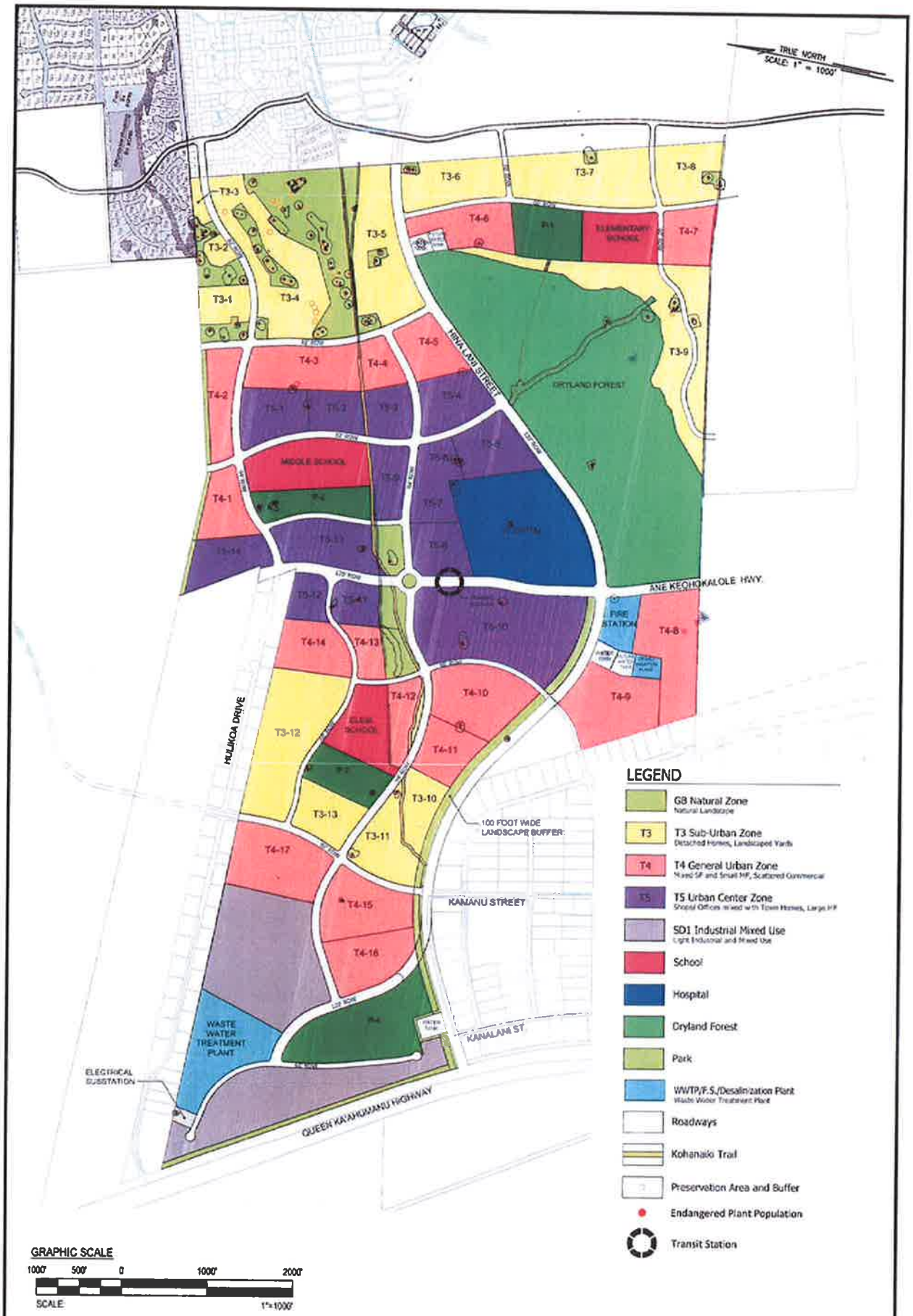
KALOKO MAKAI INFRASTRUCTURE
LOCATION MAP

FIGURE
1 – 1



NOTE: PARCEL 28 HAS BEEN SUBDIVIDED INTO PARCEL 28 AND PARCEL 63. THE TMK MAP DOES NOT REFLECT THE CURRENT CHANGES.

Prepared by: Wilson Okamoto Corporation Engineers • Planners	KALOKO MAKAI INFRASTRUCTURE TAX MAP KEY	FIGURE 1–2



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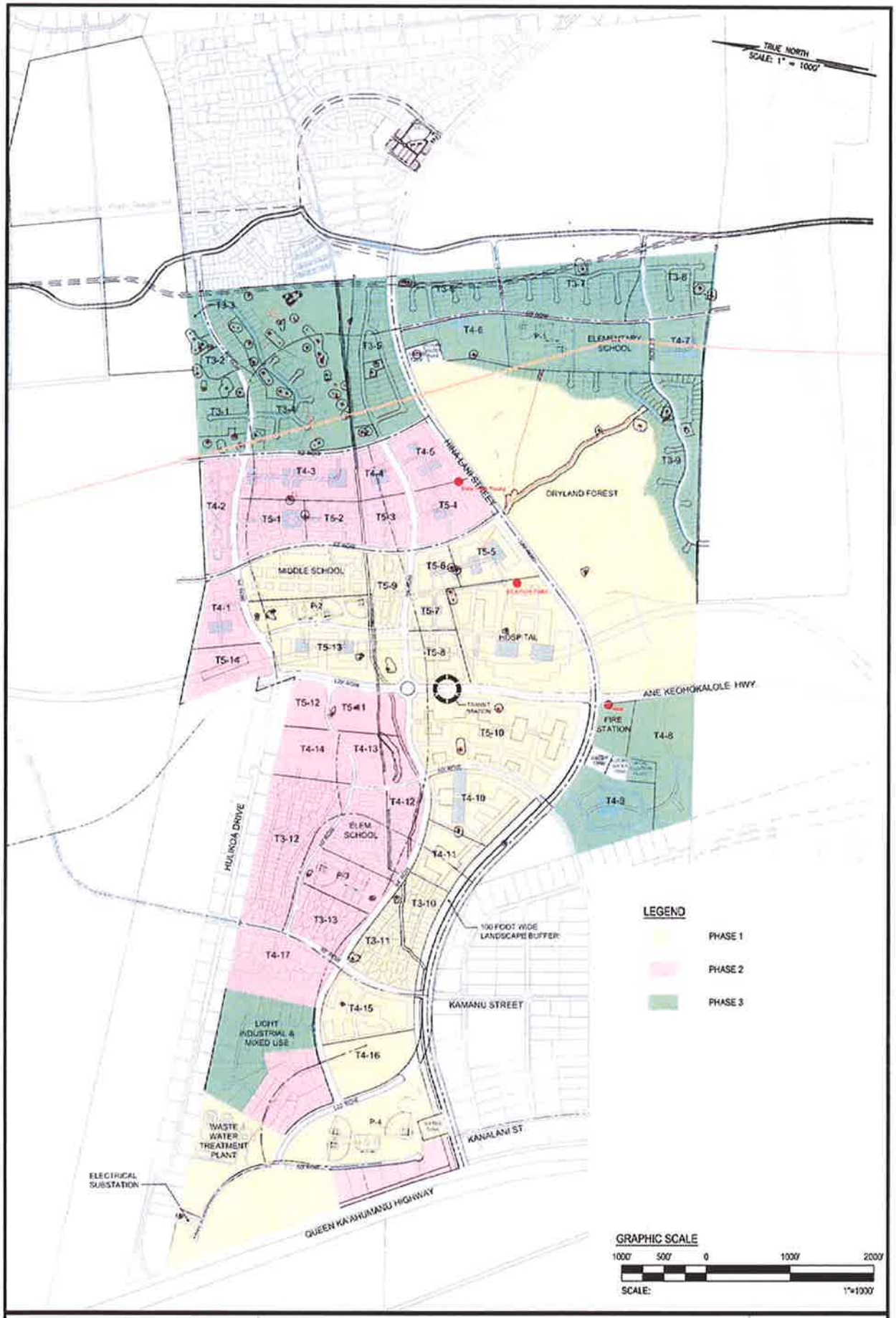
KALOKO MAKAI INFRASTRUCTURE
CONCEPTUAL LAND USE PLAN

FIGURE
1-3



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KALOKO MAKAI INFRASTRUCTURE
PHASE DEVELOPMENT

FIGURE
1 – 4

2. WASTEWATER SYSTEM

The Kaloko Makai Project used to fall within the boundary of the *North Kona Improvement District Project Sewer Master Plan (2006)* prepared by the Department of Environmental Management (DEM), County of Hawaii. Under an implementation study for the North Kona Improvement District (NKID), the Project site was further evaluated and excluded from the above. The NKID assesses future improvements and additions to the wastewater collection system servicing the Kealakehe Wastewater Treatment Plant (KWWTP) and its north Kona tributary area.

2.1 Existing Conditions

Currently, the Kaloko Makai Project site is undeveloped and there is no county and/or private wastewater collection system servicing the Project area. Properties within the nearby Kaloko Light Industrial Subdivision are serviced by individual wastewater systems consisting of septic tanks with seepage pits, or leach field disposal. Planned developments within Kaloko Light Industrial Subdivision and Lanihau Properties incorporate individual septic systems for short term use and installation of dry sewers for long term build out of NKID. Current development of the Kaloko Heights Project (located mauka of Kaloko Makai) incorporates a private wastewater treatment system.

2.2 Design Wastewater Flows

Wastewater flows for the Project are derived using the Project's program requirements provided by SCD-TSA Kaloko Makai, LLC, and generalized simulation of projected demands for similar developments.

Design peak flows were calculated for each of the Project's parcels using the average wastewater flows, maximum wastewater flows, dry weather infiltration/inflow (I/I), design maximum flows, and wet weather I/I.

The wastewater system for the Project will be designed based on County flow standards. If applicable County standards cannot be established, the City and County of Honolulu standards will be used. The City and County of Honolulu, Department of Wastewater Management Design Standards set forth the criteria to be used to estimate wastewater flows from developments, as shown below:

1. Average Wastewater Flow: The average wastewater flow is the sum of the products of wastewater flow rates multiplied by the number of residential units or areas.

2. Peaking Factor: The peaking factor is determined by using the Babbit equation to determine the maximum hour wastewater flow.

$$MF=5 / p^{0.2}$$

Where: MF = maximum flow peaking factor
P = population in thousands

3. Maximum Wastewater Flow: The maximum wastewater flow is determined by multiplying the average wastewater flow by a County adopted flow factor. A flow factor was determined using the cumulative total average daily flows for each phase.

4. Dry Weather I/I: Assuming that the sewerlines will be laid above the normal groundwater table, an additional quantity of 5 gallons per capita per day (gpcd) is used to account for water entering the collection system through pipe and manhole joints.

5. Design Maximum Flow: The design maximum flow is the sum of the maximum wastewater flow and dry weather I/I.

6. Wet Weather I/I: Assuming that the sewerlines will be laid above the normal groundwater table, an additional quantity of 1,250 gallons per acre per day (gad) is used to account for water entering the collection system through pipe joints and sewer structures.

7. Design Peak Flow: The design peak flow is the sum of the design maximum flow and wet weather I/I.

The average dry weather wastewater flow was calculated to be 2.34 million gallons per day (MGD) and the peak wet weather is 11.80 MGD. See Appendix A for wastewater demand calculations.

2.3 Proposed Improvements

2.3.1 Treatment System

2.3.1.1 Alternative 1: On-site Wastewater Treatment Plant

If a connection to the Kealakehe WWTP is not available to the Project prior to Hawaii County Council's approval of the Change of Zone (COZ) for the Project, and no connection to a public WWTP is available to Kaloko Makai, a private on-site WWTP will be developed to serve the Project.

The current Kaloko Makai Conceptual Land Use Plan reserves approximately 20 acres for the development of a private WWTP at the western end of the Project site. The WWTP will be designed to accept sewage flows from the Project site and provide treatment to meet R-1 water quality standards set forth by the State of Hawaii, Department of Health (DOH). The R-1 quality water will be stored in reservoirs on-site for distribution and use by Kaloko Makai and public facilities. It may also be made available for use by private commercial or residential developments as landscape irrigation water.

According to DOH *Guidelines for the Treatment and Use of Recycled Water (2002)*, R-1 water means recycled water that is at all times oxidized, then filtered, and then exposed, after the filtration process, to:

a. A disinfection process that, when combined with the filtration process, has been demonstrated to inactivate and/or remove 99.999 percent of the plague-forming units of F-specific bacteriophage MS2, or polio virus in the wastewater. A virus that is at least resistant to disinfection as polio virus may be used for purposes of demonstration; and
b. A disinfection process that limits the concentration of fecal coliform bacteria to the following criteria:
    1) The median density measure in the disinfected effluent does not exceed 2.2 per 100 milliliters utilizing the bacteriological results of the last seven days for which analyses have been completed; and
    2) The density does exceed 23 per 100 milliliters in more than one sample in any 30-day period; and
    3) No sample shall exceed 200 per 100 milliliters.

Kaloko Makai Development – Conceptual Wastewater Management System report was prepared by Brown and Caldwell consultants to master-plan the WWTP. A summary of the report is provided below and the entire report is included in Appendix B.

The initial treatment goal will be readily achievable via conventional secondary treatment, followed by coagulant addition, filtration and disinfection with ultraviolet light. The subsequent goal requires an advanced wastewater treatment process. Components of the treatment process consist of the following:

Influent Pump Station: A pump station will be required to lift raw wastewater from the sewer system to the treatment processes.

Headworks: Headworks will include screening systems to remove debris, grit, or inorganic particles (e.g., sand) from the waste stream. Grit and screenings will be disposed at the West Hawaii Landfill.

Biological Treatment: Organic matter and nutrients will be removed using an activated sludge process. The process will incorporate biological nutrient removal (BNR). BNR incorporates aerobic and anoxic zones within the treatment process and recycle flows to facilitate biological reduction of TN (Total Nitrogen) and TP (Total Phosphorus) to 10 mg/L (milligrams/liter) and 2 mg/L, respectively meeting DOH requirements. Clarifiers will be used to separate the activated sludge from the secondary effluent.

Coagulant Addition/Flocculation: Coagulants (such as aluminum sulfate and/ or polymer) will be added to the secondary effluent downstream of the secondary clarifiers and mixed to combine small particles into larger "flocs" that can be removed in the filtration process.

Filtration: The filtration process will provide two treatment benefits: turbidity reduction to meet R-1 water recycling requirements, and additional nitrogen removal. Denitrification filters are available and accepted by the California Department of Public Health (CDPH) for Title-22 recycled water production and are also capable of reducing TN concentrations to 5 mg/L via denitrification. The DOH allows the use of filtration processes that are accepted by CDPH for R-1 water production. Addition of a carbon source (typically methanol) is required upstream of the filters to facilitate

denitrification process. The DOH requires that R-1 water have effluent turbidity of less than 2.0 Nephelometric turbidity units (NTU) at all times.

Disinfection: The effluent will be disinfected with ultraviolet light (UV) to meet R-1 water requirements. The DOH requires that R-1 water have a median density of fecal coliform that does not exceed 2.2 per 100 mL.

Effluent Pump Station: An effluent pump station will deliver R-1 water to the R-1 storage tank for reuse, or to the infiltration basins for disposal.

Aerobic Digester: Waste solids (sludge) from the biological treatment and filtration systems will be pumped to an aerobic digester system for stabilization and thickening via periodic decanting.

Mechanical Dewatering: Aerobically digested sludge will be mechanically dewatered prior to being hauled offsite for disposal or composting at the West Hawaii Landfill.

The Kaloko Makai WWTP will be designed to reduce nitrogen and phosphorous concentrations in the treated effluent to: TN to a concentration of <10 mg/l, and TP to a concentration of <2 mg/l (aerobic nitrification processes combined with anoxic/anaerobic sand filters to perform denitrification, or comparable technology.) Installation of the private WWTP shall be subject to conditions of approval by the DOH, including any lower concentrations of TN and/or TP in the effluent, and Hawaii Administrative Rules (HAR) Chapter 11-62.

2.3.1.2 Alternative 2: Off-site Wastewater Treatment Plant

The DEM is considering development of a decentralized treatment plant. The tributary area considered for the decentralized treatment plant includes the Kaloko Makai property. The decentralized WWTP will likely be located on State land north of Kaloko Makai and next to Queen Kaahumanu Highway. Detailed planning of the decentralized treatment plant with respect to treatment process, flow capacity, and land area requirements have not been determined.

DEM is also considering a new County WWTP to be located in the Kaloko Makai vicinity. This plant will be designed to the extent feasible to utilize a natural treatment system that can double as an open space feature.

A natural wastewater treatment plant or system is also known as a "constructed wetland" or a "constructed ecosystem," and is an alternative to mechanical wastewater treatment systems, which are methods conventionally used to treat and purify wastewater. Constructed wetlands simulate natural wastewater treatment systems, using flow beds to support water-loving plants. The roots of these plants help provide an aerobic environment to aggressively break down contaminants. However, concerns have been raised as to the proposed location of this new wastewater facility, especially its proximity to the Kona International Airport.

If a connection to either the Kealakehe WWTP or a proposed natural wastewater treatment system is available to the Project prior to the change of zone (COZ), Kaloko Makai will develop a system of dry sewer lines within the Project to be used for the connection into the Kealakehe WWTP or natural WWTP.

Currently, the DEM is planning to build a portion of NKID in conjunction with the next phase of the Queen Kaahumanu Widening Project. DEM proposes to install a dry gravity force main along Queen Kaahumanu Highway from Hina Lani Street to a future pump station. Prior to becoming active, DEM needs to implement at least two more projects to connect to the Kealakehe WWTP.

2.3.2 Collection System

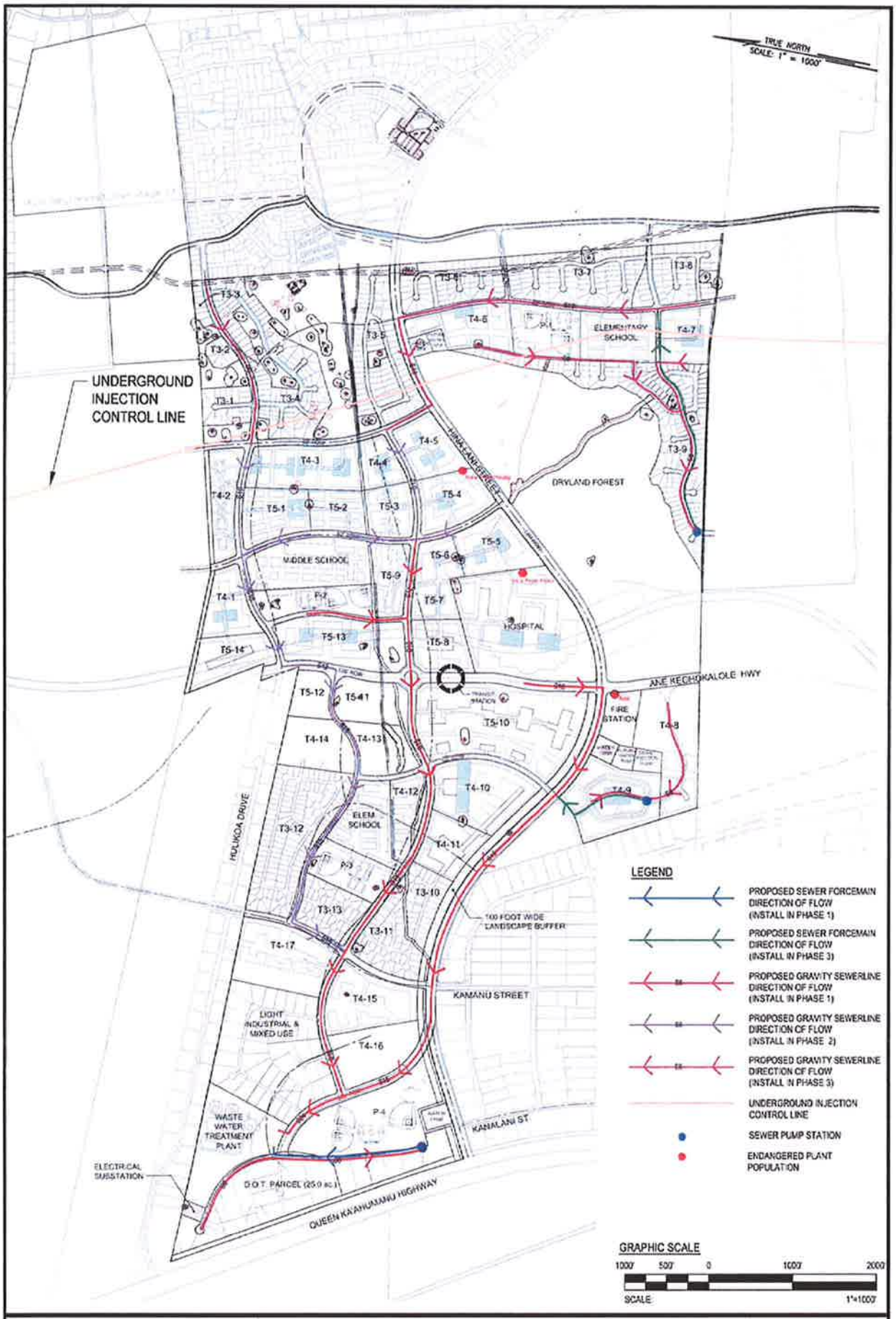
A proposed gravity sewer system will collect wastewater from areas located mauka of the WWTP and within the Kaloko Makai development. For areas located makai of the WWTP, a proposed gravity sewer system and pump station force mains will collect and convey wastewater to the WWTP. Three sewer pump stations are required as shown in Figure 2-1 where topography limits use of a gravity sewer system.

Design of the sewer system will follow DEM guidelines and criteria. Pipe sizes will vary from 8-inch to 24-inch based on the quantity of wastewater flow (see Figure 2-1). Lateral pipe sizes, force main, and pump station requirements will be determined during the design phase of the Project. The development of the sewer system is described as followed:

- **Phase 1** – Phase 1 will have approximately 16,200 LF of sewer lines designed to accommodate a peak flow of approximately 4.42 MGD of wastewater. The sewer lines will be installed along Hina Lani Street, as well as majority of the Spinal Roadway. Phase 1 sewer lines will service a hospital, fire station, offices, single and multi-family homes, as well as the Light Industrial area and parks 2, 3, and 4. There will also be a sewer forcemain and pump station installed below park 4 in the Cul-De-Sac Road. A WWTP will be designed during phase 1 in the makai portion of the Project site which will be able to accommodate a total peak flow of approximately 11.80 MGD of wastewater.

- **Phase 2** – Phase 2 will have approximately 11,000 LF of sewer lines designed to accommodate a peak flow of approximately 4.11 MGD. Phase 2 sewer lines will be installed along Collector Roads 1, 2, 3, and the Spinal Roadway. They will service the Elementary and Middle school, as well as offices, and single and multi-family homes. Phase 2 will tie back into the Kamanu Street extension and Spinal Roadway intersection, as well as in the mauka portion of the Spinal Roadway.

- **Phase 3** – Phase 3 will have approximately 15,000 LF of sewer lines designed to accommodate a peak flow of approximately 3.26 MGD. It will service an Elementary school and a desalinization tank, as well as offices, and single and multi-family homes. There will be 2 sewer forcemains and pump stations installed during phase 3. The first forcemain and pump station is located in the eastern portion of the project site near the elementary school and parcel T3-9. The other forcemain and pump station is located below the desalinization plant. Phase 3 sewer lines will tie back into the 15-inch sewer line along Hina Lani Street, as well as in the mauka portion of the Spinal Roadway.



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KALOKO MAKAI INFRASTRUCTURE
PROPOSED SEWER LAYOUT

FIGURE 2-1

2.4 Wastewater Reuse

The information provided below summarizes Kaloko Makai Development – Conceptual Wastewater Management System, a report prepared by Brown and Caldwell Consultants. The report is an assessment on the recycled water system. The report in its entirety is included in Appendix B.

Based on the report prepared by Brown and Caldwell Consultants, an average R-1 quality water flow rate of 2.37 MGD was estimated. This projection has the potential to provide irrigation water for approximately 273 acres without routine supplemental water addition. The DOH has restrictive requirements for R-1 irrigation on property located above the Underground Injection Control (UIC) line including groundwater or vadose zone monitoring; no excess irrigation for salt flushing below the root zone. Brown and Caldwell recommends R-1 reuse be limited to properties located below the UIC line at approximately 620-foot elevation.

The Kaloko Makai development includes 45 acres of parks and 30 acres of schools located below the UIC Line that will likely be the largest users of the R-1 water. Based on preliminary estimates, approximately 60 acres of the total park and school acreage will ultimately be irrigated using R-1 water. Other users of R-1 water include landscaping for the hospital, light industrial, multi-family and commercial areas.

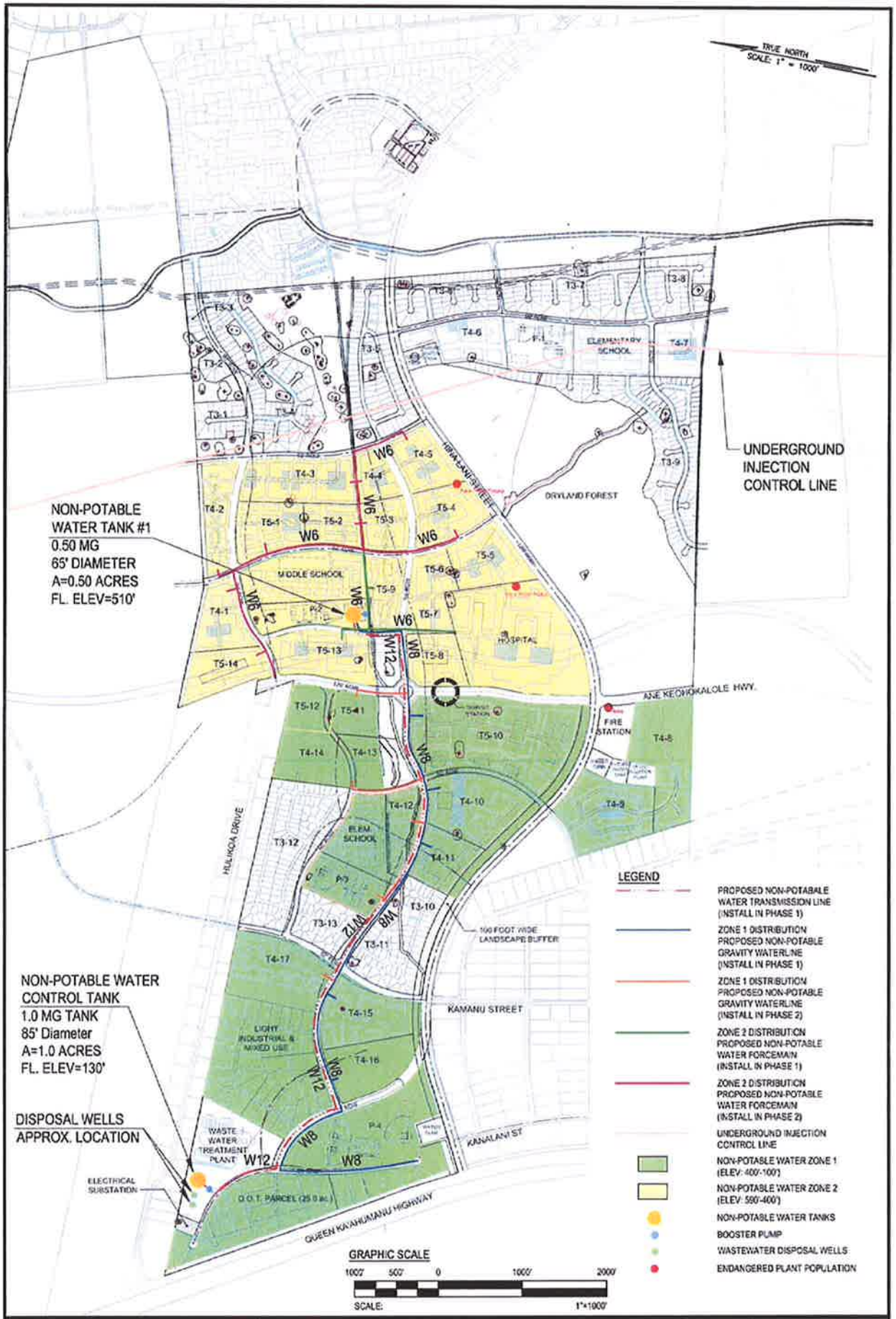
At full build out, the total demand of non-potable R-1 water for the Project site is 0.57 MGD (see Appendix A – Potable/Non-Potable Water Demand) which will be stored in a 1.0 million gallon (MG) tank located adjacent to the WWTP (see Figure 2-2). Phase 1 for the Kaloko Makai Development will require approximately 0.30 MGD of non-potable water, phase 2 will require approximately 0.19 MGD of non-potable water, and phase 3 will require approximately 0.08 MGD of non-potable water. The 1.0-MG tank will provide additional storage when R-1 supply is not sufficient to meet irrigation demands.

The project is divided into 2 pressure zones based off topography (See Figure 2-2). A high pressure 12-inch non-potable transmission water line will be installed during phase 1 to supply R-1 water to a 0.5 MG tank located at Park-2. A pressurized system will provide landscape irrigation for the adjacent middle school, Park-2, and multi-family housing. Landscaping for the parks, elementary school, commercial, hospital, light industrial and multi-family properties will be irrigated by a system of

appropriate pipe sizes and fittings. Other appurtenances will be installed to facilitate the system for irrigation use. Other recycled water users can be added to the system if they are located near the distribution lines that service the largest users.

A gravity system using class 250 pipe and fittings will irrigate properties below the 0.5 MG tank located at Park-2. A reduced pressure backflow preventer will be installed to provide the appropriate pressure needed for irrigation use.

The amounts of wastewater produced by the developments in phase 1 will likely not produce enough R-1 water after treatment to meet parks and schools irrigation requirements. Supplemental water source (potable) will be required to satisfy the irrigation demands. On the other hand, during periods of wet weather, there will be excess R-1 water which will be disposed of via deep injection wells.



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KALOKO MAKAI INFRASTRUCTURE

CONCEPTUAL NON-POTABLE WATER LAYOUT

FIGURE 2-2

3. POTABLE WATER SYSTEM

3.1 Existing Conditions

Kaloko Makai Project site is undeveloped and not serviced by the County of Hawai'i, Department of Water Supply (DWS),

The DWS operates and maintains potable water supply facilities in the vicinity of the Project. The DWS facilities include three water reservoirs along Hina Lani Street, each with a capacity of 1.0 MG, and each supplying a different pressure zone. The 20-inch transmission main along Hina Lani Street, connects the water reservoirs extending the water system from Queen Kaahumanu Highway to Mamalahoa Highway, and completing the Hina Lani water supply system. The Hina Lani water system provides water to the Kaloko Light Industrial subdivision and the County housing project off of Hina Lani Street.

Of the three existing water reservoirs, the makai reservoir (Control Tank #1) has been abandoned by DWS and will be dedicated to DEM for use as an R-1 water storage reservoir.

DWS currently has three projects planned in the vicinity of Kaloko Makai.

1. DWS is participating with the State of Hawaii, Department of Transportation, Highways Division's (DOT) in the Queen Kaahumanu Highway Widening Project, Phase II to install a new 16" water main in parallel with an existing 12" water main along Queen Kaahumanu Highway.

2. A water tank has been constructed by a private developer at 1200-feet elevation for the Kaloko Heights Project. DWS is still awaiting the transfer of ownership of the water tank.

3. The third project is another water tank along Hina Lani Street, which is the last water tank developed for the Hina Lani water system.

3.2 Projected Potable Water Demands

Potable water demand for the Project is derived using the Project's program requirements provided by SCD-TSA Kaloko Makai, LLC, and generalized simulation of projected demands for similar developments.

Based on demand factors shown in the *Water System Standards 2002*, Department of Water Supply, County of Hawaii, an average daily potable water demand of 2.18 MGD is projected for the Project. The projected maximum daily consumption is approximately 3.28 MGD. The anticipated required storage volume for the entire Project is approximately 3.27 MG. (See Appendix A)

3.3 Proposed Improvements

3.3.1 Alternative Sources for Potable Water

DWS indicated that due to delays in planning and construction of the Ane Keohokalole Highway (Mid-Level Road), water service in the North Kona area is not adequate to support new developments. The Project needs to develop a new water source and provide a new potable water system which includes treatment, storage, transmission and distribution facilities. Currently, the Hina Lani water system has been adequately designed to accommodate the Project and its associated water facilities.

It should be noted that source development, which is subject to Commission on Water Resources Management (CWRM) review, should be a priority. According to DWS, suitable and reliable potable water source is more favorable if located above the 1,700-feet elevation, up-slope of the Project site.

In consultation with Tom Nance Water Resources Engineering (TNWRE) and Hookuleana, LLC, Kaloko Makai is investigating the following four alternatives to meet its potable water needs. TNWRE's report is included in its entirety as Appendix B.

1. On-site wells at 710-foot elevation – Preferred Alternative
2. On-site wells at 710-foot elevation with Reverse Osmosis (RO) Treatment
3. Off-site wells approximately 3-4 miles south of Kaloko Makai
4. Desalinization of On-site Saline Groundwater

In providing sources of potable water for the Project, Kaloko Makai will comply with applicable laws and regulations. As necessary, Kaloko Makai will undertake additional research to assess the potential impacts and appropriate mitigation measures of the selected systems.

3.3.1.1 On-site Wells at 710-foot elevation

A deep exploratory borehole at 710-foot elevation at the eastern end of the Project site will be undertaken to determine if fresh groundwater can be found at depth and to determine the feasibility of its development. If successful, three production wells would be developed in the area. Under this preferred alternative, the possibility of developing potable quality wells at 710-foot elevation is suggested by the discoveries of two deep monitor wells (state Nos. 3858-01 and 3959-01), both of which encountered fresh groundwater under artesian pressure at a depth below the saline groundwater table which is hydrologically disconnected from the basal lens.

The potable source facility developed would be integrated into the DWS system, with two-thirds of their capacity allocated to supply the Project.

The Project will consist of the following elements:

- Three (3) production wells each of 1150 GPM production capacity and driven by a 350 horsepower motor
- Pump control building
- Security fencing
- Access road improvements
- Three (3) 1-2 MG concrete reservoir, as required by DWS
- New 16- to 20-inch transmission lines connecting to an existing 16-inch water main on Māmalahoa Highway

3.3.1.2 On-site wells at 710-foot elevation with Reverse Osmosis Treatment

If artesian groundwater is found below the saline groundwater table and its salinity at the projected draft rates do not meet drinking water standards, the RO treatment process will be considered. In addition to producing drinking quality water this treatment process will produce a wastewater stream, referred to as a concentrate that will be disposed of via injection wells located at the Project's on-site WWTP at the makai end of the Project site. Due to the operating costs of the RO treatment, DWS may not accept the wells and RO treatment plant for dedication. In that case, the capacity of the wells, as feedwater sources for RO treatment, will be sized to provide the Project's maximum day use in a 24-hour pumping day assuming 65%

product recovery in the RO process. As a private system, provision of standby well pumping capacity will be required. At full build-out, the disposal of concentrate will be 1.15 MGD as a year-round average. The cost of construction will be borne by Kaloko Makai.

The Project will consist of the following elements:

- Four (4) production wells of 1,170 GPM capacity each and each well driven by a 350 horsepower motor with standby.
- Pump control building
- Security fencing
- Access road improvements
- Three (3) 1-2 MG concrete reservoir, as required by DWS
- Transmission lines connecting to an existing water main on Hina Lani Street
- Desalinization Treatment Plant
- RO Concentrate disposal wells

An on-site desalination plant will be constructed in the event the water does not meet DOH standards for domestic use (i.e. too saline). The on-site desalination facility will include storage, transmission and a distribution system. The desalination plant will be situated in the vicinity of the mid-level water tank in Kaloko Makai. Feed lines from the wells to the treatment facility will follow along Hina Lani Street. The desalination facility will treat the water through a reverse osmosis (RO) process.

3.3.1.2.1 Reverse Osmosis Treatment Process

Feedwater from the wells are initially pre-treated prior to RO process to remove particles that can negatively affect the RO membranes.. This pre-treatment will reduce damage and wear to RO membranes, which increases the RO process performance and life span of the system.

After pre-treatment, high pressure created by pumps will force the pre-treated water through the RO membranes filtering and reducing total dissolved solids. The water is then conditioned for pH adjustment and disinfection. The water is then used as "potable" drinking water.

The wastewater of the RO process is a concentrated saline brine solution which will be discharged in on-site deep injection wells at depths below the feedwater source and the basal groundwater, in an area with 30 parts per thousand (ppt) salinity. The injection wells will be situated below the Underground Injection Control (UIC) line.

Since the concentrate would have a greater density than the surrounding saline groundwater, the concentrate will flow seaward without rising above the surrounding saline groundwater and will not rise to the basal lens. It will then be discharged into the ocean offshore at a substantial depth and distance from the shoreline.

In addition to potable water and brine concentrate, the desalination process will also produce small amounts of reject water from the pre-treatment process and from membrane cleaning and membrane cleaning solution. These by-products will be properly treated and processed at the on-site wastewater treatment facility or disposed of in the same injection wells used for the concentrated brine solution.

The proposed desalination system is subject to regulation as a public water system and needs to meet conditions of the DOH, including HAR Chapter 11-20, 11-21, and 11-25. The desalination water system will have no impact on potable or brackish groundwater. Likewise, it will not affect nearshore waters. This includes groundwater used by neighboring projects or anchialine pools and fishponds in the area, including nearby Kaloko-Honokōhau National Park.

3.3.1.3 Off-site wells to the south of Kaloko Makai

In the event that neither of the two on-site well alternatives described above is feasible, development of potable wells approximately 3-4 miles to the south will be undertaken. The exact locations of these wells will depend on land acquisition costs and additional costs for DWS infrastructure required to transmit this well supply north to the Project site. In general, however, there are two distinctly different possibilities, wells above Mamalahoa Highway tapping the high level groundwater directly, or wells in the near vicinity of the State's deep monitor well tapping the high level groundwater at depth below saline groundwater.

The Project will consist of the following elements:

- Three (3) production wells with 1,120 GPM or four 840 GPM pumps and appurtenances
- Pump control building
- Improvements to DWS transmission/distribution system
- Security fencing
- Access road improvements
- Three (3) 1-2 MG concrete reservoir, as required by DWS
- Transmission line connecting to existing water main on Hina Lani Street

Cost of construction would be borne by Kaloko Makai. The water tanks may be dedicated to DWS and an agreement negotiated with the DWS for use of the water.

Each mid-level well is anticipated to yield from 1.0-2.0 MGD. This amount is not significant in terms of the remaining sustainable yield of the aquifer. No adverse groundwater effects have been observed from any of the existing wells in the regions, individually or cumulatively.

3.3.1.4 Desalinization of On-site Saline Groundwater

In the event that none of the alternatives previously mentioned are feasible, raw water supply wells and a desalinization plant will be installed near existing Kaloko Water Tank #1 along Hina Lani Drive. The raw water supply wells will draw saline groundwater from beneath the basal lens at depths between 250 and 350-feet below sea level, requiring total well depths at about 710-feet. Water recovery from this saline feedwater supply is approximately 40%.

The Project will consist of the following elements:

- Three (3) treatment trains each of 750 GPM capacity supplied by a 1900 GPM raw water supply well.
- Pump control building
- Security Fencing
- Access road improvements
- Three (3) 1-2 MG concrete reservoir, as required by DWS
- Transmission lines connecting to an existing water main along Hina Lani
- Desalinization treatment plant
- RO Concentrate disposal wells

Pressure transfer devices would be installed to recover energy from the RO's concentrate stream. The concentrate will be hypersaline and amount to 4.9 MGD at full build out. The cost of construction will be borne by Kaloko Makai.

3.4 Storage and Distribution

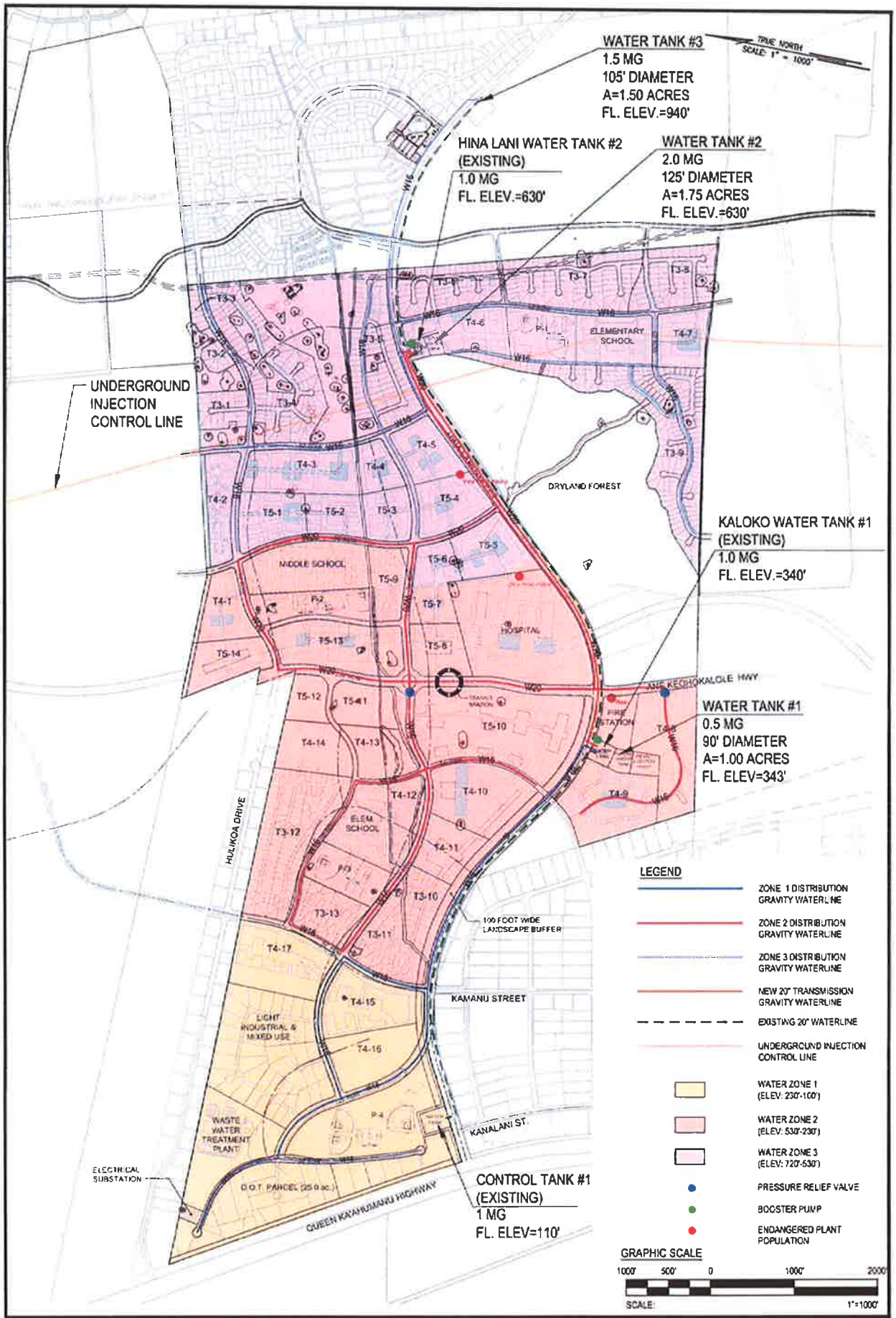
During the preliminary planning stages, water source development and plans for water storage for the Project should be studied, investigated, determined, verified, and confirmed. The transmission lines vary in size from 16-inch to 20-inch based on the demand and will be integrated with the existing DWS water system (See Figure 3-1)

The project site has been divided into 3 different pressure zones based on topography. The desalination plant, reservoir size and locations, booster pumps, and on-site and off-site water system will be determined during the design phase based on these pressure zones and in consultation with TNWRE. The on-site potable water distribution system will be determined once the Project layout and roadway scheme are approved by the County Department of Public Works.

The preferred alternative for the potable water system for the Kaloko Makai development will consist primarily of gravity flow (See Figure 3-1). During phase 1, an on-site well will be drilled at elevation 710 feet, which will supply potable water for proposed Water Tank #2 at elevation 630 feet. A new 20-inch gravity waterline will connect at Water Tank #2 to accommodate a flow of 1161 GPM and to service zone 2. Pressure release valves will be installed below Ane Keohokalole Street to reduce pressures gained due to the drop in elevation. Internal pipe pressures shall follow the *Water System Standards 2002*. There will also be a new 20" transmission line installed during phase 1 to transmit water from Water Tank #2 to Water Tank #1 at elevation 343 feet. A new 16" gravity waterline will connect from Water Tank #1 to accommodate a flow of approximately 343 GPM and to service zone 1. During phase 2, a booster pump will be installed at Water Tank #2 to transmit water to Water Tank #3 at elevation 840 feet through the existing 20-inch water line along Hina Lani Street. A new 16-inch gravity waterline will connect from Water Tank #3 to accommodate a flow of approximately 515 GPM and to service zone 3.

The existing DWS water system includes the required fire flow capacity. Additional fire flow capacity has not been included in sizing of the new water tanks. Fire protection requirements for the Project will be analyzed and will consist of appropriate improvements and/or upgrades and waterline extension to the various parts of the Project site. The need for any additional pressurized system for the Project will be determined by the mechanical or other consultants during the design phase of the Project.

The Fire Department will be consulted during the design phase of the Project to determine the need for on-site roadside fire hydrants and to review fire truck access requirements.



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KALOKO MAKAI INFRASTRUCTURE

PROPOSED POTABLE WATER LAYOUT

FIGURE 3-1

4. DRAINAGE SYSTEM

This section reviews the existing topography and drainage conditions of the Project site. It also describes proposed improvements to meet County Best Management Practice (BMP) requirements. The proposed improvements are subject to change based on the refinement of plans and availability of more detailed information.

4.1 Existing Conditions

There are currently no existing BMP's to filter and treat storm water runoff prior to disposal into drywells. The County of Hawaii currently operates and maintains a series of swales and drywells along Hina Lani Street. Typically, the V-type swales are 6' wide running along roadside shoulders. Drywells are located to intercept runoff collected in the swales and are approximately 5-feet in diameter, 20-feet deep, and capped with a catch basin/grated inlet drywell cover. Drywells allow collected storm water runoff to percolate into the ground to replenish ground water source.

4.1.1 Topography and Soils Condition

The Project site is located along the west coast of the Island of Hawaii, mauka of Queen Kaahumanu Highway. Based on information shown on the USGS maps, existing topography is characterized by moderate mauka to makai slopes. Site elevations range from approximately 80 feet above Mean Sea Level (MSL) along Queen Kaahumanu Highway to approximately 700 feet above MSL along the mauka boundary. (See Figure 4-1).

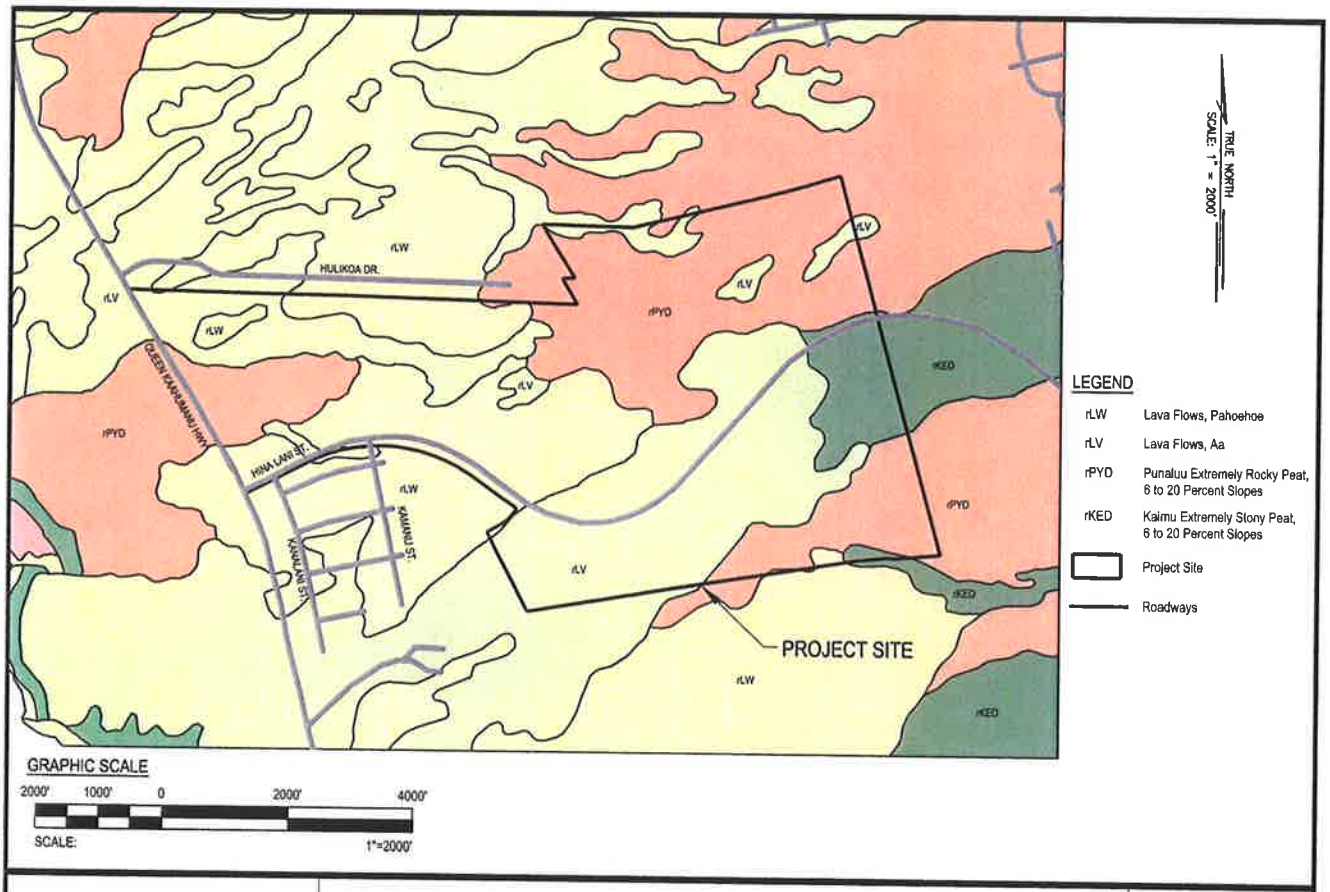
According to the U.S. Natural Resources Conservation Service's (NRCS) *Soil Survey of the Island of Hawaii, State of Hawaii* (1972), the Project site is largely comprised of four soil types designated by the (see Figure 4-2):

- Punaluu Extremely Rocky Peat, *6 to 20 percent slope* **(rPYD)** – This soil is low on the leeward side of Mauna Loa. Rock outcrops occupy 40-50 percent of the surface. In a representative profile the surface layer is black peat about 4 inches thick. It is underlain by pahoehoe lava bedrock. The peat is rapidly permeable. The pahoehoe lava is very slowly permeable, although water moves rapid through the cracks. Runoff is slow, and the erosion hazard is slight. This soil is used for pasture. (Capability subclass VIIs, non-irrigate; pasture group 3)

- Lava Flow, Pahoehoe, **(rLW)** – Pahoehoe lava has been mapped as a miscellaneous land type. This lava has a billowy, glassy surface that is relatively smooth. In some areas however, the surface is rough and broken, and there are hummocks and pressure domes. Pahoehoe lava has no soil covering and is typically bare of vegetation except for mosses and lichens. (Capability subclass VIIIs, non-irrigated)

- Lava Flow, Aa, **(rLV)** – Aa lava has been mapped as a miscellaneous land type. This lava has practically no soil covering and is bare of vegetation, except for mosses, lichens, ferns, and a few small ohia trees. Aa is rough and broken, and is a mass of clinkery, hard, glassy, sharp pieces piled in tumbled heaps. (Capability subclass VIIIs, non-irrigated)

- Kaimu Extremely Stony Peat, *6 to 20 percent slope* **(rKED)** – This soil is at low elevations on Mauna Loa. In a representative profile the surface layer is very dark brown extremely stony peat about 3 inches thick. It is underlain by fragmental Aa lava. Permeability is rapid, runoff is slow, and the erosion hazard is slight. This soil is not suitable for cultivation. Most of it is in native woodland. Small areas are used for pasture, macadamia nuts, papaya, and citrus fruits. (Capability subclass VIIs, non-irrigated; pasture group 5)



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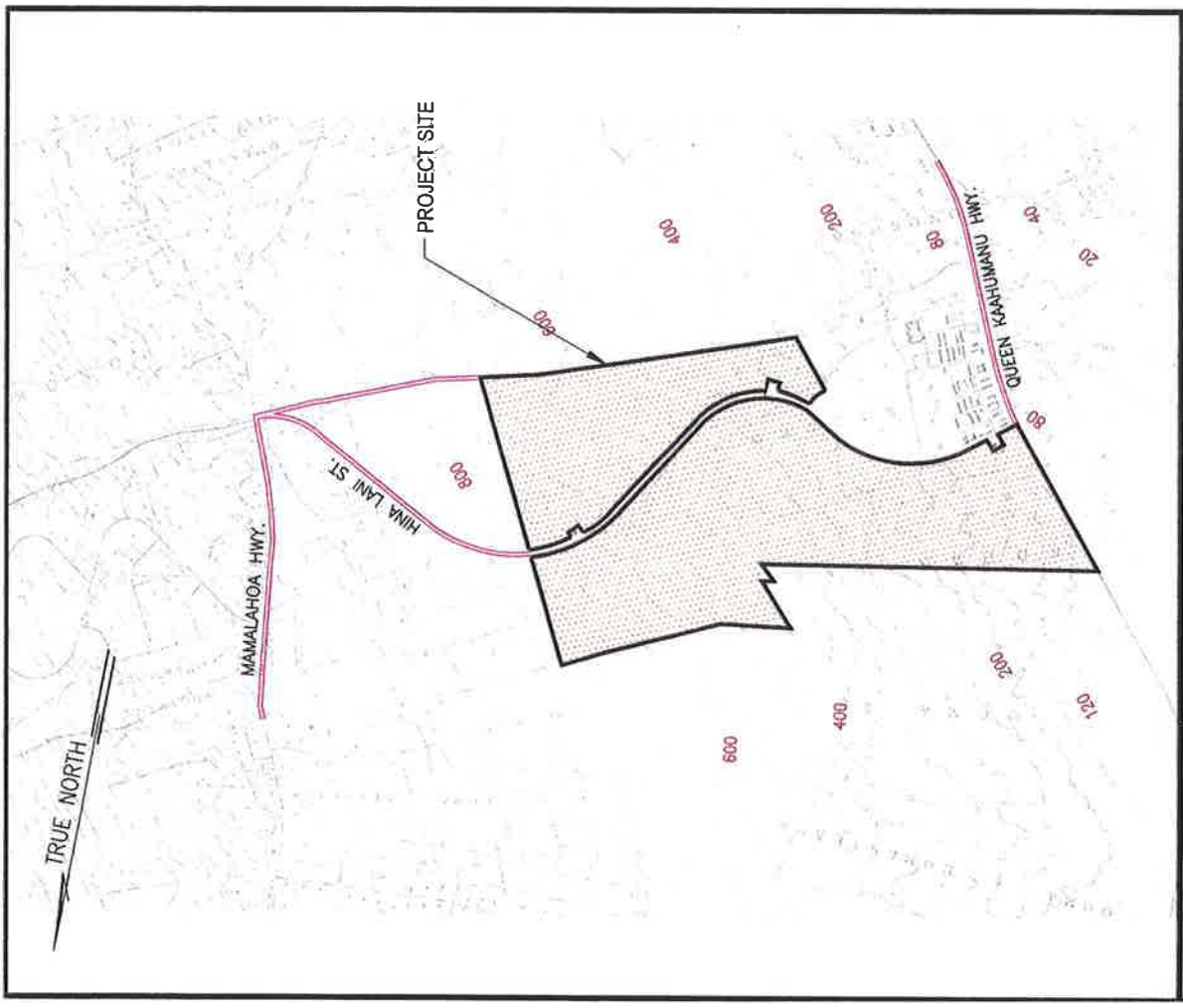
KALOKO MAKAI INFRASTRUCTURE
SOILS MAP

FIGURE
4–2



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KALOKO MAKAI INFRASTRUCTURE
TOPOGRAPHIC MAP

FIGURE
4–1

4.1.2 Existing Hydrology

Surface runoff Mauka of the Project sheet flows toward the Project site and percolates into the ground. The existing Project area consists of about 5,036 acres of off-site and on-site drainage. The existing area can be categorized into eleven (11) distinct drainage basins, based on approximate ridgelines and natural topography (see Figure 4-3). Runoff from the eleven existing drainage basins was calculated for a 100 year – 24 hour storm event (see Table 4-1).

Drainage Basins 1 and 2. Drainage Basins 1 and 2 encompass approximately 156 acres and 880 acres, respectively. These areas are covered with slight to moderate vegetation and lava rock with very few paved areas. Runoff generated in these basins flow in a westerly direction toward the ocean and percolates through the ground. These drainage basins can be considered off-site.

Drainage Basins 3, 4, and 5. Drainage Basins 3, 4, and 5 encompass approximately 152, 64, and 74 acres, respectively and are on-site. These basins contain only slight to moderate vegetation and lava rock with no paved areas. Surface flow travels in a westerly direction toward the ocean and percolates through the ground.

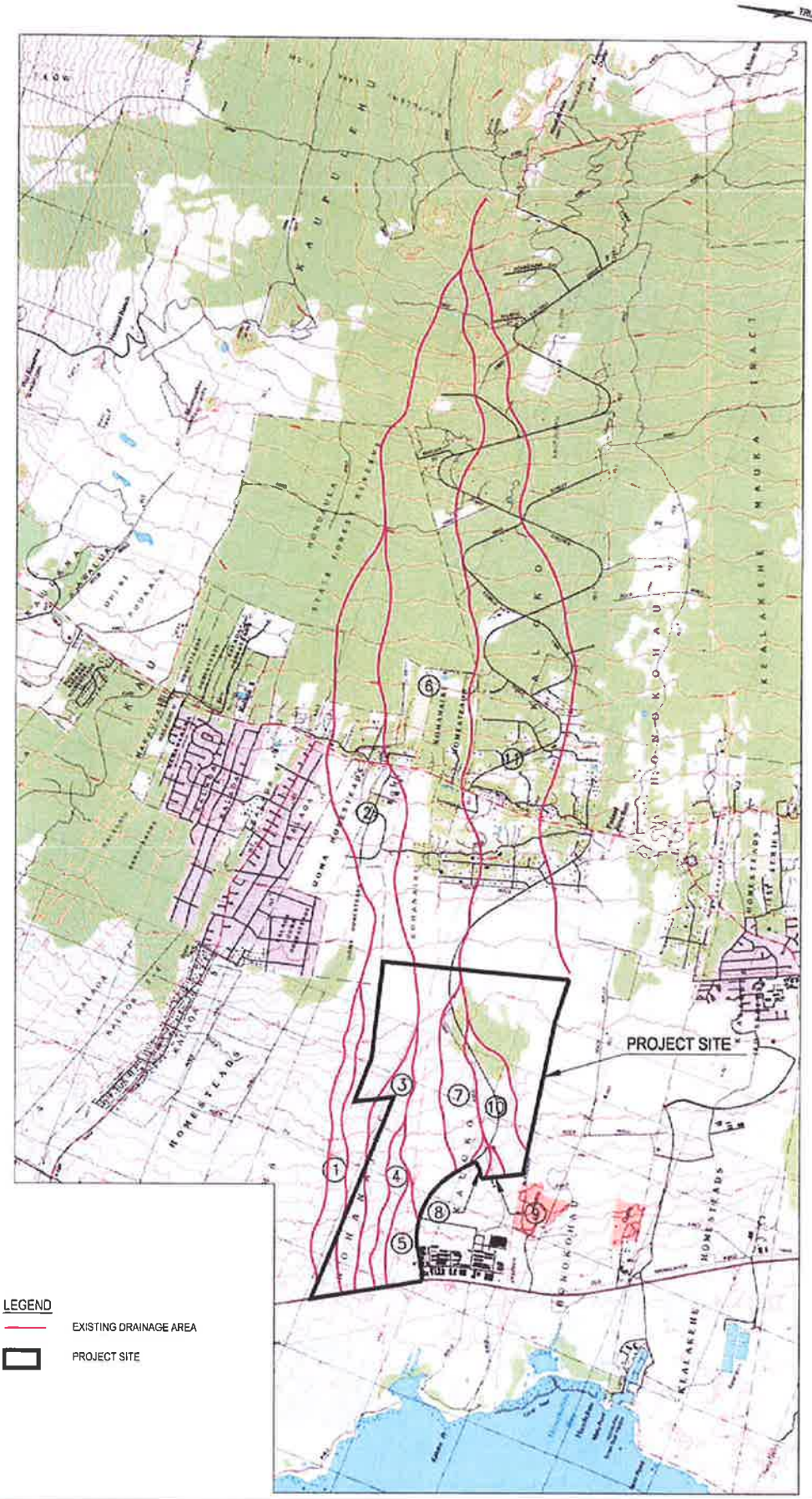
Drainage Basins 6, 7, and 8. Drainage Basins 6, 7, and 8 encompass approximately 1,674, 148, and 13 acres, respectively. These drainage basins contain mostly slight to moderate vegetation and lava rock with Drainage Basin 6 also having some residential paved areas. Runoff generated in these drainage basins flow in a westerly direction toward the ocean and percolates through the ground. Drainage Basin 8 is on-site while Drainage Basin 7 is off-site. Drainage Basin 6 is both on and off-site.

Drainage Basin 9 and 10. Drainage Basins 9 and 10 encompass approximately 11 and 132 acres, respectively and are completely on-site. Both drainage basins consist of slight to moderate vegetation and lava rock. Hina Lani Street is the only pavement crossing the drainage basins. Runoff generated flow toward the ocean in a westerly direction and percolates through the ground.

Drainage Basin 11. Drainage Basin 11 encompasses approximately 1,732 acres and consists of more development (residential uses and Hina Lani Street) than any other drainage basin. This drainage basin also contains slight to moderate vegetation and lava rock. Runoff generated flows in a westerly direction toward the ocean and percolates through the ground.

Table 4-1 Existing Hydrology

Existing Condition									
Sub Basin	AREA (acre)	C	LENGTH	HEIGHT	SLOPE	VELOCITY (fps)	T_c (sec)	T_c (min)	I (in)	Q (ft³/s)
1	155.67	0.21	1102.5	690.00	0.063	3	3675.00	61.25	8.00	265.26
2	880.39	0.23	27429.5	2760.00	0.101	3	9143.17	152.39	8.00	1637.53
3	151.82	0.20	9530.5	520.00	0.055	3	3176.83	52.95	8.00	242.92
4	64.09	0.20	6020	360.00	0.060	3	2006.67	33.44	7.00	89.72
5	73.79	0.20	3857	240.00	0.062	3	1285.67	21.43	7.00	103.31
6	1674.71	0.27	32375	4300.00	0.133	3	10791.67	179.86	7.50	3328.48
7	148.25	0.23	6531	400.00	0.061	3	2177.00	36.28	8.00	275.75
8	12.94	0.23	1032.5	60.00	0.058	3	344.17	5.74	8.00	24.08
9	10.45	0.23	1022	60.00	0.059	3	340.67	5.68	7.00	17.01
10	132.29	0.23	5498.5	300.00	0.055	3	1832.83	30.55	7.00	215.31
11	1732.03	0.30	32033.43	4480.00	0.140	3	10677.81	177.96	7.00	3606.95
Total	**5036.45**									**9806.32**



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KALOKO MAKAI INFRASTRUCTURE

EXISTING DRAINAGE AREA

FIGURE
4-3

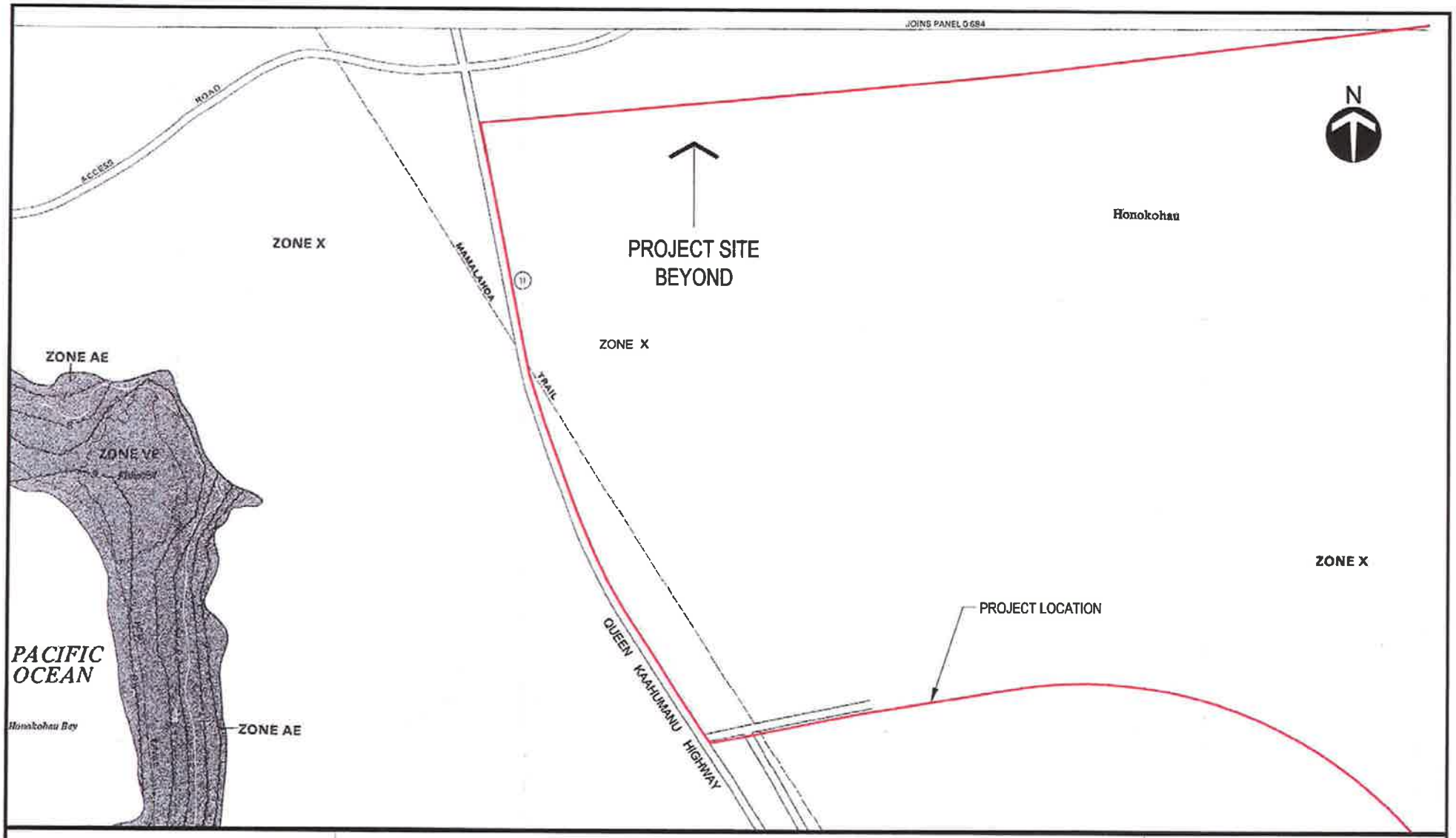
4.1.3 Flood Zone

According to the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM), Community Panel 155166 0692C revised April 02, 2004, the Project site is within Zone "X", "Areas determined to be outside of 500-year flood plain." The other FIRM panel 155166 0684C covering the Project site, is determined to be in Zone X. (See Figure 4-4)

4.2 Peak Runoff Rates

The peak runoff rates for the drainage area were calculated using the Rational Method, with a recurrence interval of 100 year-24 hour storm event in conformance with the County of Hawaii, Department of Public Works Storm Drainage Standard.

Increase in storm water runoff is generally related to the type of development or improvements undertaken to previously undeveloped areas. This increase of storm water runoff is created by changes in a number of factors including soil infiltration characteristics (soil permeability), relief (slope of ground), vegetation cover (percentage of vegetation cover over the drainage area), and development type (industrial, residential, agriculture, others). Of these factors, development type is the most significant characteristic that affects storm water runoff. The rate at which surface runoff flows (measured in cubic feet per second, cfs) will change and the quantity of runoff (measured in acre-feet, ac-ft) will also change resulting from the altered landscape.



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KALOKO MAKAI INFRASTRUCTURE
FLOOD INSURANCE RATE MAP

FIGURE
4–4

4.3 Post Development Improvements

The natural drainage pattern will be modified due to on-site development, including roadways, residential lots, and commercial areas. Runoff from the off-site mauka areas is not expected to increase and will be redirected away from the Project site through drainage channels located on the eastern and northern borders of the Project site. However, the proposed drainage system improvements will maintain or reduce the rate of runoff discharged off the Project site to equal or less than the existing rates, in compliance with County BMP Requirements. The use of detention basins, and natural swales or channels will store and filter the storm runoff, removing pollutants via percolation (see Figure 4-5).

4.3.1 Proposed Hydrology

As the Kaloko Makai Development is built, the runoff pattern defining the existing eleven drainage basins will be modified by the construction of roadways and drainage facilities. To calculate the peak runoff rates for the proposed condition, the existing eleven drainage areas were further divided into 21 drainage areas (see Figure 4-6). Runoff from the proposed Project was calculated for a 100 year – 24 hour storm event (see Table 4-2).

Drainage Basin 1. Drainage Basin 1 encompasses approximately 24 acres and located on the northeast corner of the Project Site. This drainage basin will consist of large single family lots.

Drainage Basin 2. Located on the east side of the Project Site, Drainage Basin 2 is roughly 102 acres and consists of large single family lots.

Drainage Basin 3. Drainage Basin 3 encompasses approximately 126 acres located on the southeast corner of the Project Site. This drainage basin will consist of single family lots, large single family lots, multi family lots, a park, and elementary school.

Drainage Basin 4. Drainage Basin 4 has an area of approximately 15 acres and is located on the north side of the Project Site. This area will consist of mixed single and multi family lots.

Drainage Basin 5. At approximately 60 acres, Drainage Basin 5 is located near the northeast corner of the Project Site and will consist of single family, multi family, and mixed use lots all make up this drainage basin.

Drainage Basin 6. Located near the east side of the Project Site, Drainage Basin 6 is approximately 26 acres. It is planned to be used for both single family and multi family lots.

Drainage Basin 7. Drainage Basin 7 is approximately 228 acres and is located near the southeast corner of the Project Site. Most of this basin consist of the native dryland forest while the rest will be used for a park, elementary school, and single family residential lots.

Drainage Basin 8. Drainage Basin 8 is located on the north side of the Project Site and is roughly 27 acres. This drainage basin will consist of mixed use, affordable housing, and for single and multi family lots.

Drainage Basin 9. This drainage basin encompasses approximately 47 acres. Situated at the northern end of the Project site, Drainage Basin 9 will consist of a middle school, park, and mixed use and multi family lots.

Drainage Basin 10. Drainage Basin 10 is centrally located and encompasses approximately 91 acres. This drainage basin will consist of various uses including medical offices, a transit station, hospital, lodge, and business center.

Drainage Basin 11. This drainage basin is near the north end of the Project Site and approximately 25 acres. It is planned for mixed use lots.

Drainage Basin 12. Located on the north end of the Project Site, Drainage Basin 12 runs parallel to Hulikoa Drive. It is approximately 56 acres and will consist of single and multi family lots as well as affordable housing and live-work lots.

Drainage Basin 13. Drainage Basin 13 is situated near the center of the Project Site and is roughly 54 acres. It will consist of a shopping center, legal offices, multi family lots, a transit station, and a senior Independent living center.

Drainage Basin 14. This drainage basin is located near the center of the Project Site and is about 13 acres. It will consist of single and multi family logs.

Drainage Basin 15. Drainage Basin 15 encompasses approximately 68 acres and will consist of single family, multi family, and live-work lots. It is located along the southern border of the Project Site.

Table 4-2 Proposed Hydrology

Proposed Condition										
Sub Basin	AREA (acre)	C	LENGTH	HEIGHT	SLOPE	VELOCITY (fps)	T_c (sec)	T_c (min)	i (in.)	Q (ft^3/s)
Off Site										
A	133.75	0.20	10755.92	680	0.063	3	3585.31	59.76	7.00	187.24
B	680.90	0.20	24516.6	2600	0.106	3	8172.20	136.20	8.00	1089.44
C	20.59	0.27	1983.63	160	0.081	3	661.21	11.02	7.00	38.20
D	1441.19	0.27	24609.37	3680	0.150	3	8203.12	136.72	8.00	3055.33
E	1451.97	0.30	25859.59	4240	0.164	3	8619.86	143.66	8.00	3455.68
Total Off-Site	**3728.40**									**7825.90**
On Site										
1	23.74	0.33	2086	160	0.077	12	173.83	2.90	7.00	54.83
2	101.47	0.33	2443	160.00	0.065	12	203.58	3.39	7.00	234.39
3	125.98	0.40	899.5	80.00	0.089	12	74.96	1.25	7.00	348.34
4	14.75	0.59	1330	100.00	0.075	12	110.83	1.85	7.00	60.92
5	59.54	0.59	1816.5	80.00	0.044	12	151.38	2.52	7.00	245.89
6	26.15	0.59	1456	60.00	0.041	12	121.33	2.02	7.00	108.01
7	228.42	0.33	5292	240.00	0.045	12	441.00	7.35	7.00	527.66
8	27.14	0.66	1309	80.00	0.061	12	109.08	1.82	7.00	124.46
9	46.53	0.53	1715	80.00	0.047	12	142.92	2.38	7.00	170.98
10	90.65	0.59	2796.5	120.00	0.043	12	233.04	3.88	7.00	374.39
11	25.08	0.40	1113	80	0.072	12	92.75	1.55	7.00	69.33
12	55.66	0.40	1344	80.00	0.060	12	112.00	1.87	7.00	153.91
13	54.24	0.59	2086	100.00	0.048	12	173.83	2.90	7.00	223.99
14	12.87	0.40	1277.5	40.00	0.031	12	106.46	1.77	7.00	35.60
15	68.02	0.53	1466.5	60.00	0.041	12	122.21	2.04	7.00	249.97
16	71.90	0.66	2443	120.00	0.049	12	203.58	3.39	7.00	329.66
17	38.94	0.59	1473.5	100.00	0.068	12	122.79	2.05	7.00	160.81
18	40.37	0.27	938	60.00	0.064	12	78.17	1.30	7.00	74.88
19	74.37	0.66	983.5	60.00	0.061	12	81.96	1.37	7.00	341.01
20	59.24	0.59	1641.5	100.00	0.061	12	136.79	2.28	7.00	244.65
21	62.24	0.40	1487.5	100.00	0.067	12	123.96	2.07	7.00	172.09
Total On-Site	**1307.30**									**4305.78**

Drainage Basin 16. Approximately 72 acres make up this drainage basin located at the northwest corner of the Project Site. This basin will consist of light industrial and mixed use, multi family residential lots , affordable housing, and live-work .

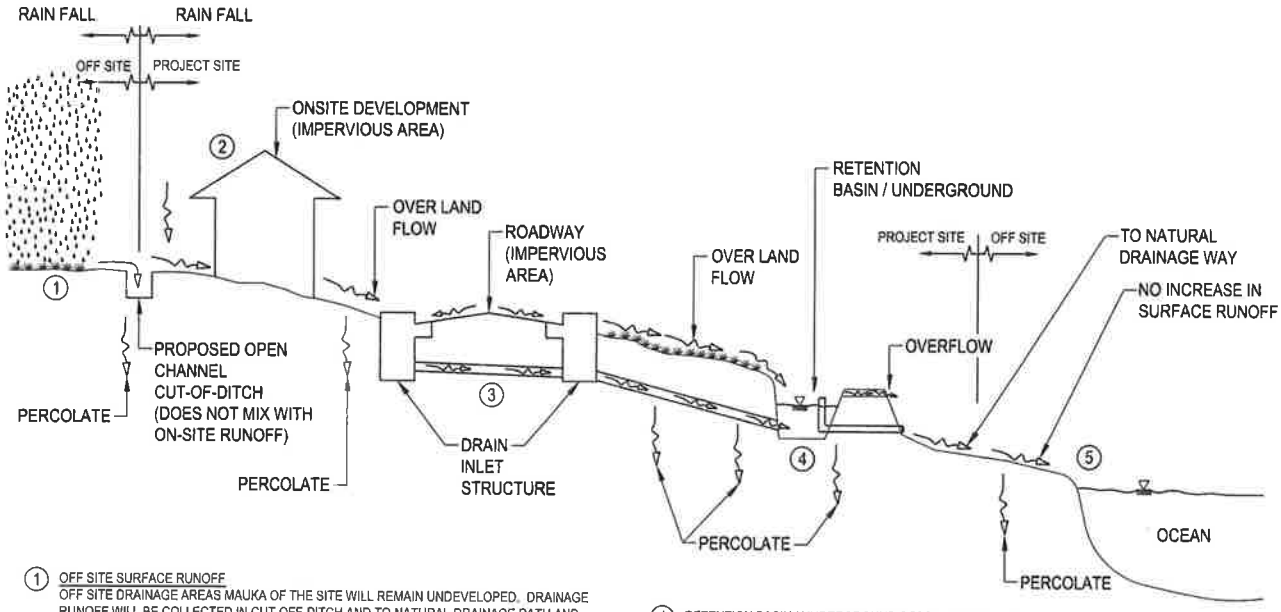
Drainage Basin 17. Drainage Basin 17 is situated near the southwest corner of the Project Site. It is approximately 39 acres and will include single and multi family lots, affordable housing, and live-work areas.

Drainage Basin 18. Located in the southwest corner of the Project Site, Drainage Basin 18 is about 40 acres. It will contain a park and water tank site.

Drainage Basin 19. This drainage basin runs along the western border and northwestern corner of the Project Site and is approximately 74 acres. It includes a waste water treatment plant.

Drainage Basin 20. A fire station, desalination plant, water tank, live-work and mixed use lots, multi family residential areas, and affordable housing will all make up the nearly 60 acres of this drainage basin. It is located on the southern end of the Project Site.

Drainage Basin 21. Situated near the center of the Project Site, this drainage basin is planned to contain single and multi family residential areas, live-work lots, senior housing, a park, and elementary school. It is approximately 62 acres.



1. OFF SITE SURFACE RUNOFF
OFF SITE DRAINAGE AREAS MAUKA OF THE SITE WILL REMAIN UNDEVELOPED. DRAINAGE RUNOFF WILL BE COLLECTED IN CUT-OFF-DITCH AND TO NATURAL DRAINAGE PATH AND ALLOWED TO PERCOLATE.

2. ON SITE RUNOFF
THE PROPOSED DEVELOPMENT OF THE SITE WILL INCREASE THE STORM WATER RUNOFF VOLUME DUE TO THE ADDITIONAL IMPERVIOUS AREAS.

3. DRAINAGE PIPE SYSTEM
ON SITE RUNOFF WILL BE DIVERTED TO DRAIN INLET STRUCTURES AND PIPED THROUGH A SERIES OF DRAINLINES THROUGHOUT THE PROJECT SITE TO PROPOSED BASINS.

4. RETENTION BASIN / UNDERGROUND RETENTION SYSTEM
BASINS WILL BE PROVIDED TO CAPTURE THE ADDITIONAL RUNOFF VOLUME CREATED BY THE NEW DEVELOPMENT. THE BASINS WILL "RETAIN" THE INCREASED RUNOFF VOLUME AND ALLOW TO PERCOLATE.

5. DOWNSTREAM PROPERTIES
THE RUNOFF VOLUME LEAVING THE PROJECTS SITE WILL BE REDUCED, DUE TO THE ON SITE PROPOSED IMPROVEMENTS. THE PROPOSED KALOKO DEVELOPMENT WILL NOT ADVERSELY AFFECT THE EXISTING RUNOFF CONDITIONS AND THE ADJACENT DOWNSTREAM PROPERTIES. THERE WILL BE NO INCREASE IN SURFACE RUNOFF.

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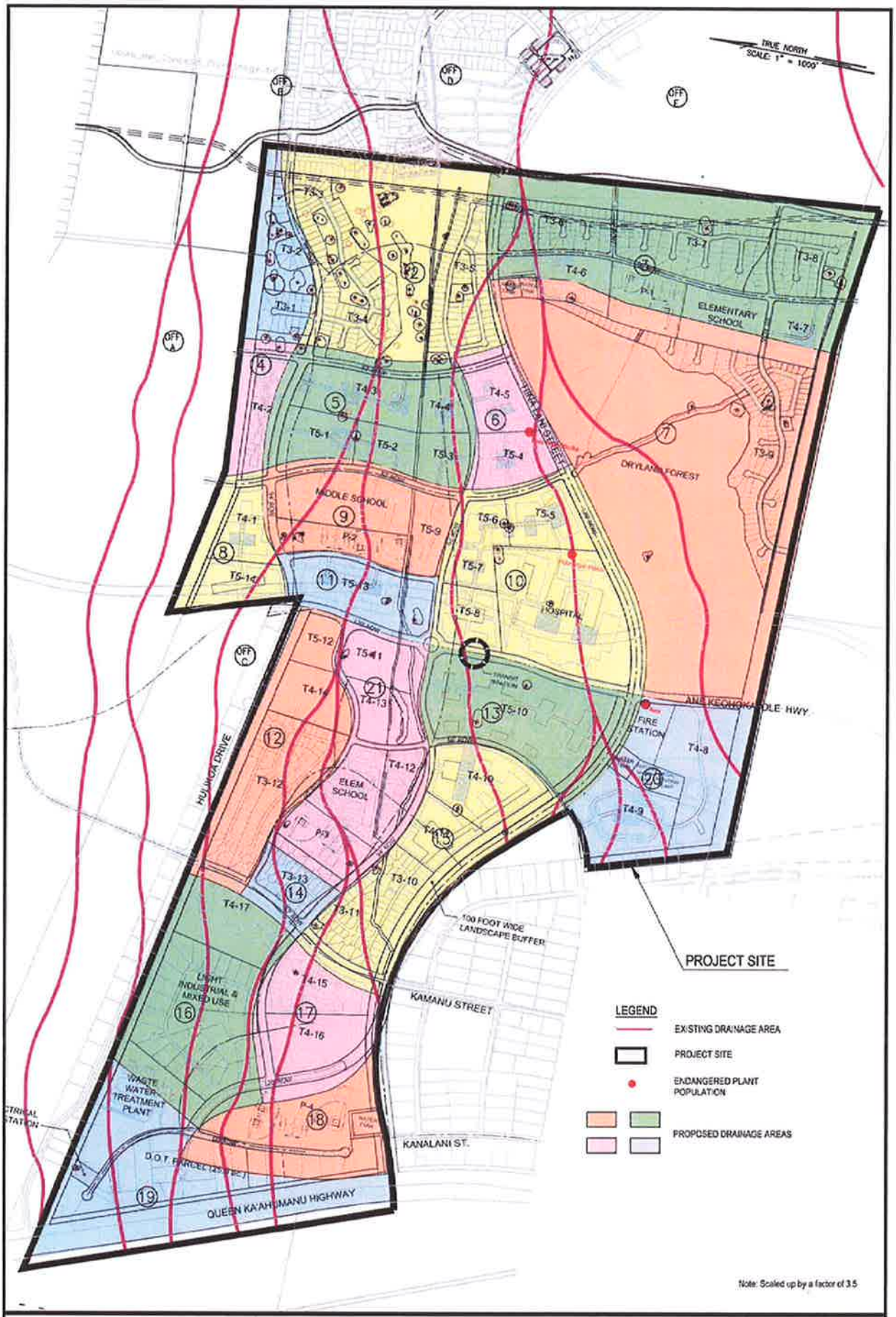
KALOKO MAKAI INFRASTRUCTURE
CONCEPTUAL DRAINAGE DIAGRAM

FIGURE
4-5



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KALOKO MAKAI INFRASTRUCTURE
POST DEVELOPMENT AND OFFSITE
DRAINAGE BASINS

FIGURE
4–6

4.3.2 Future Runoff Volume Calculations

In order to accommodate the additional flow, detention basins will be provided to retain the increased drainage runoff volume. The Area-Duration method was used with a 100 year–24 hour storm event to determine the required capacity of each detention basins. This calculation method uses the runoff coefficient (C) of the existing and proposed conditions to determine the increase of storm water runoff volumes. Basin volumes are measured in acre-feet and Table 4-3 illustrates the volumes of the pre development and post-development conditions.

4.4 Proposed Improvements

The natural drainage pattern will be modified due to on site development, including roadways, residential lots, and commercial areas. Runoff from the off site mauka areas is not expected to increase and will be redirected away from the project site through drainage channels located on the eastern and northern borders of the Project site. However, the proposed drainage system improvements will maintain or reduce the rate of runoff discharged off the Project site to equal or less than the existing rates, in compliance with County BMP Requirements.

4.4.1 Temporary Best Management Practice (BMP)

During construction, temporary BMP's will be designed, installed, and maintained by the contractor for each phase to limit the amount of sediments and other pollutants generated from the Project. Some temporary BMP's may include stabilized construction entrance/exist, geotextiles, silt fences, storm drain inlet protection, and temporary swales. NPDES permits will be applied for should storm water discharge into any water under jurisdiction of the United States of America.

4.4.2 Permanent Best Management Practice (BMP)

Permanent BMP's will be designed for each phase of construction and will include ultimate build-out. Drain inlets and catch basin filters may be used to accommodate roadway drainage, as well drainage for school, parks, and other properties. Hydrodynamic devices may be used to separate pollutants such as grease and oils in storm water runoff before discharge. Low impact development structures such as biofilters and bioswales can also be used to treat storm water runoff. All permanent BMP's will meet County BMP standards to filter first flush sediment and other pollutants prior to discharge off-site, into injection wells, or percolation into the ground

4.4.3 Detention Basins

A drainage basin approximately 4-7 feet deep will be placed at each park located throughout the Project site (see Figure 4-7). Approximately 30% of the park is assumed useable as a drainage basin due to the natural topography and usage of the park. Any additional storm water runoff will be stored in an underground retention system located throughout the park. Storm water collected in the drainage basin and underground retention system will percolate through the ground. At each drainage basin, a spillway will be constructed to allow any excess storm water to overflow.

4.4.4 Drainage Pipe System

Depending on the type of development proposed, use of an underground storm drainage system consisting of drainlines, drain inlets, and storm drain manholes will be required to collect and convey storm drainage runoff to the drywells and/or detention basins. The proposed drainage system will be designed to minimize the impacts to near shore coastal waters. The actual number of drywells and size of detention basins will be determined during the design phase of the Project. A geotechnical engineer should be retained during the design and construction phase of the Project to verify percolation results of the drywells to confirm discharge capacities. Drywells will require an underground Injection Well Permit from the State Department of Health.

The storm water utility line sizes, inlet locations, drywell requirements and detention/retention basin sizes will be determined during the design phase of the Project.

4.4.5 Open Channels

An open drainage channel will be constructed along the eastern boundary (mauka) of the Kaloko Makai development to redirect any off-site drainage away from the Project site and into the natural drainage paths flowing through the Project site (see Figure 4-7). A second drainage channel will be constructed along the eastern boundary of the dryland forest to prevent any on-site drainage from entering the dryland forest. A third and fourth drainage channel will be built along the northern boundary of the Kaloko Makai development to capture any redirect generated uphill from flowing into the Project site.

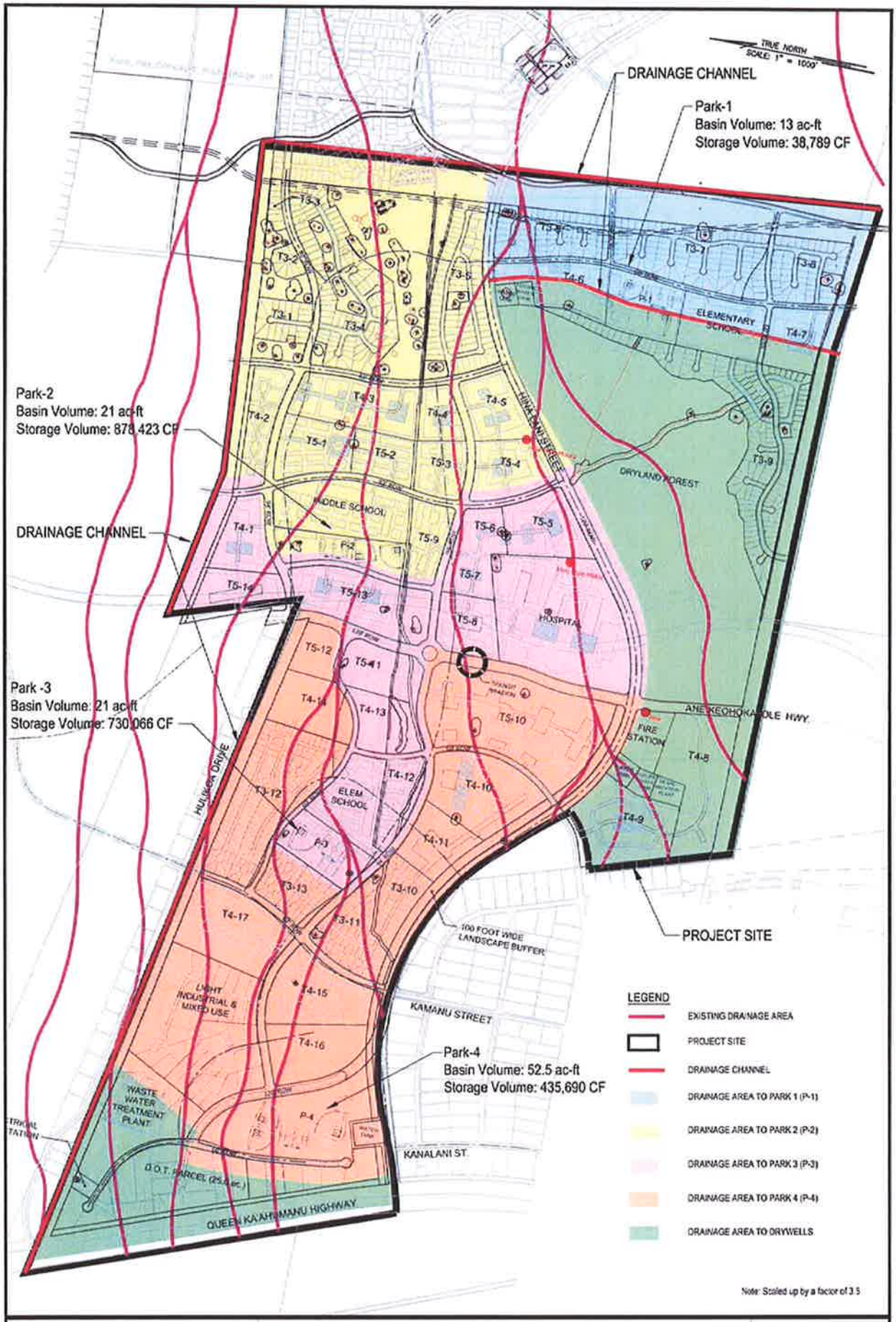
Table 4-3 On-Site Existing and Proposed Volumes
Area-Duration Method
100 Year - 24 Hour Event

Basin	Analysis Method	Area (Acres)	$I_{100\ year}$ (in.)	Pre C	Post C	Pre V (ac-ft)	Post V (ac-ft)	Net V (ac-ft)
Off-Site								
A	Rational	133.75	7	0.20		15.60		
B	Rational	680.90	7.5	0.20		85.11		
C	Rational	20.59	7	0.27		3.18		
D	Rational	1441.19	8	0.27		254.61		
E	Rational	1451.97	8	0.30		287.97		
On-Site								
1	Rational	23.74	7	0.20	0.33	2.77	4.57	1.80
2	Rational	101.47	7	0.20	0.33	11.84	19.53	7.69
3	Rational	125.98	7	0.20	0.40	14.70	29.03	14.33
4	Rational	14.75	7	0.20	0.59	1.72	5.08	3.36
5	Rational	59.54	7	0.20	0.59	6.95	20.49	13.54
6	Rational	26.15	7	0.20	0.59	3.05	9.00	5.95
7	Rational	228.42	7	0.20	0.33	26.65	43.97	17.32
8	Rational	27.14	7	0.20	0.66	3.17	10.37	7.20
9	Rational	46.53	7	0.20	0.53	5.43	14.25	8.82
10	Rational	90.65	7	0.20	0.59	10.58	31.20	20.62
11	Rational	25.08	7	0.20	0.40	2.93	5.78	2.85
12	Rational	55.66	7	0.20	0.40	6.49	12.83	6.33
13	Rational	54.24	7	0.20	0.59	6.33	18.67	12.34
14	Rational	12.87	7	0.20	0.40	1.50	2.97	1.46
15	Rational	68.02	7	0.20	0.53	7.94	20.83	12.90
16	Rational	71.90	7	0.20	0.66	8.39	27.47	19.08
17	Rational	38.94	7	0.20	0.59	4.54	13.40	8.86
18	Rational	40.37	7	0.20	0.27	4.71	6.24	1.53
19	Rational	74.37	7	0.20	0.66	8.68	28.42	19.74
20	Rational	59.24	7	0.20	0.59	6.91	20.39	13.48
21	Rational	62.24	7	0.20	0.40	7.26	14.34	7.08
	Total On-Site	1307.30				152.52	358.82	206.30

4.4.6 Roadway Culverts

Proposed roadway culverts will be provided throughout the Project Site to divert runoff under roadways, which will prevent excessive flooding on the roadways. Roadway culvert plans and profiles will be finalized during the final design of the Project.

In addition, bioswales, landscape elements designed to remove silt and other pollutants, along roadways may be an option where appropriate.



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KALOKO MAKAI INFRASTRUCTURE
DETENTION BASIN DRAINAGE AREAS

FIGURE
4 – 7

5. ROADWAY AND PARKING SYSTEM

The review of the roadway and parking system is based on the review of the Conceptual Land Use Plan prepared by SCD-TSA Kaloko Makai, LLC. This section will concentrate on on-site related roadway and parking system issues.

5.1 Existing Conditions

Access to the Project Site is provided by Queen Kaahumanu Highway and Hina Lani Street. Queen Kaahumanu Highway, located along the western boundary of the Project Site is a two-way, two-lane State highway, currently being widened to a 4-lane divided arterial road.

Hina Lani Street is a two-way, two-lane County roadway with paved shoulders and no curb, gutter, or sidewalk Hina Lani Street bisects the Project Site in an east-west alignment, and connects to Queen Kaahumanu Highway to the west, Mamalahoa Highway to the east, and Ane Keohokalole in the center.

5.2 Projected Demands

On-site parking requirements for the Project will be based on information provided by SCD-TSA Kaloko Makai, LLC. The current site plan allows street parking in residential areas and parking lots in commercial areas.

5.3 Proposed Improvements

The primary access to the Project site will be provided by Queen Kaahumanu Highway and Hina Lani Street. The Ane Keahokalole Highway (Mid-Level road) will provide a secondary access to the Project Site.

The third access point to the Project site will be from Mamalahoa Highway via Hina Lani Street.

Based on the Conceptual Land Use Plan prepared by SCD-TSA Kaloko Makai, LLC, the internal roadway system for the proposed Project will include extending Kamanu Street. The Ane Keohokalole Highway (Mid-Level Road) is a secondary arterial being developed by the County of Hawaii bisecting the Project site in a north-south alignment and will be developed as part of the Project road improvements.

5.4 Roadway Types

There will be five (5) major types of roadways within the Project site as described below (see Figures 5-1 to 5-6). Sidewalks will be provided to meet ADAAG requirements unless it is technically infeasible. Industrial roads will be designed for WB-40 vehicles and all other roadways will be designed for SU vehicles.

1. Primary Arterials – There are three (3) primary arterial roadway sections for the development. The existing mid-level roadway (Ane Keohokalole Highway) alignment bisects the Spinal Roadway.

    a. Spinal Roadway – The Spinal Road bisects the Project site in an east-west alignment. This roadway will consist of a 94-foot right-of-way with four travel lanes (one 14-foot lane and one 12-foot lane), 22-foot curbed median, 2-foot curb and gutter, and 8-foot sidewalk on both sides of the roadway.

    b. Future Ane Keohokalole Highway (Phase 2) – The existing Ane Keohokalole Highway will be extended to the north through the Project Site. This roadway will consist of a 120-foot right-of-way and will initially be built with two 12-foot travel lanes, one 6-foot bike lane, 2-foot curb and gutter, and an 8-foot wide sidewalk on one side of the street. As traffic demand increases the roadway will ultimately be expanded to six travel lanes (one 14-foot lane and two 12-foot lanes), 12-foot curbed median, two 6-foot bike lane, 2-foot curb and gutter, and 8-foot wide sidewalk on both sides of the street.

    c. Hina Lani Street Extension (Phase 1) – Initially this extension will not connect to the existing Hina Lani Street and will only provide access to the industrial area. This roadway will primarily be designed as an industrial roadway to include two 18-foot travel lanes, 2-foot curb and gutter, and 10-foot sidewalk. As the capacity of the roadway increases, the roadway will be widened to six travel lanes and provide access from Hina Lani Street to the future Queen Ka'ahumanu Highway interchange.

2. Secondary Arterial – There are two (2) secondary arterial roadway sections for the development.

a. Kamanu Street Extension – Kamanu Street is aligned in a north-south direction. The existing Kamanu Street will be extended to the north intersection with Hulikoa Road. This roadway segment will consist of an 82-foot right-of-way with four travel lanes (one 14-foot lane and 12-foot lane), two 6-foot bike lane, 2-foot curb and gutter, and 7-foot sidewalk on both sides of the street.

b. Secondary Arterial Roadway – This roadway section will consist of an 82-foot right-of-way with a 62-foot travel way, 2-foot curb and gutter, and 8-foot sidewalk on both sides of the street.

3. Collector Roads – There are three (3) collector roadway sections for the development. The Collector Roads connect to Hina Lani Street or bisect Ane Keohokalole Highway.

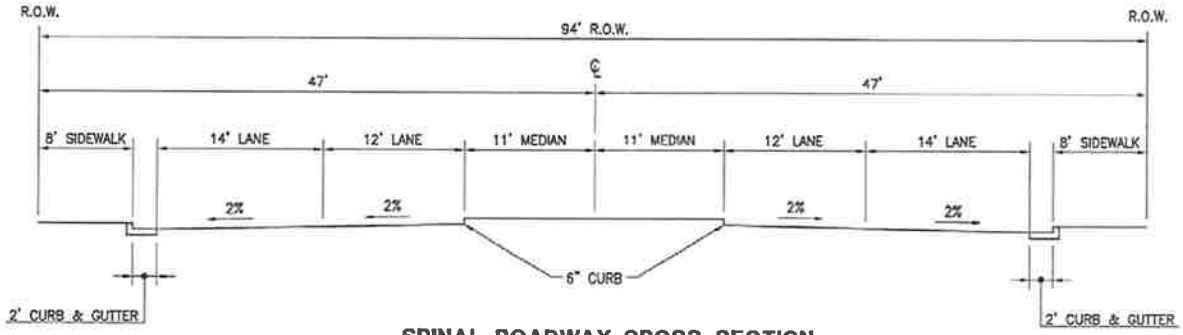
   a. Collector Road 1 –This roadway section will consist of 60-foot right-of-way with two 18-foot travel lanes, 2-foot curb and gutter, and 10-foot sidewalk on both sides of the street.

   b. Collector Road 2 – This roadway section section will consist of a 94-foot right-of-way with two 35-foot travel ways, 2-foot curb and gutter, and 10-foot sidewalk on both sides of the street.

   c. Collector Road 3 – This roadway section will consist of a 82-foot right-of-way with two 29-foot travel lanes, 2-foot curb and gutter, and 10-foot sidewalk on both sides of the street.

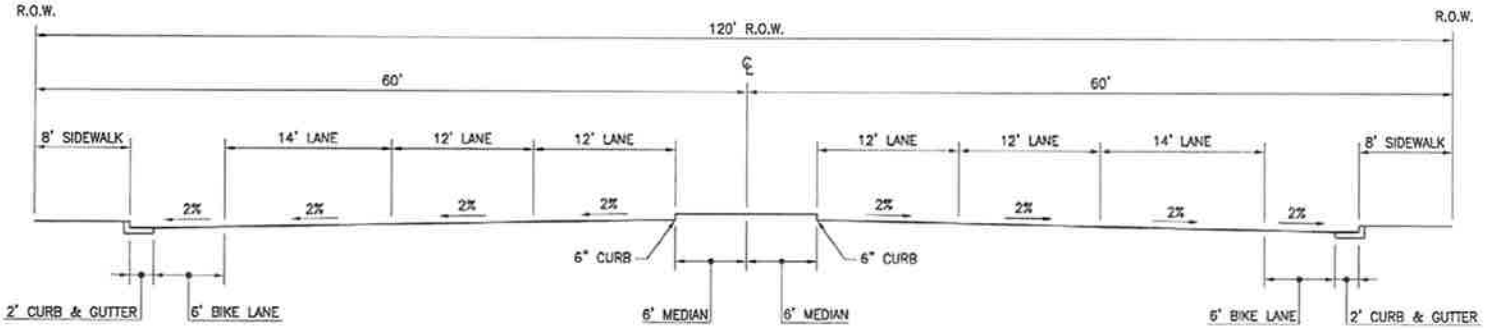
4. Industrial Road – This roadway section will consist of 60-foot right-of-way with two 18-foot travel lanes, 2-foot curb and gutter, and 10-foot sidewalk on both sides of the street.

5. Minor Roads and Cul-De-Sacs – The minor streets for the development will consist of a 50-foot right-of-way with two 16-foot travel lanes, 2-foot curb and gutter, and 7-foot sidewalk on both sides of the street.



SPINAL ROADWAY CROSS SECTION

SCALE: 1"=10'



FUTURE HINA LANI & ANE KEOHOKALOLE ROADWAY CROSS SECTION

SCALE: 1"=10'

GRAPHIC SCALE

Prepared by
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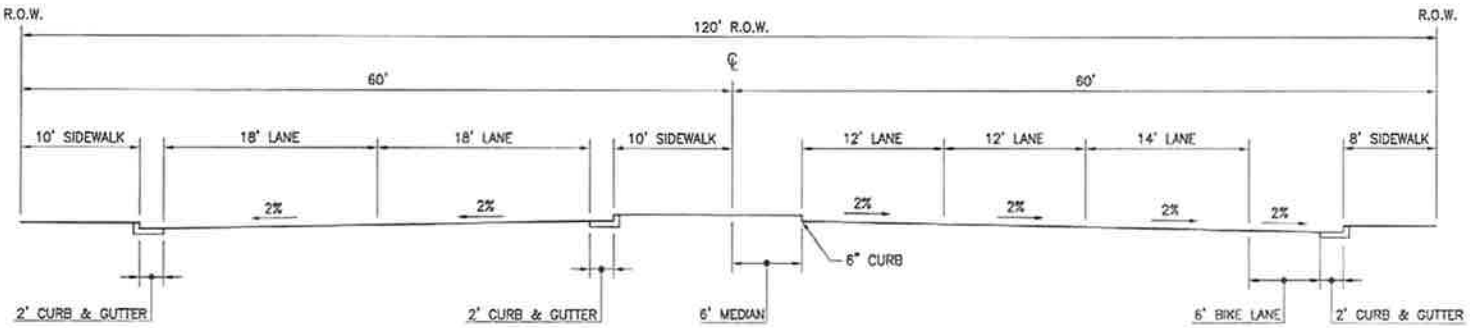
KALOKO MAKAI INFRASTRUCTURE
PRIMARY ARTERIAL ROADWAY SECTIONS 1

FIGURE
5-1



HINA LANI (PHASE 1) CROSS SECTION

SCALE: 1"=10'

GRAPHIC SCALE

10' 5' 0 10' 20'

SCALE 1"=10'

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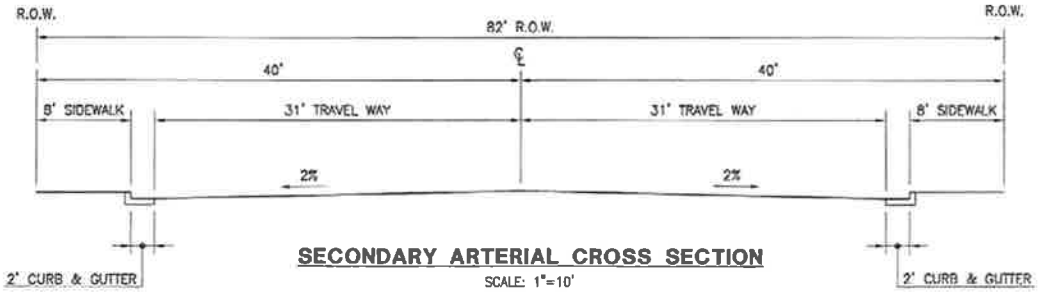
Wilson Okamoto
Corporation
Engineers • Planners

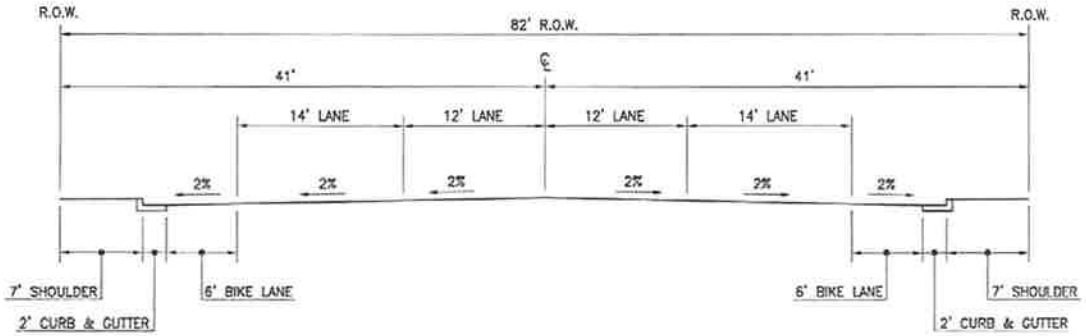
KALOKO MAKAI INFRASTRUCTURE
PRIMARY ARTERIAL ROADWAY SECTIONS 2

FIGURE
5-2



SECONDARY ARTERIAL CROSS SECTION

SCALE: 1"=10'



KAMANU STREET EXTENSION CROSS SECTION

SCALE: 1"=10'

GRAPHIC SCALE

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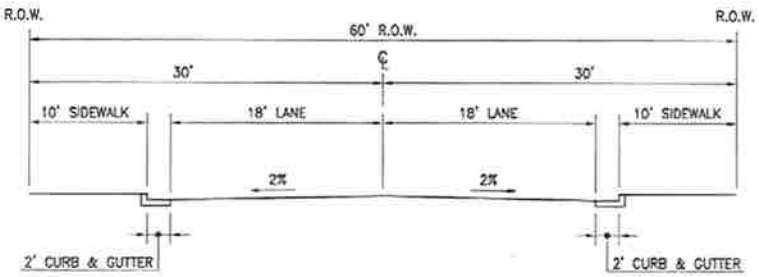
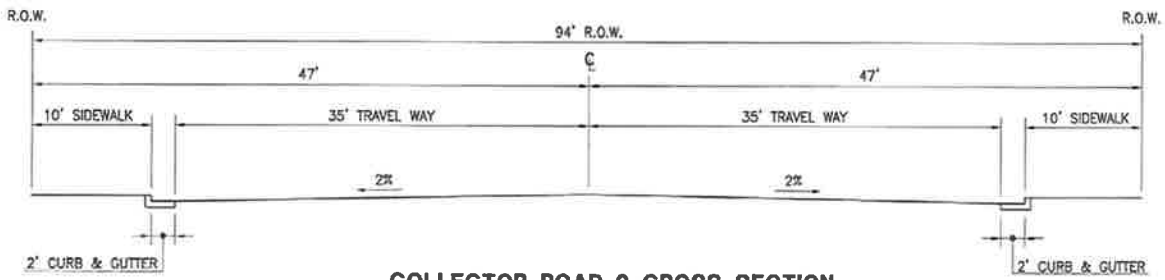
KALOKO MAKAI INFRASTRUCTURE
SECONDARY ARTERIAL SECTIONS

FIGURE
5-3



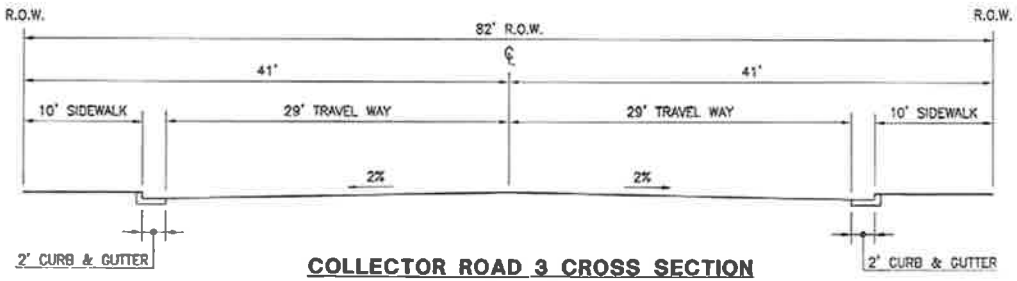
COLLECTOR ROAD 1 CROSS SECTION

SCALE: 1"=10'



COLLECTOR ROAD 2 CROSS SECTION

SCALE: 1"=10'



COLLECTOR ROAD 3 CROSS SECTION

SCALE: 1"=10'

GRAPHIC SCALE

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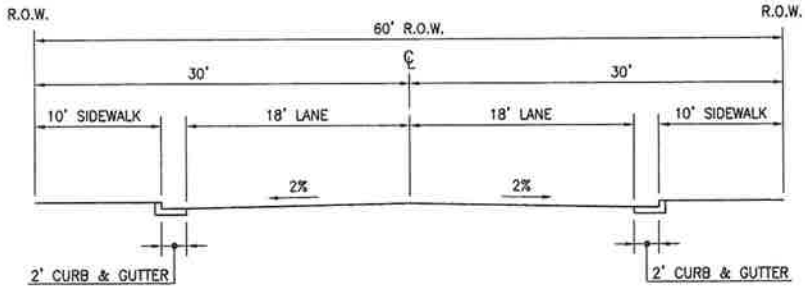
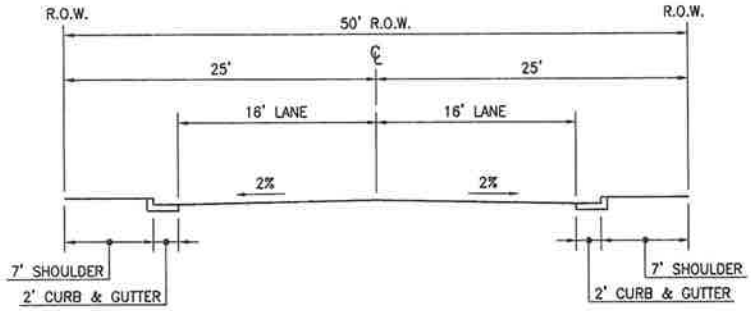
KALOKO MAKAI INFRASTRUCTURE
COLLECTOR ROADWAY SECTIONS

FIGURE
5-4



INDUSTRIAL ROADWAY CROSS SECTION

SCALE: 1"=10'



MINOR STS. & CUL-DE-SAC CROSS SECTION

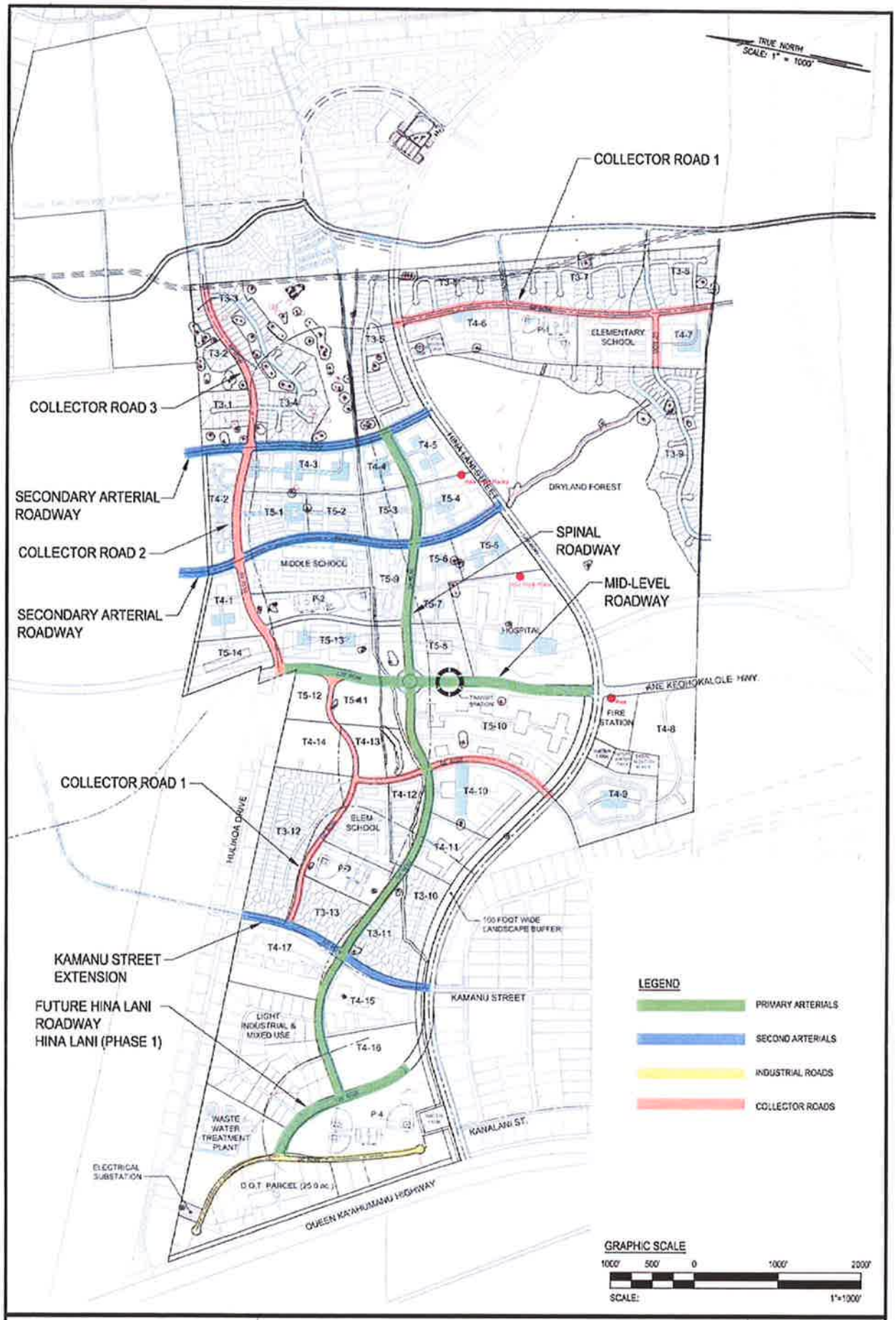
SCALE: 1"=10'

GRAPHIC SCALE

Prepared by:
Wilson Okamoto
Corporation
Engineers • Planners

KALOKO MAKAI INFRASTRUCTURE
INDUSTRIAL ROAD, MINOR ROAD,
& CUL-DE-SAC SECTIONS

FIGURE
5-5



Prepared by:
Wilson Okamoto Corporation
Engineers • Planners

KALOKO MAKAI INFRASTRUCTURE

ROADWAY SITE LAYOUT

FIGURE 5-6

6. ELECTRICAL, TELEPHONE, CABLE, AND DATA SYSTEMS

6.1 Background

Electrical, telephone, data line access to the Internet, and cable TV service for the Project will be provided by Hawaii Electric Light Company (HELCO), Hawaiian Telcom and Time Warner Cable.

6.2 Existing Conditions

The existing electrical, telephone, and cable systems in the vicinity of the Project site consists of overhead lines located along Queen Kaahumanu Highway.

6.3 Projected Demands

The Project will need to contact HELCO to confirm the availability of service in the area as well as identify any other constraints or items that may be of concern.

6.4 Proposed Improvements

Electrical, telephone, cable TV service, and data line access to the Internet for the Project, if available, will be provided through Hawaii Electric Light Company, Hawaiian Telcom and Time Warner Cable.

7. OTHER UTILITIES

7.1 Fuel Systems

If propane or diesel fuel service is required, an on-site tank system would be required since no gas or fuel lines exist near the Project site. Sizing and locations of the various fuel tanks will be determined during the design phase of the Project.

8. REFERENCES

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APPENDIX A

- Projected Wastewater Demand Calculations
- Projected Water Demand Calculations

Projected Wastewater Demand Calculations

EQUATIONS		
R=(D/12)/4	n=	0.015
A=PixR^2	Q=VxAx0.646317	
V=(1.486/n)x(R^2/3)x(S^1/2)		

KEY			
A	Average Wastewater Flow = Contribution x Capita (GPD)	E	Design Average Flow (GPD)
B	Max Flow Factor	F	Design Max Flow (GPD)
C	Max Flow (GPD)	G	Wet Weather Infiltration/Inflow @ 1250 GPAD (GPD)
D	Dry Weather Infiltration/Inflow @ 5 GPCD (GPD)	H	Design Peak Flow (GPD)

SEWER LOCATION			TRIB. AREA (Acres)		CPA	#	CPU	#	WASTEWATER FLOW COMPUTATION							
Parcel	Type of Use / Unit	Contribution Gal/Cap/Day	Increment	Total	Cap/Acre	Units[1]	Cap/unit	Capita	A	B	C	D	E	F	G	H
PHASE 1																
	Light Industrial	80	25.0	25.0	100.0			2,500	200,000	4.2	832,553	12,500	212,500	845,053	31,250	876,303
WWTP	Industrial	80	20.0	45.0				20	1,600	5.0	8,000	100	1,700	8,100	25,000	33,100
Elec. Sub	ESS	80	1.0	46.0				20	1,600	5.0	8,000	100	1,700	8,100	1,250	9,350
P-4	Park	20	25.0	71.0	40.0			1,000	20,000	5.0	100,000	5,000	25,000	105,000	31,250	136,250
	MF, Affordable Housing	80	13.1	84.1		30	2.8	84	6,720	5.0	33,600	420	7,140	34,020	16,375	50,395
	SF	80	13.1	84.1		88	4.0	352	28,160	5.0	140,800	1,760	29,920	142,560	16,375	158,935
	Live Work, MF	80	15.4	99.5		35	2.8	98	7,840	5.0	39,200	490	8,330	39,690	19,250	58,940
	SF	80	15.4	99.5		104	4.0	416	33,280	5.0	166,400	2,080	35,360	168,480	19,250	187,730
	Retail/Office Space	40	0.5	100.0	140.0			64	2,571	5.0	12,856	321	2,893	13,177	574	13,751
T3-11	SF	80	11.6	111.6		58	4.0	232	18,560	5.0	92,800	1,160	19,720	93,960	14,500	108,460
T3-10	SF	80	7.4	119.0		37	4.0	148	11,840	5.0	59,200	740	12,580	59,940	9,250	69,190
	MF	80	9.4	128.4		22	2.8	62	4,928	5.0	24,640	308	5,236	24,948	11,750	36,698
	SF	80	9.4	128.4		63	4.0	252	20,160	5.0	100,800	1,260	21,420	102,060	11,750	113,810
	Live Work, MF	40	18.0	146.4		41	2.8	115	4,592	5.0	22,960	574	5,166	23,534	22,500	46,034
	SF	80	18.0	146.4		121	4.0	484	38,720	5.0	193,600	2,420	41,140	196,020	22,500	218,520
	Retail/Office Space	40	0.3	146.7	140.0			48	1,928	5.0	9,642	241	2,169	9,883	430	10,313
T5-10	MF	80	39.1	185.8		423	2.8	1,184	94,752	4.8	457,993	5,922	100,674	463,915	48,875	512,790
	Retail/Office Space	40	3.6	189.4	140.0			498	19,927	5.0	99,633	2,491	22,417	102,124	4,448	106,571
T5-13	MF, Mixed Use, Aff. Housing	80	14.3	203.7		215	2.8	602	48,160	5.0	240,800	3,010	51,170	243,810	17,875	261,685
	Retail/Office Space	40	1.4	205.0	140.0			193	7,713	5.0	38,567	964	8,678	39,532	1,722	41,253
P-3	Park	20	10.0	215.0	40.0			400	8,000	5.0	40,000	2,000	10,000	42,000	0	42,000
School	School	25	18.0	233.0				750	18,750	5.0	93,750	3,750	22,500	97,500	22,500	120,000
T5-9	MF	80	7.7	240.7		116	2.8	325	25,984	5.0	129,920	1,624	27,608	131,544	9,625	141,169
	Mixed Use	40	0.5	241.2	140.0			64	2,571	5.0	12,856	321	2,893	13,177	574	13,751
T5-5	MF	80	11.9	253.1		179	2.8	501	40,096	5.0	200,480	2,506	42,602	202,986	14,875	217,861
	Long Term Care, Medical Offices	40	0.7	253.8	140.0			96	3,857	5.0	19,284	482	4,339	19,766	861	20,627
T5-6	MF	80	5.5	259.3		83	2.8	232	18,592	5.0	92,960	1,162	19,754	94,122	6,875	100,997
	Long Term Care	40	0.7	260.0	140.0			96	3,857	5.0	19,284	482	4,339	19,766	861	20,627
T5-7	Lodge	80	5.3	265.3		0	4.0	0	0	5.0	0	0	0	0	6,625	6,625
	Business Center, Medical Offices	40	0.9	266.2	140.0			129	5,142	5.0	25,712	643	5,785	26,354	1,148	27,502
T5-8	MF	80	9.1	274.4		137	2.8	384	30,688	5.0	153,440	1,918	32,606	155,358	11,375	166,733
	Transit Station, TOD Square, Medical Offices, Senior	40	1.4	275.8	140.0			193	7,713	5.0	38,567	964	8,678	39,532	1,722	41,253
Hospital	Medical	400	40.0	315.8				200	80,000	5.0	400,000	1,000	81,000	401,000	50,000	451,000
Greenbelt	Park	0	0.0	71.0	0.0			0	0	5.0	0	0	0	0	0	0

		GPD
Average Wastewater Daily Discharge	=	818,302
Total Design Average Flow	=	877,016
Total Design Maximum Flow	=	3,967,010
Total Design Peak Flow	=	4,420,225

Projected Wastewater Demand Calculations

Parcel	SEWER LOCATION Type of Use / Unit	Contribution Gal/Cap/Day	TRIB. AREA (Acres) Increment	TRIB. AREA (Acres) Total	CPA Cap/Acre	# Units[1]	CPU Cap/unit	# Capita	WASTEWATER FLOW COMPUTATION A	B	C	D	E	F	G	H
PHASE 2																
Industrial	Light Industrial	80	25.0	25.0	100.0			2,500	200,000	4.2	832,553	12,500	212,500	845,053	31,250	876,303
[illegible]	MF	80	18.8	43.8		43	2.8	120	9,632	5.0	48,160	602	10,234	48,762	23,500	72,262
	SF	80	18.8	43.8		127	4.0	508	40,640	5.0	203,200	2,540	43,180	205,740	23,500	229,240
	Retail Office Space	40	0.3	44.1	140.0			48	1,928	5.0	9,642	241	2,169	9,883	430	10,313
T3-12	SF	80	28.5	72.6		171	4.0	684	54,720	5.0	273,600	3,420	58,140	277,020	35,625	312,645
T3-13	SF	80	9.9	82.5		60	4.0	240	19,200	5.0	96,000	1,200	20,400	97,200	12,375	109,575
P-3	Park	20	10.0	92.5	40.0			400	8,000	5.0	40,000	2,000	10,000	42,000	0	42,000
School	School	25	12.0	104.5				1000	25,000	5.0	125,000	5,000	30,000	130,000	15,000	145,000
[illegible]	MF	80	6.5	111.0		13	2.8	36	2,912	5.0	14,560	182	3,094	14,742	8,125	22,867
	SF	80	6.5	111.0		39	4.0	156	12,480	5.0	62,400	780	13,260	63,180	8,125	71,305
[illegible]	MF	80	5.0	116.0		11	2.8	31	2,464	5.0	12,320	154	2,618	12,474	6,250	18,724
	SF	80	5.0	116.0		32	4.0	128	10,240	5.0	51,200	640	10,880	51,840	6,250	58,090
	Retail/Office Space	40	0.1	116.2	140.0			16	643	5.0	3,214	80	723	3,294	143	3,438
[illegible]	MF	80	11.0	127.2		24	2.8	67	5,376	5.0	26,880	336	5,712	27,216	13,750	40,966
	SF	80	11.0	127.2		70	4.0	280	22,400	5.0	112,000	1,400	23,800	113,400	13,750	127,150
	Retail/Office Space	40	0.2	127.4	140.0			32	1,286	5.0	6,428	161	1,446	6,589	287	6,876
T5-11	MF	80	6.3	122.5		90	2.8	252	20,160	5.0	100,800	1,260	21,420	102,060	7,875	109,935
	Senior, Live Work	40	0.3	122.8	140.0			48	1,928	5.0	9,642	241	2,169	9,883	430	10,313
T5-12	MF	80	5.5	128.3		101	2.8	283	22,624	5.0	113,120	1,414	24,038	114,534	6,875	121,409
	Mixed Use	40	0.5	128.8	140.0			64	2,571	5.0	12,856	321	2,893	13,177	574	13,751
T5-14	MF	80	10.6	139.4		155	2.8	434	34,720	5.0	173,600	2,170	36,890	175,770	13,250	189,020
	Retail/Office Space	40	0.5	139.8	140.0			64	2,571	5.0	12,856	321	2,893	13,177	574	13,751
[illegible]	MF	40	12.7	152.5		26	2.8	73	2,912	5.0	14,560	364	3,276	14,924	15,875	30,799
	SF	80	12.7	152.5		76	4.0	304	24,320	5.0	121,600	1,520	25,840	123,120	15,875	138,995
[illegible]	MF	80	10.7	163.2		22	2.8	62	4,928	5.0	24,640	308	5,236	24,948	13,375	38,323
	SF	80	10.7	163.2		64	4.0	256	20,480	5.0	102,400	1,280	21,760	103,680	13,375	117,055
[illegible]	MF	80	15.4	178.6		31	2.8	87	6,944	5.0	34,720	434	7,378	35,154	19,250	54,404
	SF	80	15.4	178.6		93	4.0	372	29,760	5.0	148,800	1,860	31,620	150,660	19,250	169,910
[illegible]	MF	80	5.6	184.2		12	2.8	34	2,688	5.0	13,440	168	2,856	13,608	7,000	20,608
	SF	80	5.6	184.2		33	4.0	132	10,560	5.0	52,800	660	11,220	53,460	7,000	60,460
[illegible]	MF	80	9.6	193.8		22	2.8	62	4,928	5.0	24,640	308	5,236	24,948	12,000	36,948
	SF	80	9.6	193.8		64	4.0	256	20,480	5.0	102,400	1,280	21,760	103,680	12,000	115,680
	Retail Space	40	0.5	194.3	140.0			64	2,571	5.0	12,856	321	2,893	13,177	574	13,751
T5-1	MF	80	10.7	205.0		161	2.8	451	36,064	5.0	180,320	2,254	38,318	182,574	13,375	195,949
T5-2	MF	80	7.2	212.2		116	2.8	325	25,984	5.0	129,920	1,624	27,608	131,544	9,000	140,544
T5-3	MF	80	7.4	219.6		119	2.8	333	26,656	5.0	133,280	1,666	28,322	134,946	9,250	144,196
T5-4	MF	80	10.9	230.5		175	2.8	490	39,200	5.0	196,000	2,450	41,650	198,450	13,625	212,075
	Retail Space	40	0.6	231.1	140.0			80	3,214	5.0	16,070	402	3,616	16,472	717	17,189

		GPD
Average Wastewater Daily Discharge	=	763,165
Total Design Average Flow	=	817,048
Total Design Maximum Flow	=	3,702,339
Total Design Peak Flow	=	4,111,820

Projected Wastewater Demand Calculations

Parcel	SEWER LOCATION Type of Use / Unit	Contribution Gal/Cap/Day	TRIB. AREA (Acres) Increment	TRIB. AREA (Acres) Total	CPA Cap/Acre	# Units[1]	CPU Cap/unit	# Capita	WASTEWATER FLOW COMPUTATION A	B	C	D	E	F	G	H
PHASE 3																
Industrial	Light Industrial	80	25.0	25.0	100.0			2,500	200,000	4.2	832,553	12,500	212,500	845,053	31,250	876,303
T3-1	SF	80	5.7	30.7		17	4.0	68	5,440	5.0	27,200	340	5,780	27,540	7,125	34,665
T3-2	SF	80	2.2	32.9		6	4.0	24	1,920	5.0	9,600	120	2,040	9,720	2,750	12,470
T3-3	SF	80	1.7	34.6		5	4.0	20	1,600	5.0	8,000	100	1,700	8,100	2,125	10,225
T3-4	SF	80	25.6	60.2		76	4.0	304	24,320	5.0	121,600	1,520	25,840	123,120	32,000	155,120
T3-5	SF	80	21.9	82.1		112	4.0	448	35,840	5.0	179,200	2,240	38,080	181,440	27,375	208,815
T3-6	SF	80	13.5	95.6		71	4.0	284	22,720	5.0	113,600	1,420	24,140	115,020	16,875	131,895
T3-7	SF	80	23.2	118.8		117	4.0	468	37,440	5.0	187,200	2,340	39,780	189,540	29,000	218,540
T3-8	SF	80	11.5	130.3		63	4.0	252	20,160	5.0	100,800	1,260	21,420	102,060	14,375	116,435
[illegible]	SF	80	11.8	142.1		83	4.0	332	26,560	5.0	132,800	1,660	28,220	134,460	14,750	149,210
	MF	80	11.8	153.9		35	2.8	98	7,840	5.0	39,200	490	8,330	39,690	14,750	54,440
	Retail Space	40	0.3	154.2	140.0			48	1,928	5.0	9,642	241	2,169	9,883	430	10,313
P-1	Park	20	11.2	165.4	40.0			448	8,960	5.0	44,800	2,240	11,200	47,040	0	47,040
School	School	25	12.0	177.4				750	18,750	5.0	93,750	3,750	22,500	97,500	15,000	112,500
[illegible]	SF	80	9.1	186.5		54	4.0	216	17,280	5.0	86,400	1,080	18,360	87,480	11,375	98,855
	MF	80	9.1	195.6		37	2.8	104	8,288	5.0	41,440	518	8,806	41,958	11,375	53,333
T3-9	MF	80	38.3	233.9		193	2.8	540	43,232	5.0	216,160	2,702	45,934	218,862	47,875	266,737
[illegible]	SF	80	20.3	254.2		134	4.0	536	42,880	5.0	214,400	2,680	45,560	217,080	25,375	242,455
	MF	80	20.3	274.5		90	2.8	252	20,160	5.0	100,800	1,260	21,420	102,060	25,375	127,435
[illegible]	MF	40	18.6	293.1		82	2.8	230	9,184	5.0	45,920	1,148	10,332	47,068	23,250	70,318
	SF	80	18.6	311.7		123	4.0	492	39,360	5.0	196,800	2,460	41,820	199,260	23,250	222,510
	Mixed Use	40	0.6		140.0			80	3,214	5.0	16,070	402	3,616	16,472	717	17,189
Fire Station	Fire Station	80	5.5	298.6				20	1,600	5.0	8,000	100	1,700	8,100	6,875	14,975
Desal. Plant	Desalination Plant	80	1.7	313.4				20	1,600	5.0	8,000	100	1,700	8,100	2,125	10,225
Dryland Forest	Park	0	150.0	463.4	0.0			0	0	5.0	0	0	0	0	0	0
Greenbelt	Park	0	40.3	503.7	0.0			0	0	5.0	0	0	0	0	0	0

		GPD
Average Wastewater Daily Discharge	=	600,276
Total Design Average Flow	=	642,947
Total Design Maximum Flow	=	2,876,606
Total Design Peak Flow	=	3,262,004

OVERALL TOTALS

		GPD
Average Wastewater Daily Discharge	=	2,181,763
Total Design Average Flow	=	2,337,011
Total Design Maximum Flow	=	10,545,955
Total Design Peak Flow	=	11,794,048

Assumptions:

4 persons per Single Family Dwelling Units and Hotel/Lodge Units
2.8 persons per Multi-Family Dwelling/Mixed Use Unit
40 cpa for Park area; 140 cpa for office/retail space; 100 cpa for industrial area
80 gal/cap/day (gpcd) for SF/MF; 40 gpcd for Office/Retail/Commercial; 20 gpcd for Park
Schools - Used maximum extreme enrollment numbers; 750 for elementaries and 1000 for middle schools. Assume schools will be at or near capacity.
[1] # Units taken from *Kaloko Makai Land Use Summary (6-7-12) Computed SF-MF Land Areas per Pod* Spreadsheet
[2] 200 units assumed for the lodge and hospital
Areas used in calculations (infiltration/inflow, etc.) were taken from the "Parcel Size" column in the *Kaloko Makai Land Use Summary (6-7-12) Computed SF-MF Land Areas per Pod Spreadsheet*
Dry and Wet weather Infiltration/Inflow is assumed above the groundwater table

Reference:

Based on Kaloko Makai - Business Plan Use-Density Spreadsheet, as of 5/11
Design Standards fo the Department of Wastewater Management, Volume I, July 1993, Department of Wastewater Management, City and County of Honolulu

Projected Water Demand Calculations

Parcel I.D.	Land Use	Land Use Description	Parcel Size (Acres)	Landscaped Areas Defined (Acres)	Density of Parcel (D.U./Acre)	Maximum Density (D.U./Acre)	Landscape Density (D.U./Acre)	# of Units	SF Units	MF Units	Retail Space	Office Space	Water Usage: Split (Units) <Potable / Non-Potable> (Rate)	Water Usage: Potable (MGD)	Water Usage: Non-Potable (MGD)
PHASE 1															
INDUSTRIAL	Industrial	Light Industrial	25.0	5.00									<2000/2000> / acre	0.050	0.010
WWTP	WWTP	Waste Water Treatment Plant	20.0	2.00									Arbitrary	0.002	-
ELEC. SUB	ESS	Electrical Substation	1.0	0.10									Arbitrary	0.002	-
P-4	Park	District Sized Park &Drainage Retention	25.0	18.75									<600/3400> / acre	0.015	0.064
T4-16	Res./MU	MF, Affordable Housing	13.1	3.93	9.0	12	2.25	118	88	30			88 SF <400/0> 30 MF <276/124>	0.043	0.004
T4-15	Res./MU	Live-Work, MF, & SF	15.4	4.62	9.0	12	2.25	139	104	35	10,000	10,000	104 SF <400/0> 35 MF <276/124> 20 Commercial ft^2 <83/37>	0.053	0.005
T3-11	SF	Single Family	11.6	4.64	5.0	6		58	58	0			58 SF <400/0>	0.023	0.000
T3-10	SF	Single Family	7.4	2.96	5.0	6		37	37	0			37 SF <400/0>	0.015	0.000
T4-11	Res./MU	Mixed SF and MF	9.4	2.82	9.0	12	2.25	85	63	22			63 SF <400/0> 22 MF <276/124>	0.031	0.003
T4-10	Res./MU	Live-Work, MF, & SF	18.0	5.40	9.0	12	2.25	162	121	41	7,500	7,500	121 SF <400/0> 41 MF <276/124> 15 Commercial ft^2 <83/37>	0.061	0.006
[illegible]	Res./MU	Shopping Center, Legal Offices, MF, Transit Station, Senior Independent Living	39.1	11.73	10.8	30		423	0	423	75,000	80,000	423 MF <276/124> 155 Commercial ft^2 <83/37>	0.130	0.058
[illegible]	Res./MU	Mixed Use, Aff. Housing, Retail, Office.	14.3	4.29	15.0	30		215	0	215	45,000	15,000	215 MF <276/124> 60 Commercial ft^2 <83/37>	0.064	0.029
P-2	Park		10.0	7.50				0	0	0			<600/3400> / acre	0.006	0.026
SCHOOL	School		18.0	9.00				0	0	0			<2400/1600> / acre	0.043	0.014
[illegible]	Res./MU	Mixed Use, MF	7.7	2.31	15.0	30		116	0	116	20,000		116 MF <276/124> 20 Commercial ft^2 <83/37>	0.034	0.015
[illegible]	Res.	Long Term Care, Medical Offices	11.9	3.57	15.0	30		179	0	179	15,000	15,000	179 MF <276/124> 30 Commercial ft^2 <83/37>	0.052	0.023
[illegible]	Res.	Long Term Care	5.5	1.65	15.0	30		83	0	83	15,000	15,000	83 MF <276/124> 30 Commercial ft^2 <83/37>	0.025	0.011
[illegible]	Res./MU	Lodge, Business Center, Medical Offices	5.3	1.59	0.0	30		0	0	0	10,000	30,000	200 units <400/0> 40 Commercial ft^2 <83/37>	0.003	0.001
[illegible]	Res./MU	Transit Station, TOD Square, Medical Offices, MF, Senior	9.1	2.73	15.0	30		137	0	137	20,000	40,000	137 MF <276/124> 60 Commercial ft^2 <83/37>	0.043	0.019
[illegible]	Medical		40.0	10.00				200					200 units <400/0> <0/1600> / acre	0.080	0.016
TOTAL PHASE 1 UNITS			306.8					1752	471	1281	217,500	212,500		0.856	0.304

Projected Water Demand Calculations

Parcel I.D.	Land Use	Land Use Description	Parcel Size (Acres)	Landscaped Areas Defined (Acres)	Density of Parcel (D.U./Acre)	Maximum Density (D.U./Acre)	Landscape Density (D.U./Acre)	# of Units	SF Units	MF Units	Retail Space	Office Space	Water Usage: Split (Units) <Potable / Non-Potable> (Rate)	Water Usage: Potable (MGD)	Water Usage: Non-Potable (MGD)
PHASE 2															
INDUSTRIAL	Industrial	Light Industrial	25.0	5.00									<2000/2000> / acre	0.050	0.010
T4-17	Res./MU	MF, Live-Work, Affordable	18.8	5.64	9.0	12	2.25	170	127	43	7,500	7,500	127 SF <400/0> 43 MF <276/124> 15 Commercial ft² <83/37>	0.064	0.006
T3-12	SF	Single Family	28.5	11.40	6.0	6		171	171	0			171 SF <400/0>	0.068	0.000
T3-13	SF	Single Family	9.9	3.96	6.0	6		60	60	0			60 SF <400/0>	0.024	0.000
P-3	Park		10.0	7.50				0					<600/3400> / acre	0.006	0.026
SCHOOL	School		17.0	6.00				0					<2400/1600> / acre	0.029	0.010
T4-12	Res.	Multi Family & Single Family	6.5	1.95	8.0	12	2	52	39	13			39 SF <400/0> 13 MF <276/124>	0.019	0.002
T4-13	Res.	Multi Family & Single Family	5.0	5.13	8.0	12	2	43	32	11	2,500	2,500	102 SF <400/0> 11 MF <276/124> 15 Commercial ft² <83/37>	0.016	0.002
T4-14	Res.	Multi Family & Single Family	11.0	5.64	9.0	12	2.25	94	70	24	5,000	5,000	102 SF <400/0> 24 MF <276/124> 15 Commercial ft² <83/37>	0.035	0.003
[illegible]	Res./MU	MF, Senior, Live-Work	6.3	1.80	15.0	30		90	0	90	7,500	7,500	90 MF <276/124> 15 Commercial ft² <83/37>	0.026	0.012
[illegible]	Res./MU	Mixed Use	5.5	2.01	15.0	30		101	0	101	10,000	10,000	101 MF <276/124> 20 Commercial ft² <83/37>	0.030	0.013
[illegible]	Res./MU	Mixed Use, Affordable Housing	10.6	3.18	14.6	30		155	0	155	10,000	10,000	155 MF <276/124> 20 Commercial ft² <83/37>	0.044	0.020
T4-1	Res./MU	Mixed SF and MF	12.7	3.81	8.0	12	2	102	76	26			76 SF <400/0> 26 MF <276/124>	0.038	0.003
T4-2	Res./MU	Mixed SF and MF	10.7	3.21	8.0	12	2	86	64	22			64 SF <400/0> 22 MF <276/124>	0.032	0.003
T4-3	Res./MU	Mixed SF and MF	15.4	4.62	8.0	12	2	124	93	31			93 SF <400/0> 31 MF <276/124>	0.046	0.004
T4-4	Res./MU	Mixed SF and MF	5.6	1.68	8.0	12	2	45	33	12			33 SF <400/0> 12 MF <276/124>	0.017	0.001
T4-5	Res./MU	Mixed SF and MF	9.6	2.85	9.0	12	2.25	86	64	22	20,000		64 SF <400/0> 22 MF <276/124> 20 Commercial ft² <83/37>	0.033	0.003
[illegible]	Res./MU	Mixed Use	10.7	3.21	15.0	30		161	0	161			161 MF <276/124>	0.044	0.020
[illegible]	Res./MU	Mixed Use	7.2	2.16	16.0	30		116	0	116			116 MF <276/124>	0.032	0.014
[illegible]	Res./MU	MF, Senior	7.4	2.22	16.0	30		119	0	119			119 MF <276/124>	0.033	0.015
[illegible]	Res./MU	Multi Family	10.9	3.27	16.0	30		175	0	175	25,000		175 MF <276/124> 25 Commercial ft² <83/37>	0.050	0.023
TOTAL PHASE 2 UNITS			239.3					1950	829	1121	87,500	42,500		0.737	0.189

Projected Water Demand Calculations

Parcel I.D.	Land Use	Land Use Description	Parcel Size (Acres)	Landscaped Areas Defined (Acres)	Density of Parcel (D.U./Acre)	Maximum Density (D.U./Acre)	Landscape Density (D.U./Acre)	# of Units	*SF Units*	*MF Units*	Retail Space	Office Space	Water Usage: Split (Units) <Potable / Non-Potable> (Rate)	Potable (MGD)	Non-Potable (MGD)
PHASE 3															
INDUSTRIAL	Industrial	Light Industrial	25.0	5.00									<2000/2000> / acre	0.050	0.010
T3-1	SF	Large Lot Single Family	5.7	2.20	3.0	6		17	*17*	*0*			17 SF <400/0>	0.007	-
T3-2	SF	Large Lot Single Family	2.2	0.72	3.0	6		6	*6*	*0*			6 SF <400/0>	0.002	-
T3-3	SF	Large Lot Single Family	1.7	0.58	3.0	6		5	*5*	*0*			5 SF <400/0>	0.002	-
T3-4	SF	Large Lot Single Family	25.6	10.04	3.0	6		76	*76*	*0*			76 SF <400/0>	0.030	-
T3-5	SF	Single Family	21.9	8.92	5.0	6		112	*112*	*0*			112 SF <400/0>	0.045	-
T3-6	SF	Single Family	13.5	5.64	5.0	6		71	*71*	*0*			71 SF <400/0>	0.028	-
T3-7	SF	Single Family	23.2	9.36	5.0	6		117	*117*	*0*			117 SF <400/0>	0.047	-
T3-8	SF	Single Family	11.5	5.04	5.0	6		63	*63*	*0*			63 SF <400/0>	0.025	-
T4-6	Res./MU	Mixed SF and MF	11.8	1.18	10.0	12	3	118	*83*	*35*	15,000		83 SF <400/0> 35 MF <276/124> 15 Commercial ft^2 <83/37>	0.044	0.005
P-1	Park		11.2	8.40				0					<600/3400> / acre	0.007	0.029
SCHOOL	School		12.0	6.00				0					<2400/1600> / acre	0.029	0.010
T4-7	Res./MU	Mixed SF and MF	9.1	0.91	10.0	12	4	91	*54*	*37*			54 SF <400/0> 37 MF <276/124>	0.032	0.005
T3-9	SF	Single Family	38.3	3.85	5.0	6		193	*193*	*0*			193 SF <400/0>	0.077	-
T4-8	Res./MU	Mixed Use, MF, Affordable	20.3	2.03	11.0	12	4.4	224	*134*	*90*			134 SF <400/0> 90 MF <276/124>	0.078	0.011
T4-9	Res./MU	Live-Work & Affordable	18.6	1.86	11.0	12	4.4	205	*123*	*82*	15,000	10,000	123 SF <400/0> 82 MF <276/124> 25 Commercial ft^2 <83/37>	0.074	0.011
FIRE STATION	Fire	Fire Station	5.5	0.55									<1800/1200> / acre	0.010	0.001
DESAL PLANT	Desa Facility	Desalinization Plant	1.7	0.17									Arbitrary	0.002	
TOTAL PHASE 3 UNITS			233.8					1298	1054	244	30,000	10,000		0.590	0.081
DRY FOREST	OS	Dryland Forest	150.0												
OPEN SPACE	OS	Open Space	72.2												
ROADWAYS	Roads	Roadways & Buffers	107.7												
TOTAL ALL 3 PHASES			1109.8					5000	2354	2646	335,000	265,000			
COMMERCIAL COMPONENT TOTAL											600,000				

Project Total (Average Demand MGD)	2.182	0.574
Max Day Demand (MGD) (Average Demand x 1.5)	3.273	
Peak Hour Demand (MGD) (Average Demand x 5)	10.911	

APPENDIX B

- Meeting Notes (Department of Water Supply)
  Date: July 20, 2007

WILSON
OKAMOTO
CORPORATION

ENGINEERS
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1907 S. BERETANIA STREET
HONOLULU, HAWAII 96826
PH: (808) 946-2277
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7469-04
July 20, 2007

MEETING INFORMATION MEMO

SUBJECT:	Kaloko Makai Infrastructure
PERSONS PRESENT:	Dora Beck Denis Shiu Brian Lock
MEETING DATE:	July 20, 2007
MEETING LOCATION:	County of Hawaii Department of Environment Management Wastewater Division, Hilo, Hawaii

INFORMATION ITEMS:

1. Presented the Kaloko Makai, Draft Conceptual Land Use Plan, Dated June 22, 2007. Discussed the TSA/Stanford Carr Development partnership and mentioned that full project is anticipated to continue for approximately 20-30 years.
2. Discussed the status of the North Kona Improvement District (NKID). The study has been put on hold and will remain at draft status. DEM is pursuing Improvement District (ID) funding to finalize the study and construct the project. DEM is also looking into the possibility of incorporating NKID with the North Kona Community Development Plan (CDP) and utilizing Community Facilities District (CFD) funding. Both ID and CFD support a government-private owner cost sharing model, however, CFD also considers project phasing and the immediate benefit to adjacent properties at each phase. To date, DEM has not been able to appropriate funds to construct NKID.
3. DEM currently has only one construction project for North Kona. DEM is proposing work as part of the Department of Transportation, Highways Division's (DOT) Queen Kaahumanu Highway Widening Project, Phase II. The proposed scope of work includes installing a gravity sewer line along Queen Kaahumanu Highway from the future sewer pump station to Hina Lani Street. The project also proposes to install ER-1 piping from the vicinity of the sewer pump station to the vicinity of the Kohanaiki Development. The Queen Kaahumanu Highway Widening Project, Phase II is scheduled to be bid in August 2007 and awarded in November 2007. Both the sewer line and the ER-1 line will be 'dry' lines. Prior to the sewer and ER-1 lines becoming active, DEM needs to construct two more projects. One project, scheduled for construction in FY09-10, will connect

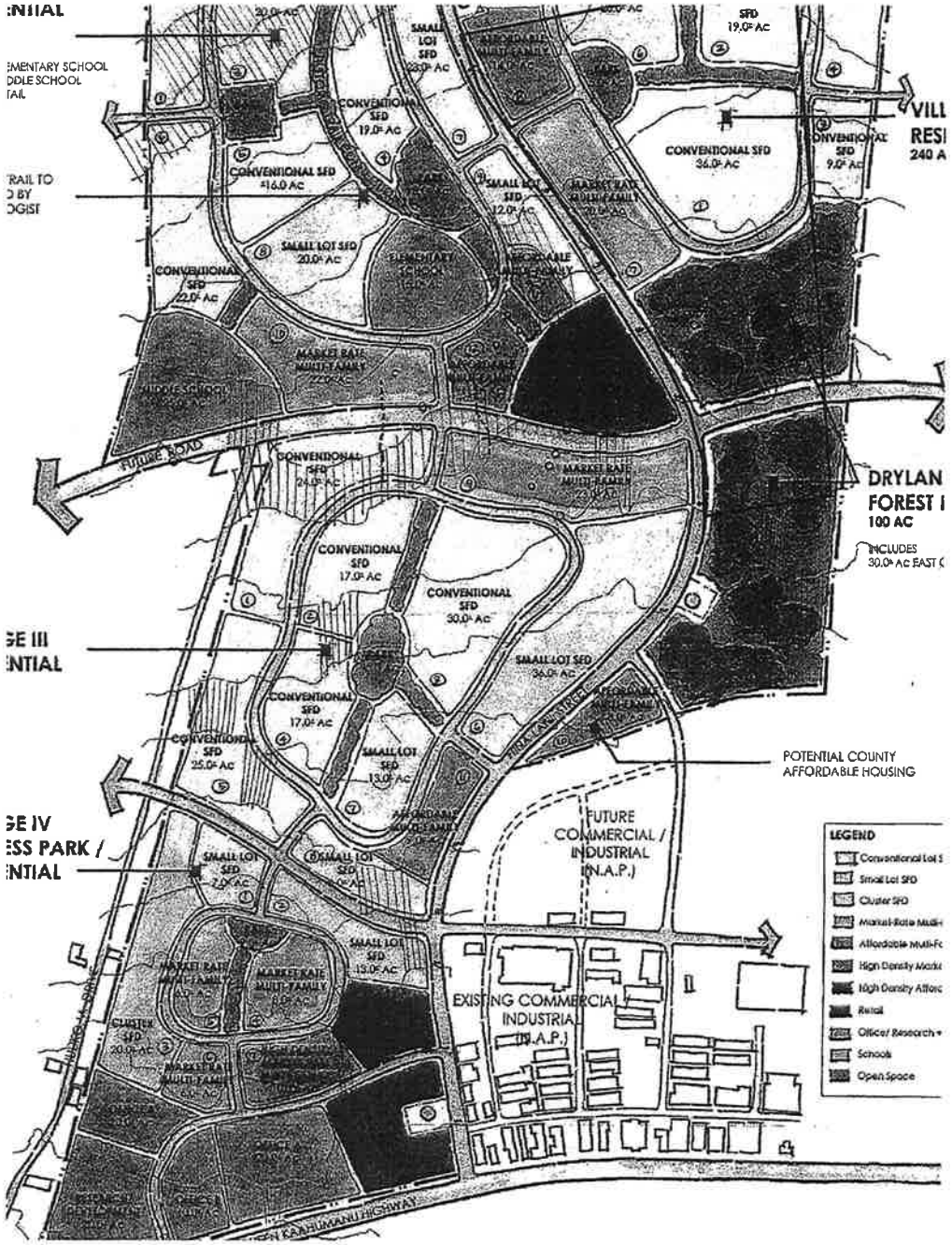
the sewer and ER-1 from the highway to the Kealakehe Wastewater Treatment Plant (KWWTP). The second project, scheduled for FY10-FY11 will expand the KWWTP to produce ER-1 Water. DEM has funds to construct their portion (non-par) of the highway widening project. DEM is pursuing additional funds as needed for the highway project. Funding for the future phases has not been identified.

4. DEM also mentioned that the County is committed to developing decentralized treatment. DEM has identified an area that includes the entire Kaloko Makai property as an 'ideal' area for possible development of decentralized treatment. Funding for decentralized treatment has not been identified.
5. DEM would like to be advised of project phasing and number of units as the information becomes available.

Brian A. Lock

cc: DS, AS, TF

Enclosure: Kaloko Makai: Conceptual Land Use Plan, 06-22-2007



APPENDIX C

- Kaloko Makai Development – Conceptual Wastewater Management System, Brown and Caldwell

1955 Main Street, Suite 200
Wailuku, HI 96793
Tel: 808-244-7005
Fax: 808-244-9026
www.brownandcaldwell.com

July 25, 2011

Brown AND Caldwell

Mr. Peter Phillips
Stanford Carr Development
1100 Alakea Street, Suite 2700
Honolulu, HI 96813

1055/137060

Subject: Kaloko Makai Development – Conceptual Wastewater Management System

Dear Mr. Phillips,

Stanford Carr Development is proposing to develop the 1040 acre Kaloko Makai project (project) north of Kailua-Kona on the Big Island. The land uses will include residential, retail, commercial, office, light industrial, a hospital, schools, parks, and open space. The project is located outside of the service area for the County of Hawaii's Kealakehe Wastewater Treatment Plant; therefore a wastewater management system must be developed. We have developed a wastewater management system concept for the development, based on information forwarded by Wilson Okamoto Corporation.

Estimated Wastewater Flow

The State of Hawaii Department of Health (DOH) requires that wastewater systems be designed based on county flow standards, and if applicable county standards are not established the City and County of Honolulu standards are to be used. The County of Hawaii (County) has not yet established wastewater flow standards. Based on City and County of Honolulu flow standards, the average dry weather flow from the development at buildout is 2.37 million gallons per day (mgd).

Wastewater Management System Concept

Figure 1 is a schematic diagram of the conceptual wastewater management system. Wastewater from the development would be delivered to a wastewater treatment plant (WWTP) that will be located within the project boundaries. The WWTP will be designed to produce R-1 recycled water suitable for irrigation reuse within the project boundaries. The WWTP will also be designed to reduce nitrogen and phosphorus concentrations in the treated effluent to address concerns over nutrient impacts to the adjacent Kaloko-Honokohau National Historical Park and the near shore reef environment. The treated effluent will be pumped to an R-1 storage tank and will be used to irrigate parks, school fields, streetscape, and other allowed used for R-1 recycled water. Supplemental groundwater will be added to the R-1 storage tank as needed to ensure that the irrigation demands of the users can be met at all times. Excess recycled water will be disposed via infiltration basins.

Each element of the wastewater management system is described in more detail below.

Wastewater Treatment System

The WWTP will be designed to achieve two simultaneous goals:

1. Produce R-1 recycled water in accordance with DOH regulations;
2. Reduce nutrient concentrations in the effluent to address potential impacts to the adjacent National Historical Park and near shore reef environments.

The first treatment goal is readily achievable via conventional secondary treatment, followed by coagulant addition, filtration, and disinfection with ultraviolet light. The second goal requires an advanced wastewater treatment process. The nearby Ooma project successfully negotiated with the National Park Service (NPS) to reach an agreement for effluent limits of 5 milligrams per liter (mg/L) of total nitrogen (TN) and 2 mg/L of total phosphorus (TP). The description that follows assumes that the NPS agrees that similar nutrient removal objectives are appropriate for the Kaloko Makai project.

Figure 2 is a schematic diagram of the wastewater treatment concept. The wastewater treatment plant would include the following processes:

Influent Pump Station: A pump station will be required to lift raw wastewater from the sewer system to the treatment processes.

Headworks: The headworks would include screening systems to remove debris and grit removal to remove inorganic particles (e.g., sand) from the waste stream. Grit and screenings will be disposed at the West Hawaii Landfill.

Biological Treatment: Organic matter and nutrients will be removed using an activated sludge process. The process will incorporate biological nutrient removal (BNR). BNR incorporates aerobic, anaerobic and anoxic zones within the treatment process and recycle flows to facilitate biological reduction of TN and TP to 10 mg/L and 2 mg/L, respectively. Clarifiers will be used to separate the activated sludge from the secondary effluent.

Coagulant Addition/Flocculation: Coagulants (such as aluminum sulfate and/or polymer) will be added to the secondary effluent downstream of the secondary clarifiers and mixed to combine small particles into larger "flocs" that can be removed in the filtration process.

Filtration: The filtration process will provide two treatment benefits: turbidity reduction to meet R-1 water recycling requirements, and additional nitrogen removal. Denitrification filters are available that are accepted by the California Department of Public Health (CDPH) for Title-22 recycled water production and are also capable of reducing TN concentrations to 5 mg/L via denitrification. The DOH allows the use of filtration processes that are accepted by CDPH for R-1 recycled water production. Addition of a carbon source (typically methanol) is required upstream of the filters to facilitate the denitrification process. The DOH

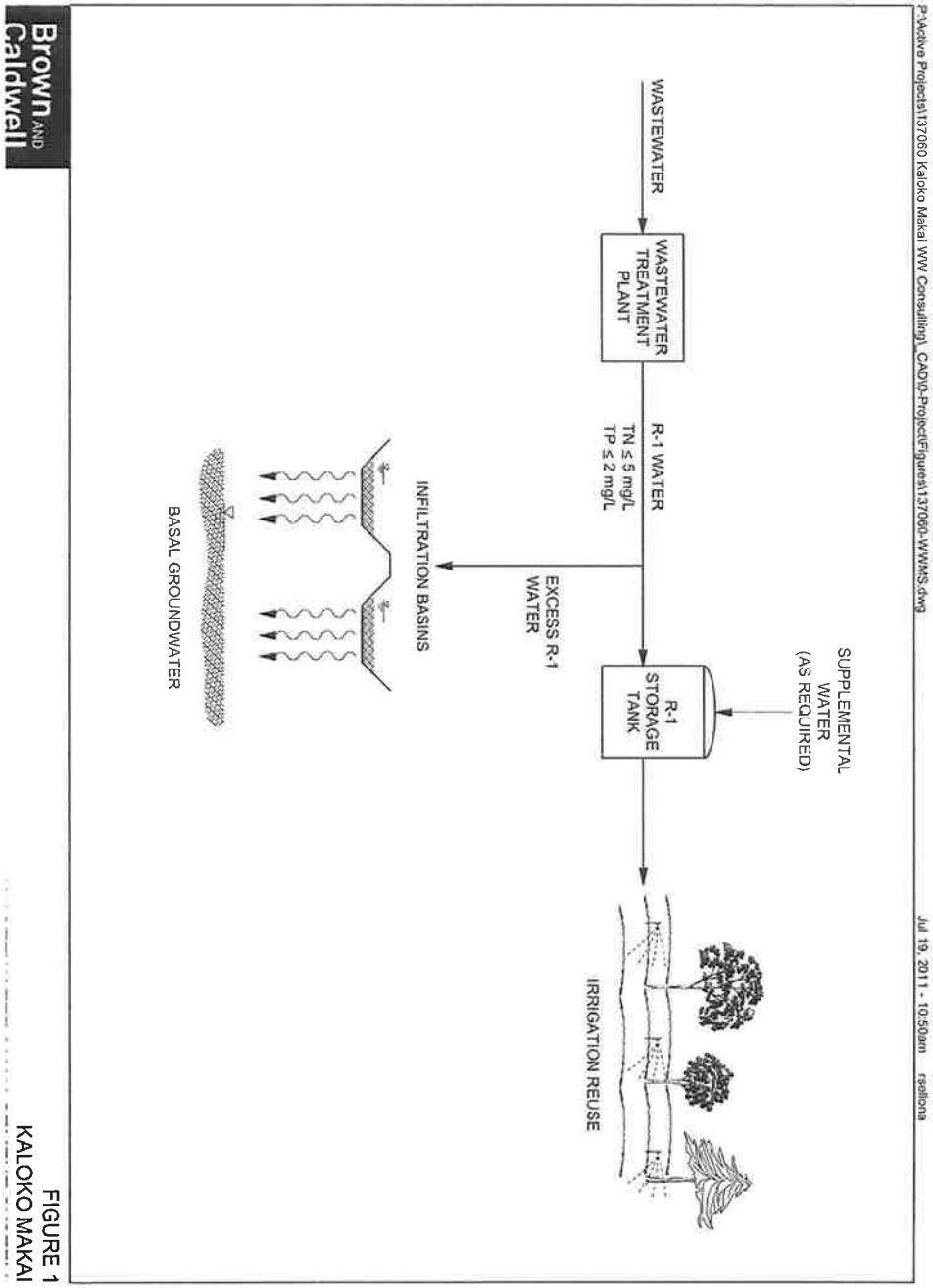


FIGURE 1
KALOKO MAKAI

requires that R-1 recycled water have effluent turbidity of less than 2.0 Nephelometric turbidity units (NTU) at all times.

Disinfection: The effluent will be disinfected with ultraviolent light (UV) to meet R-1 recycled water requirements. The DOH requires that R-1 recycled water have a median density of fecal coliform that does not exceed 2.2 per 100 mL.

Effluent Pump Station: An effluent pump station will deliver recycled water to the R-1 storage tank for reuse, or to the infiltration basins for disposal.

Aerobic Digester: Waste solids (sludge) from the biological treatment and filtration systems will be pumped to an aerobic digester system for stabilization and thickening via periodic decanting.

Mechanical Dewatering: Aerobically digested sludge will be mechanically dewatered prior being hauled offsite for disposal at the West Hawaii Landfill.

Water Recycling System

Potential acceptable uses for R-1 recycled water in the Project are listed in Table 1. Note that irrigation of single family residential parcels is not allowed by DOH.

Table 1. Potential R-1 Recycled Water Uses at Kaloko Makai

Landscape irrigation	Industrial	Other
• Parks • School yards • Athletic fields • Road sides and medians • Commercial property (if managed by an irrigation supervisor) • Multi-family residential property (if managed by an irrigation supervisor)	• Commercial and public laundries • Industrial cooling • Industrial process water	• Toilet and urinal flushing in buildings with dual water systems • Decorative fountains • Street sweeping • Dust control

The DOH has restrictive requirements for R-1 irrigation on property located above of the Underground Injection Control (UIC) line (e.g., groundwater or vadose zone monitoring, no excess irrigation to flush salts below the root zone allowed), and therefore we recommend that R-1 reuse be limited to properties located below the UIC line. It appears that most of the development is located below the UIC line; however park P-1 and the upper elementary school may be located above the UIC line and should be irrigated with other water sources.

Based on other Kona-area evaluations, an average R-1 recycled water flow rate of 2.37 mgd has the potential to provide irrigation water for up to approximately 273 acres without routine supplemental water addition. The Kaloko Makai development concept includes 50 acres of parks and 30 acres of schools located below the UIC line that will likely be the largest users of recycled water. Only a portion of the park and school acreage will be irrigated; our preliminary estimate is that approximately 60 acres of the total park and school acreage will ultimately be irrigated. Additional recycled water users (e.g., streetscape, multi-family residential, etc.) can be added to the system if they are located near the distribution lines that carry the water to the largest users.

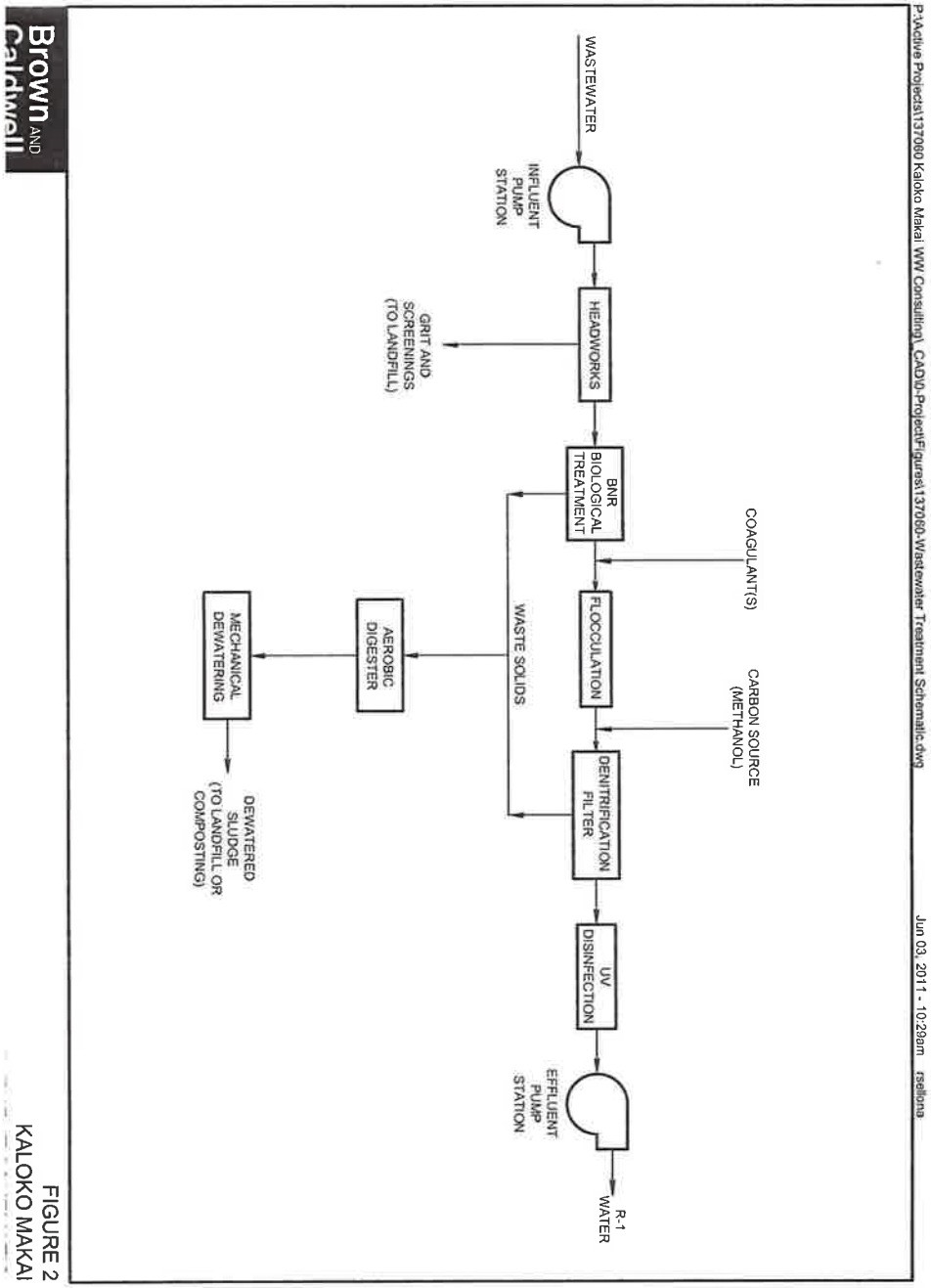


FIGURE 2
KALOKO MAKAI

The required R-1 storage tank size will be based on the peak day demand of the re-cycled water uses.

Supplemental Water

There may be times when R-1 supplies are not sufficient to meet the irrigation demands of the parcels that are connected to the R-1 distribution system. For example, in the first development phase there will likely be not enough R-1 water to irrigate the parks and schools that are slated for construction. Therefore, addition of supplemental water (potable or non-potable) to the R-1 storage tank will be required to ensure the irrigation demands can be met.

Disposal System

There will be times when there is more R-1 water available than the irrigation users require; for example, during periods of extended wet weather. The DOH requires that a disposal system be provided for when recycled water supply exceeds the demand. The United States Department of Agriculture Natural Resources Conservation Service Soil Survey indicates that Aa lava is present at the proposed wastewater treatment plant location. Aa lava is typically extremely porous, and significant volumes of water can be disposed in a relatively small area via percolation basins. Percolation basins are currently used at the Kealakehe Wastewater Treatment Plant and at the Waikoloa Resort Wastewater Treatment Plant for disposal purposes.

Please call me at (808) 442-3301 if you have any questions.

Very truly yours,

Brown and Caldwell

Craig C. Lekven, PE (Hawaii License No. 13003, Expires 4/30/12)
Supervising Engineer

CCL:ic

cc: Mr. Earl Matsukawa, Wilson Okamoto Corporation

APPENDIX D

- An Assessment of the Potential Impact of the Proposed Kaloko Makai Project on Water Resources, Tom Nance

An Assessment of the Potential Impact of the Proposed Kaloko Makai Project on Water Resources

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December 2012

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INTRODUCTION

This report provides an assessment of the potential impact of the proposed Kaloko Makai project on water resources. It has been prepared to support the project's Supplemental EIS being prepared by others.

DESCRIPTION OF THE PROJECT

Project Site and Proposed Development

Location of the 1113-acre project site is shown on Figure 1. The site is on both sides of Hina Lani Drive and extends from Queen Kaahumanu Highway on its makai end to about 760-foot elevation at its highest point. The project is to be developed in three phases and would be comprised of a mix of residential, commercial, industrial, and public uses, the latter including a 150-acre dry land forest (Figure 2).

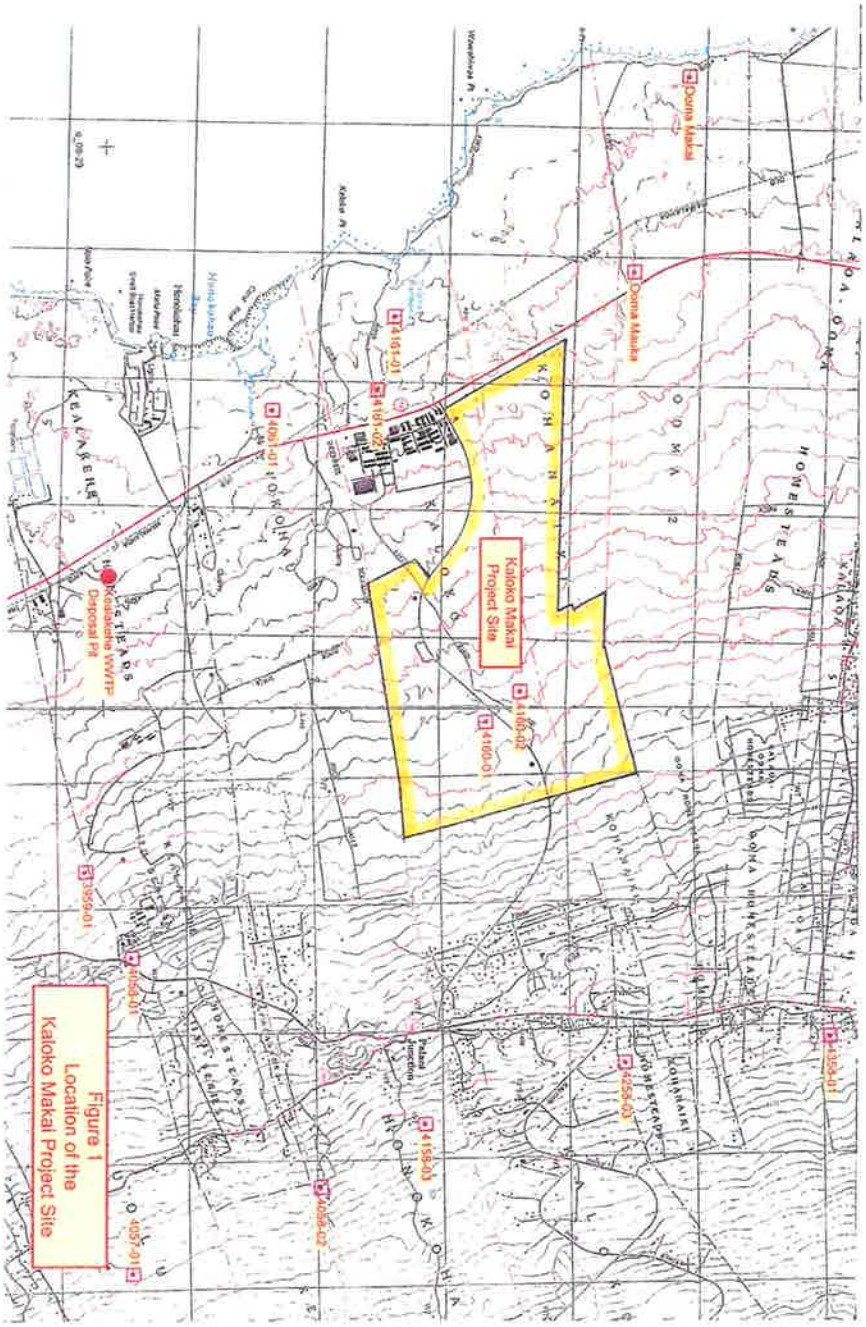
Projected Water Supply Requirements

Separate potable and non-potable systems are proposed to supply the project's water requirements. Projected supply requirements have been prepared by Wilson Okamoto Corporation (2012) and are summarized on Table 1. At full build out, projected average potable use would be 2.18 MGD. The average non-potable use would be 0.58 MGD.

Alternative Sources of Supply for the Potable System

The potable system's well pumping capacity must provide the maximum day use (defined as 1.5 times the average use) in a 24-hour pumping day. If the wells are dedicated to and incorporated into the County Department of Water Supply (DWS) system, one-third of the well capacity would be allocated to DWS and two-thirds would be allocated to the developer. Four alternative sources for potable supply are being considered: onsite wells at about 710-foot elevation at the upper end of the project; 710-foot onsite wells with desalinization; wells several miles to the south tapping the high level groundwater body; and desalinization using onsite saline groundwater as the feedwater supply. These are described in the paragraphs following.

Onsite Wells at 750-Foot Elevation Within the Project Site. The possibility of developing potable quality wells onsite at 710-foot elevation is suggested by the discoveries of two deep monitor wells (State Nos. 3858-01 and 3959-01), both of which encountered fresh groundwater under artesian pressure at depth below saline groundwater and far below and hydrologically disconnected from the basal lens. The phenomenon is discussed in detail later in this report. A deep exploratory borehole at 710-foot elevation at the upper end of the project site will be undertaken to determine if fresh groundwater can be found at depth and to determine the feasibility of its development. If successful, three production wells would be developed, each of 1150 GPM capacity and driven by 300 horsepower motors. These wells would be integrated into the DWS system, with two-thirds of their capacity allocated to supply the Kaloko Makai project.



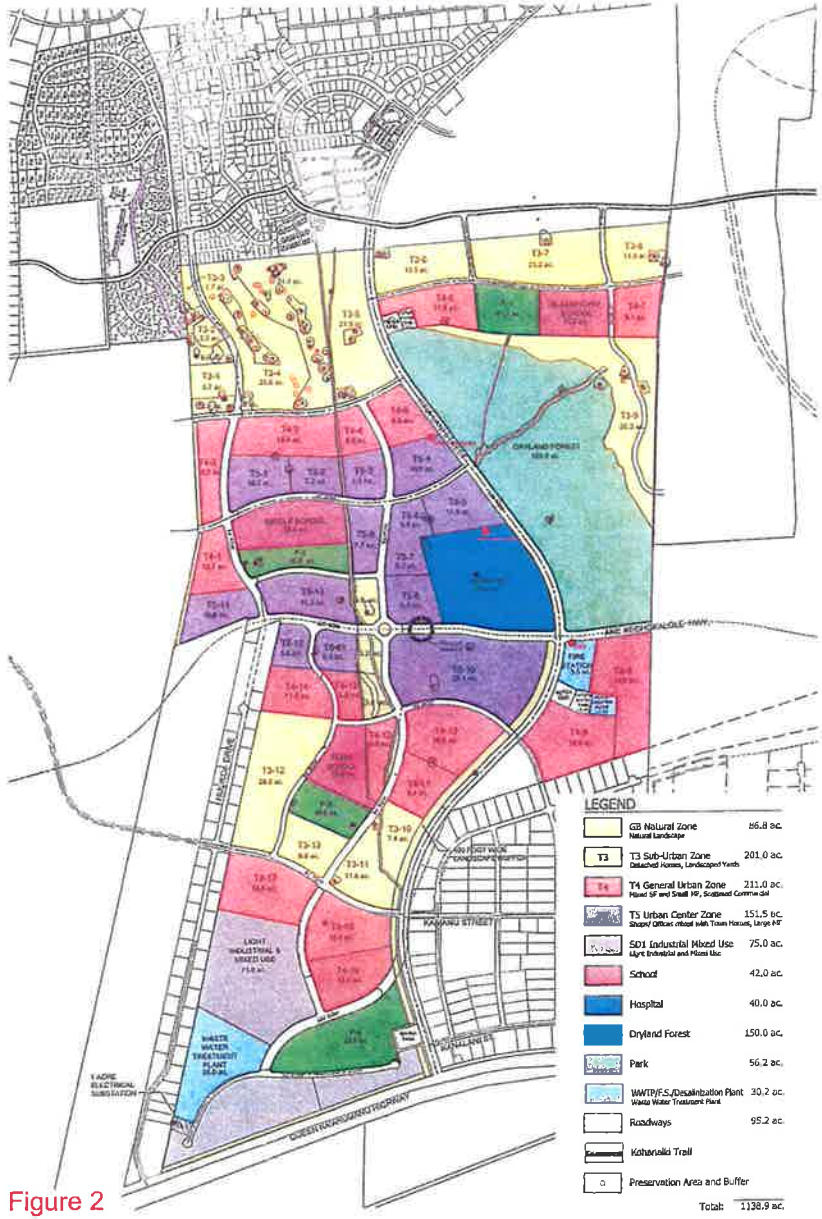


Figure 2

LAND USE PLAN

KALOKO MAKAI - VILLAGE PLAN

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JUNE 2012

KAILUA-KONA, HAWAII

SCD - TSA KALOKO MAKAI, LLC

Table 1

Modification of the Water Supply Projections With
Multi-Family Parcels Irrigated by the Non-Potable System

Development Phase	Projected Supply Requirements		Wastewater Generator for Potential Reuse (MGD)	
	Potable (MGD)	Non-Potable (MGD)	Design Amounts by Wilson Okamoto	Expected Actual Generation by TNWRE
1	0.8558	0.3044	0.8183	0.5273
2	0.7382	0.1938	0.7635	0.5288
3	0.5897	0.0856	0.6003	0.4173
Total	2.1837	0.5838	2.1821	1.4734

Note: 400 GPD/Unit water use for multi-family parcels distributed 276 GPD for potable and 124 GPD for non-potable based on Honolulu BWS Guidelines.

710-Foot Onsite Wells With Reverse Osmosis (RO) Treatment. In the event that artesian groundwater is found below saline groundwater but its salinity at projected draft rates would not meet drinking water standards, the alternative of RO treatment of this water would be considered. This treatment process would produce a wastewater stream, referred to as a concentrate, that would be disposed of injection wells located at the project's wastewater treatment plant (WWTP) at the makai end of the project site. Due to the operating costs of the RO treatment, DWS may not accept the wells and RO treatment plant for dedication. In that case, the capacity of the wells, as feedwater sources for RO treatment, would be sized to provide the project's maximum day use in a 24-hour pumping day assuming 65 percent product recovery in the RO process. As a private system, provision of standby well pumping capacity would be required. These criteria translate to four 1170 GPM well pumps, one as standby. At full build out, the disposal of concentrate would be 1.15 MGD as a year-round average.

Wells to the South of the Project Site. In the event that neither of the two onsite well alternatives described above are feasible, development of potable wells several miles to the south, would be pursued. The exact locations of these wells will depend on land acquisition costs and the costs of additions to DWS' infrastructure required to transmit this well supply north to the project site. In general, however, there are two distinctly different possibilities, wells above Mamalahoa Highway tapping the high level groundwater directly or wells in the near vicinity of the State's deep monitor well tapping the high level groundwater at depth below saline groundwater. In either case, these wells would be incorporated into DWS' system. Depending on their location, three 1120 GPM or four 840 GPM wells would be required. Improvements to DWS' transmission/distribution system would also be required for this alternative.

Desalinization of Onsite Saline Groundwater. In the event that none of the three alternatives described above are feasible, desalinization of onsite saline groundwater would be undertaken. The raw water supply wells and desalinization plant would be located next to or below DWS' existing 363-foot tank along Hina Lani Drive. The raw water supply wells would draw saline groundwater from beneath the basal lens. Tentatively, the depth from which this supply would be withdrawn would be between 250 and 350 feet below sea level, requiring total well depths on the order of 710 feet. The expectable product recovery from this saline feedwater supply is 40 percent, meaning that 2.5 gallons of saline groundwater would be required for every gallon of fresh product water produced. As a private system with redundant capacity, this would translate to four 750 GPM treatment trains with each treatment train supplied by a 1900 GPM raw water supply well.

To reduce the RO power requirements, pressure transfer devices would be installed to recover energy from the RO's concentrate stream. The concentrate itself would be hypersaline [salinity on the order of 50 parts per thousand (PPT) compared to seawater at 35 PPT]. Its disposal, amounting to 4.9 MGD at full build out, would be in three deep wells located at the project's WWTP.

Wastewater Generation, Treatment, and Reuse or Disposal

A 20-acre site for the project's WWTP would be located at the makai end of the project site (refer to Figure 2). The WWTP would produce R-1 quality effluent which would be the source of supply for the project's non-potable system. The last two columns of Table 1 list wastewater generation amounts, both as design amounts compiled by Wilson Okamoto Corporation and as expectable average amounts

compiled for this report. The expected wastewater amount substantially exceeds potential irrigation reuse in the project's non-potable system. The excess would be disposed of in injection wells at the WWTP if other uses for this water can not be found.

Rainfall-Runoff Generation and Disposal

According to the 2011 Rainfall Atlas of Hawaii (Giambelluca and Others, 2011), average annual rainfall across the project site varies from 15 to 25 inches a year. The land surface of the project site consists of unweathered and very permeable lavas with sparse deposits of ash soils and no defined drainageways. Essentially no rainfall runoff leaves the site in its present condition, even during intense storm events. It is either lost to evaporation or percolates to the underlying groundwater.

Development of the project will create impervious surfaces which will locally create surface runoff. All of this runoff would be directed into seepage pits and drywells such that no runoff will leave the site after it is developed.

DESCRIPTION OF THE HYDROGEOLOGIC ENVIRONMENT IN THE VICINITY OF THE KALOKO MAKAI PROJECT SITE

General Overview

The Kaloko Makai project site and the land upslope from it are comprised of unweathered lava flows with little or no soil cover and extraordinarily high permeability. Except where the natural ground has been converted to impervious surfaces by development, continuous flow of surface runoff during storm rainfalls does not occur. The rainfall percolates downward rather than flowing over the ground surface for any significant distance downslope. Because of this, the description of the hydrogeologic environment within and around the Kaloko Makai project site focuses exclusively on groundwater. Surface water resources are non-existent.

Groundwater in North Kona area occurs into two different modes. Along the coastline and for several miles inland, groundwater occurs as a brackish basal lens floating on saline groundwater beneath it and in hydraulic contact with seawater at the coastline. High level groundwater, the other mode of groundwater occurrence in North Kona, was first discovered in 1990 with a well drilled in Keauhou at 1620-foot elevation above Mamalahoa Highway. Since then, more than 20 high level wells have been developed from Kalaoa on the north and Kealakekua to the south. With only a few exceptions, all of these wells have been located above Mamalahoa Highway. Nine of the wells are currently in use, eight of which are owned and operated by the Hawaii County Department of Water Supply (DWS). DWS is about to put one more high level well (State No. 4158-03) into production in the near future.

Basal Groundwater Occurrence

Basal Water Levels. In the Keahole to Kailua area of north Kona which includes the Kaloko Makai site, basal groundwater levels near the shoreline are about one foot above sea level and slowly increase moving inland to between two and three feet above sea level at the mauka end of the project site. These water levels move up and down in response to the semi-diurnal tide with the tidal response

increasingly lagged and damped with distance inland. At the three monitor wells in the Kaloko Honokohau National Park (KAHO), which are 1500 to 3500 feet in from the shoreline, the tidal variation is about 50 percent of the ocean's tidal amplitude and is lagged by less than one hour. Further inland and within the Kaloko Makai project site at Well 4160-02, the tidal amplitude is about 15 percent and the lag is a little more than three hours (TNWRE 2002, page 10).

Figure 3 is a salinity and temperature profile through the water column of onsite Well 4160-02. It illustrates two relatively anomalous characteristics of the underlying basal groundwater, given the areal extent of the potentially contributing upland watershed. First, the 65.8° F. temperature in this top portion of the basal lens is four to six degrees colder than in upgradient wells which tap the high level groundwater. Second, the salinity is substantially higher than would otherwise be expected. These two characteristics are found in all basal wells from Keahole Point to at least as far south as the old Kona Airport. The subsurface geology which appears to be responsible for this occurrence is discussed in detail in subsequent sections.

Flowrate Through the Basal Aquifer. The most recent, sophisticated, and therefore most reliable computations of groundwater recharge for Hawaii Island are presented in Engott, 2011. The area within and around the Kaloko Makai project site is a part of the 167-square mile area delineated by the State Commission on Water Resource Management (CWRM) as the Keauhou Aquifer System. Its computed recharge in Engott, 2011 is 152 MGD. Reducing this by 14 MGD, the current groundwater pumpage from the aquifer system, leaves an average groundwater flowrate of about nine MGD per coastal mile across the aquifer's shoreline width. If all the rainfall-recharge into the high level aquifer were to discharge into the downgradient basal lens, this flowrate would create a robust basal groundwater body which could be developed for irrigation use and possibly even for potable supply.

This is decidedly not the case for the basal groundwater in the area from the Old Kona Airport to Keahole Point. Indications are that the actual basal flowrate is less than one-third of what might be expected if all of the discharge from the high level groundwater was into the inland margin of the basal lens. As noted above, the substantially lesser actual flowrate through the basal lens is reflected in water levels that are lower than otherwise expected, salinities which are too high for irrigation use, and anomalously cold temperatures.

Deep Monitor Well Results. Results of two deep monitor wells provide insight into the possible geologic feature creating the high level groundwater occurrence tapped by wells above Mamalahoa Highway and the resulting anomalous flowrate, salinity, and temperature in the basal lens. These two wells are the State's Keopu Monitor Well (No. 3858-01) and the Kamakana Monitor Well (No. 3959-01). Both were drilled through the basal lens, continued through the underlying saline groundwater, and then encountered fresh and confined groundwater at depth. Results of Well 3858-01 are described in Water Resources Associates, 2007. Since encountering fresh water at depth was unexpected at this location, the exact depth that it occurred in the borehole during drilling is not known and has not been determined with video logs and other measurements. During drilling of the Kamakana Monitor Well, salinity and temperature of the water in the borehole were closely monitored, enabling the different groundwater regimes penetrated by the borehole to be accurately documented. These are described below and illustrated on Figure 4.

Figure 3. Salinity and Temperature Profile through the Water Column of Well 4160-02 (September 14, 2012)

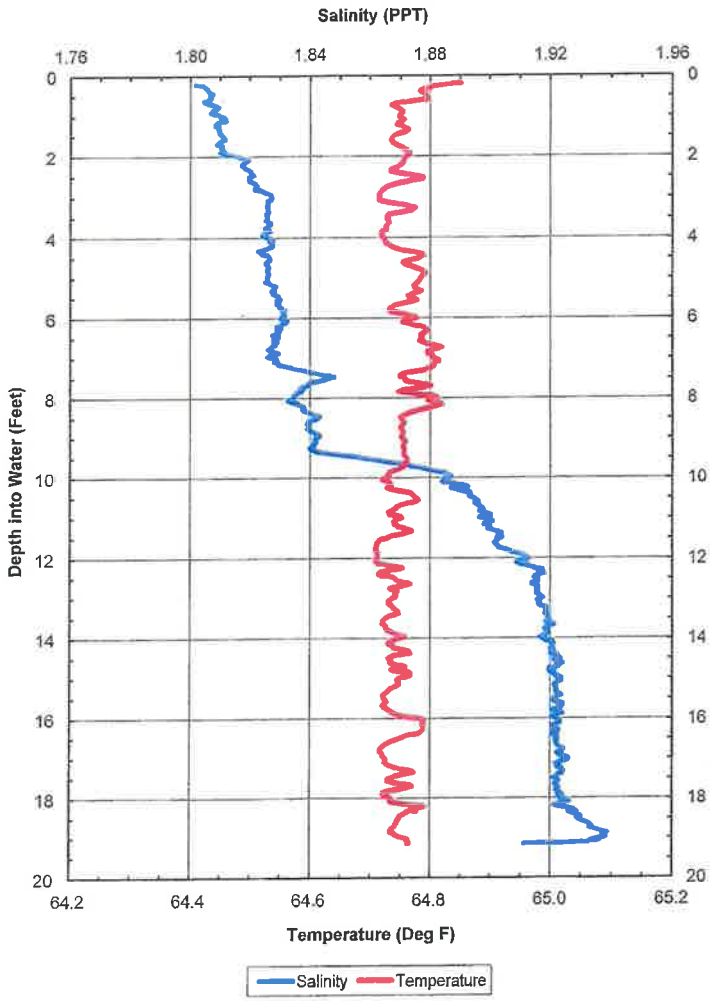
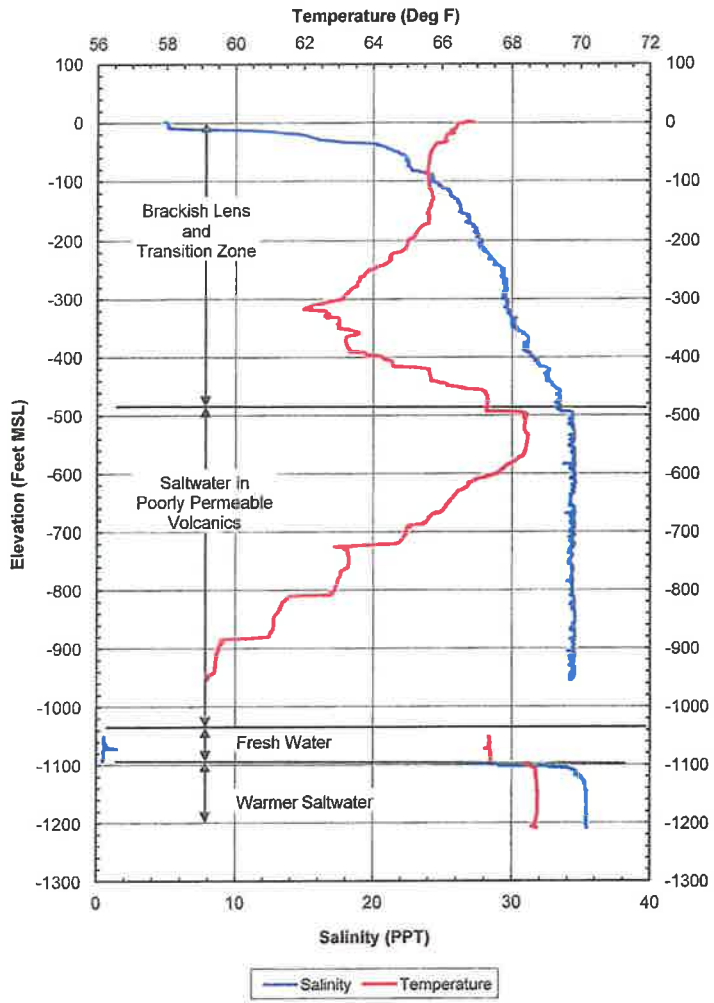


Figure 4. Composite Profile through the Water Column of the Kamakana Borehole (Profiles of 4/12/10, 5/12/10, and 8/18/10)



- Initially, a thin, relatively saline (5 PPT) and cool (66° F.) basal lens was encountered. The water level was typically about 2.5 feet (MSL) according to the available surveyed elevation. However, the mid-point of the transition zone of this basal lens is between 35 and 40 feet into water, suggesting that the actual water level relative to sea level may actually be less than two feet.

- Below the brackish basal lens is a thick transition zone which extends to a depth of 490 feet below sea level. In this transition zone, the water temperature steadily declines to 62° F. at 320 feet below sea level and then the temperature trend reverses, increasing to 67° F. at 490 feet below sea level.

- Below this thick transition zone, extending from 490 to more than 1020 feet below sea level, the salinity is essentially that of seawater and the temperature steadily declines with depth to about 59° F.

- At 1060 feet below sea level, fresh water was encountered. It was about eight degrees warmer than the saline groundwater immediately above it and had a piezometric head subsequently determined to be about 32 feet above sea level. The fresh water rushed up the borehole, mixing with the saltwater above for the first 150 feet, moving up the borehole for the next 720 feet with little or no mixing, and then mixing into the transition zone above that (Figure 5).

- The freshwater zone turned out to be less than 40 feet thick. At 1100 feet below sea level, warmer (70° F.) and slightly hypersaline (35.4 PPT) groundwater was encountered. Drilling was continued for another 120 feet with no salinity or temperature change.

Using inflatable packers to isolate the fresh water zone from the saline groundwater above and below it, short term air lift pumping was done to see if this narrow stratum containing fresh water could provide a developable supply. At low rates of pumping (120 GPM), however, the salinity of the pumped water became brackish and did not stabilize. Somewhat surprisingly, the freshwater zone had a substantial response to ocean tidal variations (Figures 6 and 7), significantly greater than the tidal response in the basal lens directly above. Comparative tidal lags and amplitudes for the respective periods of recording were as tabulated below.

Groundwater Zone	Tidal Lag (Hours)	Tidal Amplitude (% of Ocean Tide)
Fresh Water Zone	1.0	48
Brackish Basal Lens	3.0	25

Results of the two deep monitor wells provide insight on the relationship between high level and basal groundwater and the anomalies in the basal water body, at least in the near vicinity of these two monitor wells. These conclusions are:

Figure 5. Profile through the Water Column of the Kamakana Borehole After Fresh Water was Encountered (May 12, 2010)

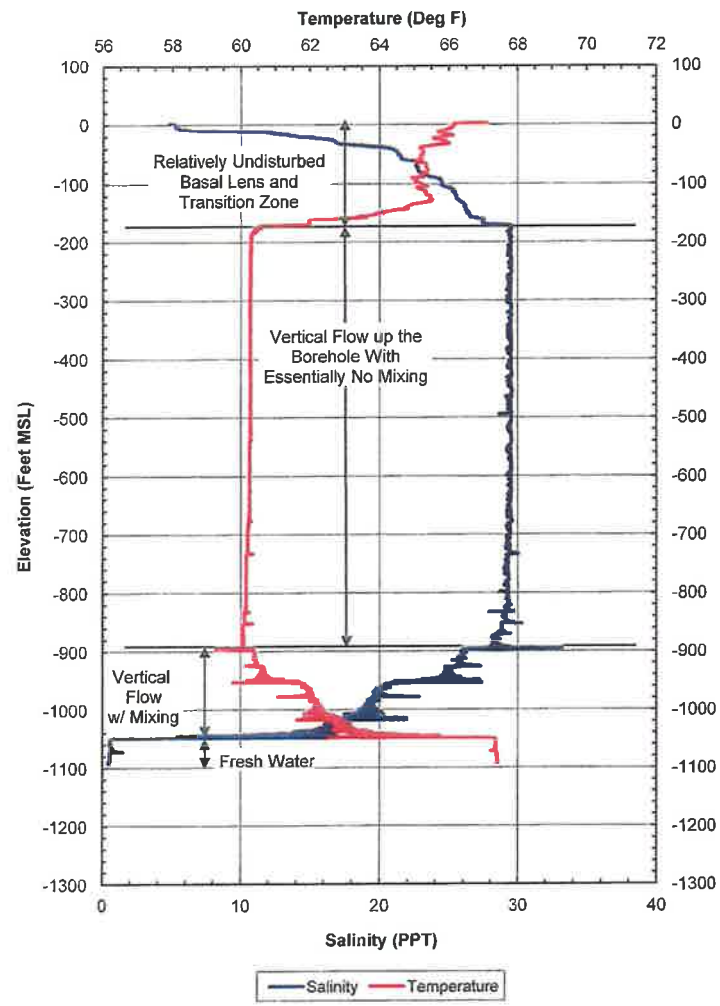


Figure 7. Tidal Variation in the Fresh Water Zone of the Kamakana Monitor Well in January 4 to 5, 2011

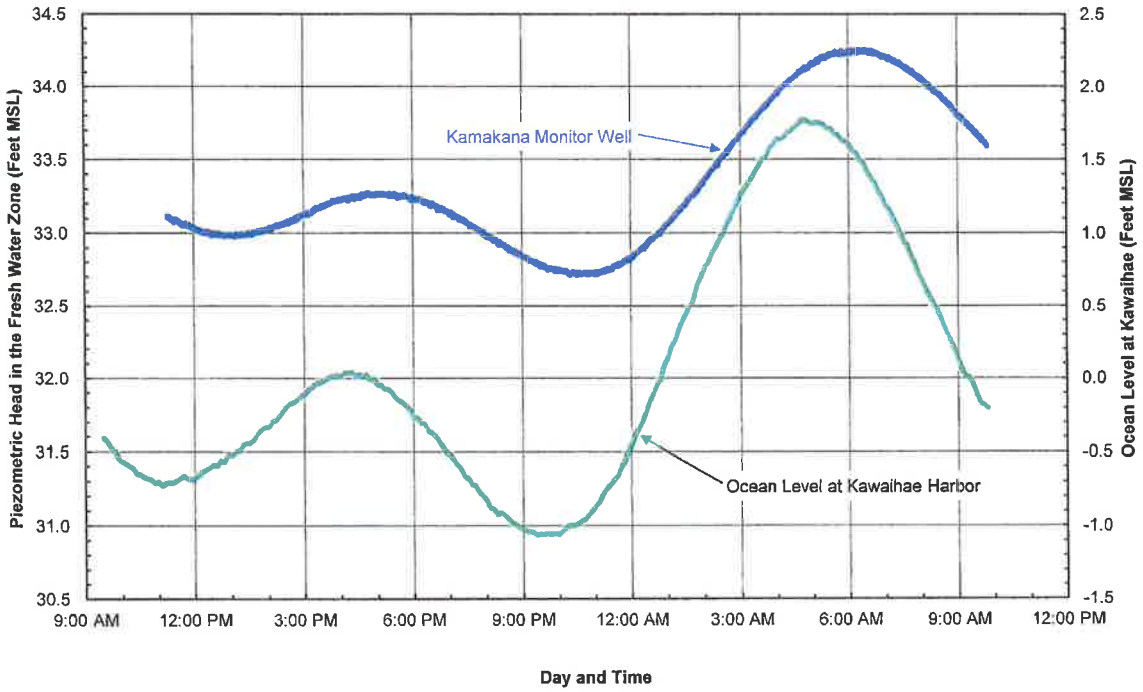
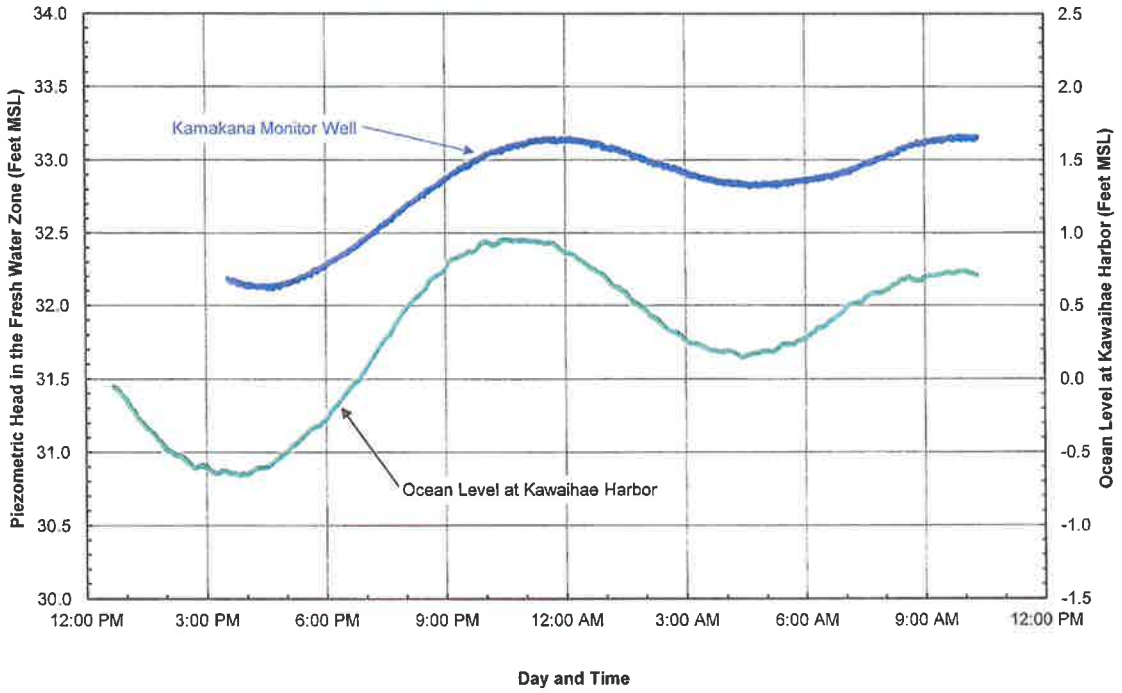


Figure 6. Tidal Variation in the Fresh Water Zone of the Kamakana Monitor Well in December 27 to 28, 2010



- The feature confining the fresh water at depth is a thick sequence of poorly permeable lava flows, in the aggregate hundreds of feet thick (the zone of vertical flow in the Kamakana borehole with essentially no mixing identified on Figure 5).

- That poorly permeable lava flows are the mechanism creating the high level groundwater in Kona is also supported by the results of two high level wells located above Mamalahoa Highway (Hualalai, State No. 4258-03 and Keopu, State No. 3957-05). During the construction and testing of both wells, water levels rose and yields were increased by drilling deeper.

- The confined fresh groundwater at depth, with an apparent hydraulic connection to seawater at depth offshore, suggests that at least some of the inland high level groundwater may discharge at depth offshore rather than flow into the basal lens at its inland margin.

- With limited amounts of warmer, high level groundwater flowing into the inland margin of the basal lens, the source of the colder temperatures in the basal lens is seawater at depth moving inland in a saltwater circulation pattern beneath the basal lens. Figure 8 compares the temperature profile through the water column of the Kamakana borehole with the ocean water directly offshore. Temperatures in the Kamakana borehole to a depth of 320 feet below sea level reflect the movement of saline groundwater below the basal lens which originated as seawater from more than 600-foot depth offshore. Deeper than 500 feet below sea level in the Kamakana borehole, the zone of poorly permeable lava with little groundwater movement on Figure 4, the temperature appear to be simply the result of cooling by the ocean water at similar depths offshore.

Groundwater Quality

Water quality analyses of samples from wells, anchialine ponds, and other locations within and near to the Kaloko Makai mauka-makai corridor are compiled in Table 2. Samples from high level groundwater wells, with very low salinity levels and nutrient concentrations reflecting only natural, rather than man-made input, are at the top of the table. Below that are samples from basal wells with significantly higher salinities and widely varying nutrient concentrations. Toward the bottom of the table are samples from the upper end of Honokohau Harbor and the discharge of the R-2 quality wastewater effluent from the Kealakehe Wastewater Treatment Plant (WWTP). The effluent discharge occurs into an excavated pit which is located on the mauka side of Queen Kaahumanu Highway and about 3700 feet nominally upgradient of Honokohau Harbor (its location is shown on Figure 1). Nutrient removal from the WWTP effluent as it moves to and discharges into upper end of Honokohau Harbor is quantified in section following.

Nutrient Removal by Natural Processes in the Groundwater Environment

The ongoing discharge of 1.3 to 1.7 MGD Kealakehe WWTP effluent into a pit which is nominally upgradient of Honokohau Harbor and the groundwater discharged into the back end of Honokohau Harbor provide an opportunity to quantify natural nutrient removal in the groundwater environment. The inland excavation of the harbor acts as a point sink for groundwater discharge, including the addition of the WWTP effluent into the groundwater. Travel from the pit disposal to the upper end of the harbor

Figure 8. Temperature Profile Comparison, Kamakana Borehole and the Ocean Offshore (Profiles of April 3, 2010 and December 9, 2011, Respectively)

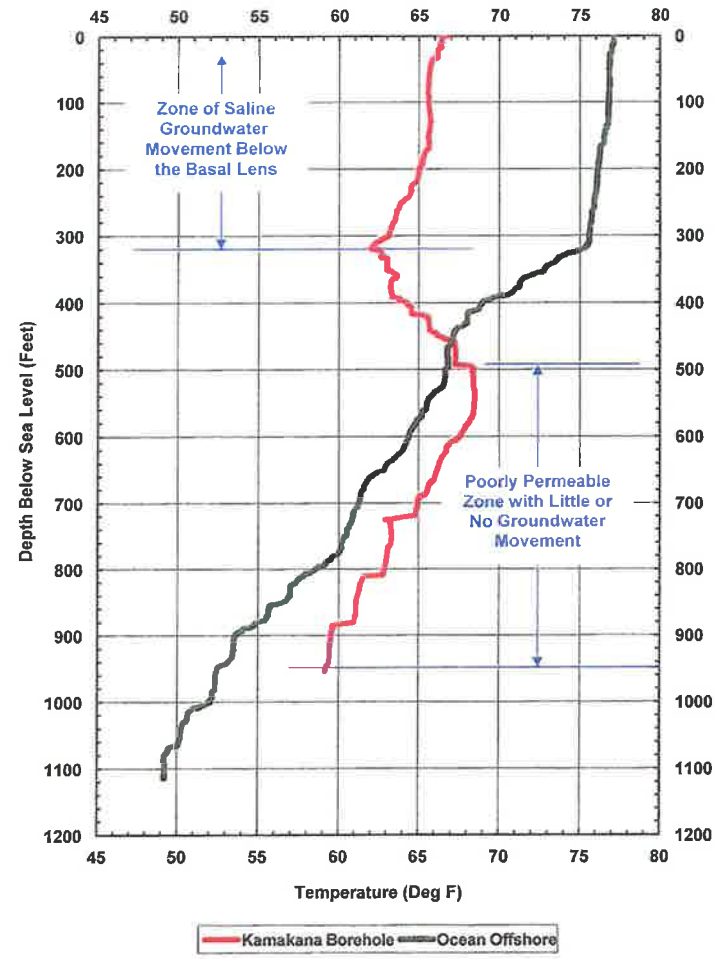


Table 2

Groundwater Quality Within and Near to the Kaloko Makai Corridor

Sampling Site	Date Sampled	Salinity (PPT)	Silica (µM)	Forms of Nitrogen (µM)				Forms of Phosphorus (µM)		
				NO_3	NH_4	TON	Total N	PO_4	TOP	Total P
High Level Potable Quality Wells										
3857-04 DWS Waiaha	11-02-11	0.129	752	74.1	1.5	20.6	96.2	4.24	0.24	4.48
	11-09-11	0.105	749	78.9	1.5	12.6	93.0	4.32	0.88	5.20
	11-25-11	0.119	750	75.9	0.9	13.1	89.9	4.30	0.60	4.90
4057-01 DWS QLT	5-26-00	0.109	801	86.0	0.0	14.7	100.7	3.76	0.08	3.84
	7-20-01	0.079	776	85.1	0.0	35.1	120.2	3.83	3.16	6.99
	11-02-11	0.116	776	87.1	1.1	22.1	110.3	4.00	0.24	4.24
	11-09-11	0.113	771	93.2	1.2	7.7	102.1	4.08	0.80	4.88
	11-25-11	0.130	746	85.4	1.1	11.7	98.2	4.00	0.50	4.50
4158-03 DWS Honokohau	5-26-00	0.144	844	80.1	0.0	14.5	94.6	3.64	0.20	3.84
	11-02-11	0.159	819	79.7	1.0	20.8	101.5	3.84	0.32	4.16
	11-09-11	0.152	804	85.0	2.6	16.6	104.2	4.24	0.80	5.04
	11-25-11	0.158	796	76.8	0.7	2.5	80.0	4.20	0.60	4.80
Basal Wells										
3959-01 Kamakana	11-02-11	5.390	578	160.4	0.7	9.7	170.8	3.84	0.88	4.72
	11-25-11	4.916	598	141.8	1.0	3.6	146.4	3.80	0.40	4.20
3960-01 QLT	10-23-94	25.543	318	28.1	0.3	4.9	33.3	1.49	0.02	1.15
	6-02-00	25.698	356	30.5	1.6	22.5	54.6	1.40	0.70	2.10
4061-01 KAHO 1	5-26-00	9.464	334	55.0	0.3	24.8	80.2	1.84	0.20	2.04
	6-10-00	9.463	304	56.2	3.5	32.1	91.8	1.44	2.96	4.40
	12-19-01	6.657	40	38.4	5.7	20.4	64.5	0.20	0.45	0.65
	11-14-07	10.015	301	67.1	2.7	33.2	103.0	1.65	0.60	2.25
	1-24-12	9.497	482	78.4	2.2	33.6	114.2	4.52	1.56	6.08
	10-29-12	9.317	518	86.3	8.6	68.0	162.9	2.00	0.90	2.90
4161-01 KAHO 3	5-26-00	6.259	672	75.0	0.2	14.8	90.0	4.36	0.04	4.40
	6-10-00	6.325	701	78.9	1.6	43.2	121.7	4.64	2.64	7.28
	12-19-01	6.305	652	79.4	4.2	0.1	83.7	4.35	0.07	4.42
	11-14-07	6.854	666	76.7	1.4	27.2	105.3	3.70	0.50	4.20
	1-24-12	6.387	589	81.4	1.2	11.9	94.5	4.32	0.16	4.48
	10-29-12	6.243	637	81.8	1.3	24.3	107.4	4.50	0.10	4.60
4161-02 KAHO 2	5-26-00	5.399	653	87.2	0.5	22.8	110.4	4.08	0.56	4.64
	6-10-00	5.361	691	104.3	5.1	42.2	151.6	9.04	2.88	11.92
	12-19-01	5.401	616	86.5	1.9	2.0	90.4	4.30	0.05	4.35
	11-14-07	5.382	651	100.4	1.9	31.6	133.9	3.20	1.15	4.35
	1-24-12	5.043	589	95.8	1.4	14.5	111.7	4.52	0.24	4.76
	10-29-12	5.009	653	107.7	2.7	32.9	143.3	5.20	0.00	5.20
4160-02 Kaloko Irrig.	5-15-94	1.734	670	68.6	0.3	2.9	71.8	5.89	0.03	5.92
	3-22-96	1.773	671	78.1	0.3	8.2	86.6	4.42	0.70	5.12
	9-14-12	1.837	633	70.0	1.1	14.4	85.5	4.70	0.60	5.30
	9-14-12	1.917	642	68.2	0.8	14.4	83.4	4.60	0.60	5.20
Ooma Mauka Monitor Well	3-15-96	7.962	661	81.8	0.2	15.8	97.8	3.08	0.16	3.24
	6-02-00	7.783	672	89.7	1.5	26.6	117.8	5.30	0.75	6.05
	6-10-00	7.850	741	91.4	1.0	35.8	128.2	3.60	0.72	4.32
	11-03-06	7.293	640	81.2	3.5	24.8	109.5	2.32	1.28	3.60
	10-29-12	7.067	644	89.5	1.8	9.6	100.9	4.00	0.20	4.20
Ooma Makai Monitor Well	11-03-06	9.945	577	67.0	2.5	22.8	99.2	2.64	1.04	3.68
	10-29-12	10.208	600	94.7	2.2	30.6	127.5	3.70	0.40	4.10
Groundwater Discharge into Honokohau Harbor										
Honokohau Harbor	6-03-00	20.987	373	39.7	0.0	4.2	43.9	2.30	0.07	2.37
	7-20-01	20.431	380	40.4	0.3	10.7	51.4	2.31	2.25	4.56
	9-03-01	20.362	341	38.1	0.3	2.7	41.1	2.05	0.27	2.32
	11-09-11	20.750	305	48.1	0.3	0.2	48.6	2.51	0.17	2.68
	11-09-11	23.216	278	38.0	0.5	1.5	40.0	2.05	0.19	2.24
	11-21-11	19.556	314	51.8	0.1	5.3	57.2	2.93	0.13	3.06
	11-21-11	21.074	318	42.8	0.1	3.6	46.5	2.71	0.09	2.80
Kealakehe WWTP Effluent										
	11-09-11	1.816	450	1037.4	26.2	1.90	1065.5	166.88	7.84	174.72
	12-09-11	1.869	782	1480.6	25.0	35.4	1541.0	193.00	4.80	197.80

Note: All samples collected by Tom Nance Water Resource Engineering (Tom Nance) and/or Marine Research Consultants (Steve Dollar) and analyzed by Marine Analytical Specialists.

consists of a 60-foot drop through the vadose zone and 3700 feet of travel with groundwater to the upper end of the harbor. Samples collected from two visually obvious groundwater discharge locations at the upper end of the harbor are a mix of: (1) the WWTP treated effluent that has undergone natural nutrient removal to the harbor; (2) the ambient groundwater; and (3) seawater. The amount of nutrient removal from the effluent can be approximated in the following steps:

- Assume a ratio of ambient groundwater to treated effluent in the discharge into the harbor;
- Using a salinity balance, solve for the amount of seawater in the mix; and then
- With the ratios of the three sources in the samples collected at the upper end of the harbor, solve for the remaining nitrogen and phosphorus that was originally in the WWTP effluent dumped into the pit.

If the groundwater to WWTP effluent ratio is selected to cover the plausible extremes of this mix, the ensuing nutrient balance calculations would bracket the probable nutrient removal rates from the WWTP effluent. In the resulting removal tabulations below, calculations were done as if only effluent is discharged into the upper end of the harbor and for a 4:1, groundwater to effluent mix. For this plausible range of effluent mixed with groundwater discharging into the upper end of Honokohau Harbor, rates of removal of nitrogen are 89 to 92 percent. For phosphorus, the removal rates are 93 to 98 percent. Several other aspects of the calculation results are worth noting:

- The calculations used the November 9, 2011 sample of the Kealakehe WWTP effluent being discharged into the pit. Had the second, December 9, 2011 sample been used instead, its higher nutrient levels would have resulted in even greater calculated removal rates.
- If it is argued that the WWTP effluent discharges to the shoreline south of Honokohau Harbor rather than into the upper end of the harbor, the nutrients in Kealakehe shoreline samples in Nance (2002) and the Keahuolu shoreline samples (TNWRE data not yet published) could be used for a similar set of calculations. Using these data results in similar, very high natural nutrient removal rates (Table 3).

ESTIMATES OF THE PROJECT'S POTENTIAL IMPACT ON BASAL GROUNDWATER

Assumptions Incorporated Into the Calculations

Relationship of Basal to High Level Groundwater. For the calculations herein, it is assumed that no high level groundwater leaks into the basal lens beneath the project site, meaning that the flow in the basal lens is entirely due to local recharge on the area between Mamalahoa Highway and the shoreline. That flowrate is estimated to be 1.7 MGD per coastal mile. Across the 1.2-mile width of the project site, the basal flowrate is estimated to be 2.0 MGD. It should be pointed out that if some or most of the high level groundwater is flowing into the basal lens, the project's relative impact on this greater basal flowrate would be less than calculated herein.

Table 3

Computed Removal Rates of Nitrogen and Phosphorus From Kealakekua WWTP Effluent Arriving at the Upper End of Honokohau Harbor

Sample Station in Honokohau Harbor	Sample Date	Computed Nutrient Removal Rates (%)			
		All WWTP Effluent		4:1, Groundwater:Effluent	
		Nitrogen	Phosphorus	Nitrogen	Phosphorus
Station 1	11-09-11	90.2	96.8	91.8	93.4
	11-21-11	89.2	96.6	87.7	97.8
Station 2	11-09-11	90.6	96.9	93.4	93.4
	11-21-11	90.5	96.6	93.0	93.1

Notes:
1. Salinity, nitrogen, and phosphorus values for Kealakehe WWTP effluent from the November 9, 2011 sample (bottom of Table 1).
2. Ambient groundwater salinity of nutrient concentrations based on Well 4061-01 in Table 1.
3. Seawater mixed in the sample assumed to be 35.0 PPT salinity; total nitrogen of 7.0 µM, and total phosphorus of 0.50 µM.
4. Discharge into the upper end of Honokohau Harbor based samples of Stations 1 and 2 in Table 2.

Ambient Quality of the Underlying Basal Groundwater. The salinity and nutrient levels in samples taken from onsite Well 4160-02 (Table 2) are assumed to represent the ambient quality of the underlying basal groundwater. These averages are: salinity of 1.75 PPT; total nitrogen of 80 µM or 1.12 mg/l; and total phosphorus of 5.5 µM or 0.17 mg/l.

Potable Supply Alternatives. Two of the four potable supply alternatives would drill wells at the inland end of the project site. If successful, wells for these two alternatives would tap fresh artesian groundwater which exists at depth below the basal lens and saline groundwater. One or the other of these options would only be pursued if it can be demonstrated, initially by testing in the exploratory borehole and subsequently by testing in the finished production wells, that pumping this water will have no impact on the basal lens above. Rather, it would simply be tapping groundwater than flows beneath the basal lens and does not leak into it.

The third potable alternative being considered would tap the high level groundwater at locations several miles or more to the south of the project site. For the purposes of this assessment, it is assumed that these offsite locations would either be to the north and south of DWS' existing Waiaha well (State No. 3857-04) or just north of the State's Keopu deep monitor well (State No. 3858-01). These locations are four and three miles to the south of the Kaloko Makai project site, respectively.

The fourth alternative, desalinization of saline groundwater, would utilize onsite wells designed to draw water from a substantial distance below the basal lens where the salinity may be on the order of 30 PPT. Extensive testing would be undertaken in the development of these wells to affirmatively demonstrate that such pumping can be done without adversely impacting the overlying basal lens.

A key requirement of all four of the supply alternatives being considered is that none would utilize water from the brackish basal lens flowing beneath the project site. Of the three alternatives that would draw from the high level groundwater body, none would impact basal groundwater in the project's mauka-to-makai corridor or elsewhere in North Kona. However, all three of these alternatives would result in a 1:1 reduction of fresh groundwater ultimately discharged into the marine environment offshore.

Landscape Irrigation Return Flow. Landscape irrigation will be supplied by both the potable and non-potable systems, the former occurring primarily in single family residential areas which will not be supplied by the non-potable system. The use of potable water for this purpose at full build out is estimated to be 0.46 MGD, calculated as an average of 4000 GPD/acre on 115 acres throughout the project site. Irrigation using R-1 effluent as the source of supply is estimated to be 0.58 MGD (Table 1). That means the excess of R-1 for disposal in injection wells at the project's WWTP site would be about 0.90 MGD as a year-round average at full build out. For the calculations herein regarding the percolation of excess applied irrigation water to the underlying basal lens, three assumptions are made. First, 12 percent of the water applied for irrigation will be in excess of crop requirements and percolate to the basal groundwater below. Second, total nitrogen and total phosphorus in the R-1 effluent are assumed to be 1500 and 200 µM, respectively, based on levels of these nutrients in the effluent from the County's Kealakehe WWTP (Table 2). Third, fertilizer levels where landscape irrigation is supplied by R-1 effluent will be far less than where the supply is the potable system. Assumed fertilizer applications are:

- In areas irrigated with potable water, nitrogen and phosphorus in fertilizers will be applied at 3.0 and 0.5 pounds/year/1000 ft^2, respectively.
- In areas irrigated where R-1 effluent, nitrogen and phosphorus in fertilizers would be applied at 10 percent of the rate applied in areas with potable water irrigation.
- Ten (10) percent of the applied nitrogen and two (2) percent of the applied phosphorus will be carried in the excess applied irrigation water below the plant root zone.

Onsite Rainfall-Recharge. As an approximation, it is assumed that 60 percent of the project site's 20 inches of average annual rainfall percolates to and becomes groundwater recharge. Over the 1113-acre site, this amounts to an average of 1.0 MGD. Drainage features of the development will capture surface runoff and direct it to seepage basins and drywells, resulting, as a first order approximation, in no change in the amount of onsite rainfall ultimately becoming groundwater recharge. However, it is also assumed that nutrient levels in the post-development rainfall percolating to groundwater will be increased by 20 µM and 2 µM for nitrogen and phosphorus, respectively.

Natural Removal of Nutrients Originating From the Project Site. Earlier in this report, computed nitrogen and phosphorus removal from Kealakehe WWTP effluent disposed of in a pit 3700 feet nominally upgradient of Honokohau Harbor were given. Selecting values slightly lower values than these computed rates, removal rates of 88 and 92 percent of nitrogen and phosphorus are assumed for the calculations herein.

Calculated Changes to Basal Groundwater Flowing Beneath the Kaloko Makai Project Site

Table 4 incorporates all of the foregoing assumptions to approximate possible changes to the brackish basal lens flowing beneath the project site as a result of its proposed development. The resulting approximations are: a 6.2 percent increase in the flowrate; a 5.1 percent reduction in salinity; and nitrogen and phosphorus increases of 5.2 and 2.1 percent, respectively.

OTHER CHANGES TO THE GROUNDWATER DISCHARGE INTO THE MARINE ENVIRONMENT

All of the foregoing calculations were for estimated changes to the brackish basal groundwater flowing directly beneath the project site. Three other aspects of the project's development, although not having an impact on this basal lens, will affect the ultimate discharge of groundwater into the marine environment. Each of these is described and quantified below.

Consumptive Use of Potable Quality Groundwater

Three of the project's four potable supply alternatives under consideration would draw water from what is referred to as the high level groundwater, either as it exists at depth below the basal lens at the inland end of the project site or at a location to the south where it can be accessed directly. The project's ultimate potable water use would be 2.18 MGD as a year-round average. Wells developed for such use would actually draw 3.23 MGD, one-third of which would be used by DWS to serve other customers in its service area. If RO treatment is necessary (Alternative 2), the draft would be slightly greater at about 3.3 MGD.

Table 4

Approximated Changes to the Brackish Basal Groundwater Flowing Beneath the Kaloko Makai Project Site

I t e m	Flowrate (MGD)	Salinity (PPT)	Nitrogen (lbs / day)	Phosphorus (lbs / day)
Present Groundwater Flow	2.0	1.75	18.66	2.83
Excess Applied Irrigation				
• As Potable Water + Fertilizer	0.055	0.15	0.502	0.011
• As R-1 Treated Wastewater + Fertilizer	0.070	0.30	0.210	0.007
Change in Local Rainfall-Recharge	No Change	No Change	0.280	0.041
Post-Development Totals : Amount	2.125	1.661	19.652	2.889
: % Change	+ 6.2	- 5.1	+ 5.2	+ 2.1

Notes: 1. The area irrigated with potable water is 115 acres. The amount of water used for this purpose is 0.46 MGD.

2. The area irrigated with R-1 effluent is 165 acres. The amount of R-1 used for this purpose is 0.58 MGD.

Based on the Keauhou Aquifer recharge calculations in Engott (2011), this total draft for the project and DWS would represent a two to three percent reduction of the total groundwater discharge into the marine environment offshore of the aquifer. Essentially all of this change would be occurring at substantial depth and distance offshore with no significant impact.

Disposal of Excess R-1 Treated Effluent in Onsite Injection Wells

As a long-term average, it appears that the amount of R-1 treated wastewater effluent will exceed its onsite irrigation reuse by about 0.90 MGD. If other uses can not be found for this water, this excess would be disposed of in injection wells located at the project's WWTP. That excess could amount to about half the present disposal by the County's Kealakehe WWTP into a pit inland of Honokohau Harbor. The disposal wells would be designed to deliver the excess effluent at depth below the basal lens so as not to impact the lens itself. To accomplish this, disposal would be at and below where the receiving groundwater salinity is 30 PPT or greater and below poorly permeable lava flows identified in the process of drilling. This may require the injection wells to deliver the water at depths of 300 feet or more below sea level. However, the extraordinary disposal depth is warranted to avoid having a significant impact on basal groundwater moving through the Kaloko-Honokohau National Historical Park or to the Park's nearshore waters. The effluent disposed of would be significantly less dense than the receiving basal groundwater. The tendency for the disposed of effluent to rise up due to its lesser density would be offset by several factors: (1) disposal beneath one or more poorly permeable lava flows; (2) the substantial vertical to horizontal anisotropy in the lava flows; and (3) progressive mixing of the effluent into the receiving groundwater, causing its density to increase. Wastewater disposal in this manner is being done at the Mauna Lani Resort without adverse impact.

Potential Disposal of RO Concentrate

Two of the four drinking water supply alternatives being considered would involve desalinization. An inevitable part of this process is the production of a wastewater stream, referred to as the concentrate. For the desalinization alternative using slightly brackish water extracted at depth below the basal lens, the expected concentrate amount assuming 65 percent product recovery would be 1.17 MGD. If it is assumed that the salinity of the feedwater supply is between 2.0 and 3.0 PPT, the salinity of the concentrate would be in the range of 5.3 to 8.2 PPT. This would be too salty for irrigation reuse and would require disposal in wells located on the project's WWTP site. The disposal wells would be designed to deliver the concentrate to below the midpoint of the transition zone between brackish basal water above and saline groundwater below in order to avoid impacting the overlying basal lens.

For the desalinization alternative using onsite saline groundwater as the feedwater source, the hypersaline (50 PPT) concentrate would amount to an average of 3.27 MGD at the project's full development. Disposal will be at the project's WWTP site and utilize the wells also used for excess R-1 disposal. Mixing the hypersaline concentrate with the excess R-1 will assist in ensuring that the less dense R-1 does not rise up into the overlying basal lens.

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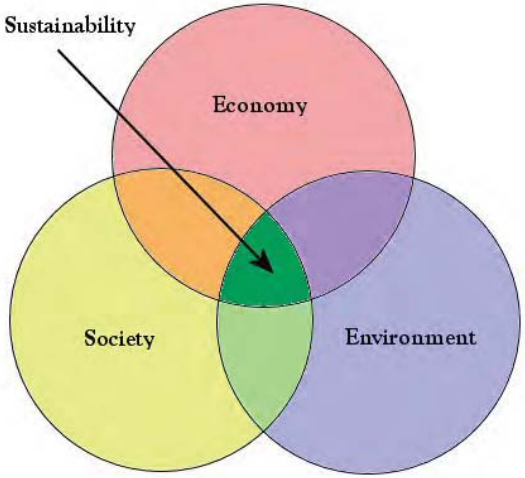
Appendix Q

Sustainability Plan
Hookuleana, LLC
November 2012

Kaloko Makai Sustainability Plan



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Ho'okuleana LLC

Introduction: Kaloko Makai Sustainability Plan

This Kaloko Makai Sustainability Plan is a comprehensive set of goals, strategies and actions focused on improving environmental quality, economic strength and social benefit within the Kaloko Makai project, as well as the broader community.

This Plan serves as a roadmap guiding Kaloko Makai toward a more sustainable future, with implementation of actions through a comprehensive, inclusive stakeholder process.

Before discussing the global context of "sustainability," we explore the Hawaiian view of " *'āina* " – core to the term "sust*aina*bility."

In a traditional Hawaiian context, nature and culture are one and the same; there is no division between the two. The wealth and limitations of the land and ocean resources gave birth to and shaped the Hawaiian worldview. In Hawaiian culture, natural and cultural resources are one and the same.

All forms of the natural environment, from the skies and mountain peaks, to the watered valleys and lava plains, and to the shoreline and ocean depths are believed to be embodiments of Hawaiian gods and deities. (Maly)

'Āina – That Which Sustains the People
(Context, here, primarily provided from writings of Kepa Maly)

The *'āina*, that which feeds, nourishes and sustains life (in English referred to as "land"), *wai* (water), *kai* (ocean), and *lewa* (sky) were the foundation of life and the source of the spiritual relationship between people and their environs. Hawaiian *mo'olelo*, or traditions, express the attachment felt between the Hawaiian people and the earth around them.

In any discussion of Hawaiian land - 'āina, that which sustains the people - and its place in culture, it is also appropriate to briefly discuss traditional Hawaiian land terms, as the terms demonstrate an intimate knowledge of the environment about them. In the Hawaiian mind, all aspects of natural and cultural resources are interrelated. All are culturally significant.

Hawaiian culture revolves around the value of "aloha 'āina" or love of the land. This love is not a passing sentiment, a summer fling or a fair weather affair. It is a deep-seated commitment to the wellbeing of the earth, which sustains us like a parent.

The Hawaiian concept of malama 'āina (literally, caring for or living in harmony with the land,) demands conservation, sustainable use and enhancement of the local, regional and global environment. By simply taking care and respecting the land, it will sustain life. This straightforward relationship has been honored for thousands of years, since the Polynesians followed the stars to the shores of Hawaii.

The traditional land use in the Hawaiian Islands evolved from shifting cultivation into a stable form of agriculture around 1200 AD (Kirch, 2000). Stabilization required a new form of land use. It is widely believed 'Umi a Līloa, the ruler of the Island of Hawai'i, was the first ruler to create the ancient Hawaiian land division, according to a chiefly management system, nearly 600 years ago.

This was the *ahupua'a* land use system, which consisted of vertical landscape segments from the mountains to the near-shore ocean environment, and into the ocean as deep as a person could stand in the water.

For hundreds of years since, on the death of all *mō'ī* (kings or queens), the new monarch re-divided the land, giving control of it to his or her favorite chiefs. The common people never owned or ruled land.

In the term *ahupua'a*, the words *ahu* (stone altar or stone mound) and *pua'a* (pig) are combined. The *pua'a* was a carved wooden image of a pig head. These stone altars served as border markers and deposition places for offerings to the agricultural god *Lono* and a high chief (*ali'i nui*), who was the god's representative.

Each *ahupua'a* in turn was ruled by a lower chief, or *ali'i 'ai*. He in turn appointed a headman, or *konohiki*. The *konohiki* served as general manager responsible for the use of an *ahupua'a* as a resource system. He in turn was assisted by specialists, or *luna*. For example, the *luna wai* was responsible for the fresh water flow and irrigation system.

Manageable parcels of land would typically run *mauka* (upland) to *makai* (toward to ocean) and would be marked with stonewall alignments. Tenants cultivated smaller crops for family consumption, to supply the needs of chiefs and provide tributes.

Kapu (restrictions/prohibitions) were observed as a matter of resource and land management among other things. Access to resources was tied to residency and earned as a result of taking responsibility to steward the environment and supply the needs of *ali'i*. The social structure reinforced land management.

Sustainability – United Nations Context

In 1983, the United Nations Secretary General invited Norwegian Prime Minister Gro Harlem Brundtland to chair a World Commission on Environment and Development. The Report of the Brundtland Commission, Our Common Future, was transmitted to the General Assembly as an Annex to document A/42/427 - Development and International Co-operation: Environment, in 1987

Chapter 2, "Towards Sustainable Development" of the Brundtland "Our Common Future" defines "sustainable development" as:

> Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts:
>
> - the concept of 'needs', in particular the essential needs of the world's poor, to which overriding priority should be given; and
> - the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs.
>
> In its broadest sense, the strategy for sustainable development aims to promote harmony among human beings and between humanity and nature.

Sustainability in Hawai'i (Hawai'i 2050)

The following definition, vision and guiding principles are incorporated in the Hawai'i 2050.

Definition:
A Hawai'i that achieves the following:

- Respects the culture, character, beauty and history of our state's island communities
- Strikes a balance between economic, social and community, and environmental priorities
- Meets the needs of the present without compromising the ability of future generations to meet their own needs

Vision:
Living responsibly and within our own means is top-of-mind for all individuals and organizations. We learn about the virtues and values of a sustainable Hawai'i. As a result, our goals of economic prosperity, social and community well-being and environmental stewardship are in balance and achieved.

Hawai'i 2050 Guiding Principles of Sustainability

- We balance economic, social, community and environmental priorities.
- We respect and live within the natural resources and limits of our islands.
- We must achieve a diversified and dynamic economy.
- We honor the host culture.
- We make decisions based on meeting the present needs without compromising the needs of future generations.
- The principles of the ahupua'a system guide our resource management decisions.
- Everyone — individuals, families, communities, businesses and government — has a responsibility for achieving a sustainable Hawai'i.

Sustainability in Kona Community Development Plan (Kona CDP)

One of the vision statements for Kona's future in the Kona CDP is "A more sustainable Kona characterized by a deep respect for the culture and the environment and residents that responsively and responsibly accommodate change through an active and collaborative community."

Smart growth refers to the management of growth to make it possible "for communities to grow in ways that support economic development and jobs; create strong neighborhood with a range of housing, commercial, and transportation options; and achieve healthy communities that provide families with a clean environment."

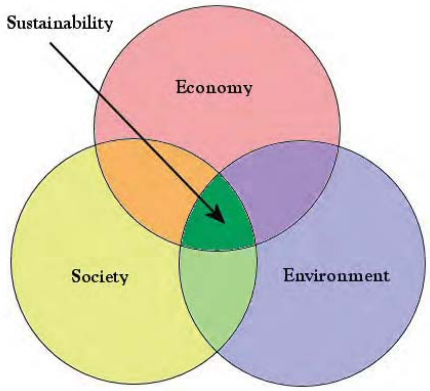
In the Kona CDP, the term "sustainability" has special meaning in an island context, where our resources are limited and the consequences of our actions have a more immediate impact.

Sustainability in Hawai'i means achieving a quality of life that achieves the following goals:

- It emphasizes respect for the culture, character, beauty and history of our state's island communities.
- It strikes a balance between economic prosperity, social and community well-being, and environmental stewardship.
- It meets the needs of the present community without compromising the ability of future generations to meet their own needs.

Typically, "sustainability" is depicted in a three-themed Venn diagram (noted below,) highlighting the economy, environment and society. The achievement of sustainable development requires integration of these components at all levels. With respect to Kaloko Makai, sustainable development is achieved when it is:

- economically feasible in order to be successful as a development, while also providing for economic opportunities for future generations who reside, work or visit Kaloko Makai
- protecting and preserving the environment, for today and tomorrow, serving as a model for others to follow
- addressing the needs of a wide variety of people, including their cultural values, as well as providing opportunities for people to interact, grow and learn together



Sustainability is not contradictory to growth, profit and development. Sustainability means that we plan to our limits; sustainable community development draws from and gives back to local strengths, resources and uniqueness. Local development can become more sustainable by having a better environmental, economic and social balance.

Ultimately, a goal is to meld Hawaiian traditional wisdom with modern sustainability concepts and take an integrated approach in the design and operation at Kaloko Makai.

This plan was created to highlight the actions of the Kaloko Makai development in terms of sustainability.

In developing this plan, a variety of recognized programs and plans were reviewed, summarized and their recommendations were incorporated into this plan. These include:

- Kona Community Development Plan (Kona CDP)
- Smart Growth
- SmartCode
- Hawai'i 2050 Sustainability Plan
- OEQC Sustainable Building Design Guidelines
- Hawaii BuiltGreen Program
- US Green Building Council Leadership in Energy and Environmental Design (LEED)
- Energy Star Program
- Whole Building Design Guide (WBDG,) of the National Institute of Building Sciences
- EPA Low Impact Development
- One Planet Living

Further discussion on these programs and plans follow in the next Chapter of this Kaloko Makai Sustainability Plan. Following this are chapters addressing issue-specific sustainability concerns. These include:

- **Natural and Cultural Resources:** Protecting and preserving archaeological sites, trails and dryland forest, for present and future generations
- **Land Use:** Focuses on consistency with local land use planning, fulfilling the community's vision for development in the future
- **Design Features:** Incorporating design features to fit development into natural features, protecting the resources, while taking advantage of natural elements
- **Transportation:** Focuses on sustainable modes of transportation and an improved infrastructure including: multi-modal bicycle, pedestrian and vehicular infrastructure, complete streets, etc
- **Economic Opportunities:** Encourages a vibrant economy through diversity of employment and sustainable business opportunities
- **Open Space and Parks:** Encourages protection of urban open spaces by focusing on the urban landscaping, green spaces and mixed-use development and recreational opportunities
- **Water Management**: Focuses on reducing and conserving water use, as well as minimizing impacts to nearby ecosystems from source to stormwater systems
- **Energy Management:** Encourages energy conservation, energy efficiency and renewable energy
- **Health:** Encourages healthy lifestyles through places to walk and recreate, as well as provide state of the art medical facilities to address community needs
- **Education:** Encourages understanding and practice of sustainable lifestyles, as well as providing opportunities for life-long learning
- **Housing:** Responds to the market and demographic trends and community needs, providing a broad range of housing types and price points

Anticipated beneficial impacts from the Kaloko Makai project include the following:

- Provision of 5,000 homes
- Increased housing choices, including affordable housing
- Increase housing inventory to meet future demands
- Support approximately 4,200 FTE project related jobs on-site
- Generate approximately $10.8 million in additional county revenues
- Contribute approximately $5.6 to $8.7 million per year net additional state revenues during building out, with net additional revenues of some $4.1 million per year after 2040
- Preservation of 150-acre Native Dryland forest
- Preservation of Kaloko-Kohanaiki historic trail
- Preservation of identified Native Hawaiian Burials and archaeological sites
- Planned growth in an area designated for urban growth by the Kona Community Development Plan
- Provision of a pedestrian and transit-friendly community

Kaloko Makai will be a sustainable community and will incorporate the following:

Sustainability Programs and Plans: Kaloko Makai will incorporate the core principles of the various sustainability programs and plans.

Natural and Cultural Resources: Kaloko Makai will work to preserve the 150-acre native Dryland forest, Kaloko-Kohanaiki historic trail and identified Native Hawaiian Burials and archaeological sites.

Land Use: Kaloko Makai is consistent with local land use plans including the County of Hawai'i General Plan and the Kona Community Development Plan.

Design Features: Kaloko Makai will include sustainable design features including strategies to reduce solar heat gain through roofs, walls and windows; using site planning and landscaping to improve natural ventilation; daylighting design; and energy efficient light fixtures.

Transportation: Kaloko Makai will incorporate provisions of a pedestrian and transit-friendly community; multi-modal interconnected roads; and complete streets design.

Economic Opportunities: Kaloko Makai proposes commercial and industrial uses which will provide a variety of job opportunities; construction and construction-related employment will have direct beneficial impact on the local economy during construction.

Open Space and Parks: Kaloko Makai proposes open space and open greenway areas encompassing the project.

Water Management: Kaloko Makai will install water efficient fixtures, appliances and high efficiency toilets to reduce indoor water use.

Energy Management: Kaloko Makai will incorporate energy conservation and efficiency measures; solar energy for water heating; encourage photovoltaic systems and other renewable energy sources.

Health: Kaloko Makai's layout and design will create an opportunity for both residents and the community to have a positive effect on their health through walkable and bikable transportation options. The setting aside of land for a new hospital will increase health services to the community.

Education: Kaloko Makai will coordinate with the DOE to ensure that the facility assessment policy is addressed. Kaloko Makai proposes land for two elementary schools and one middle school within the project.

Housing: Kaloko Makai offers increased housing choices, including affordable housing to meet future demands.

Social: Kaloko Makai promotes social sustainability through socially-focused actions that will support quality of life, sense of place and community livability for all residents and the community.

Sustainability Programs and Plans

In developing this Kaloko Makai Sustainability Plan, a variety of recognized sustainability programs and plans were reviewed, summarized and incorporated into this plan. In part, the recommendations from these programs and plans serve as guides to the sustainability actions noted in this Plan.
These include:

- Kona Community Development Plan (Kona CDP)
- Smart Growth
- SmartCode
- Hawai'i 2050 Sustainability Plan (Hawai'i 2050)
- OEQC Sustainable Building Design Guidelines
- Hawaii BuiltGreen Program
- US Green Building Council Leadership in Energy and Environmental Design (LEED)
- ENERGY STAR Program
- Whole Building Design Guide (WBDG,) of the National Institute of Building Sciences
- EPA Low Impact Development
- One Planet Living
- Complete Streets

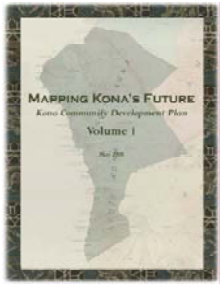
In this chapter, these various programs and plans are summarized.

As you will see, there are several consistent principles and themes that run through the various programs and plans. While some are broad-based and include several of these, others are focused on single issues.

Following are some of the consistent messages found in these programs and plans:

- Soft touch on the land
- Respect and protection of natural and cultural resources
- Use of natural elements (shading, ventilation, lighting, etc)
- Diversity of land uses, housing types, prices
- Live, work, play, shop and learn
- Walking, bicycle and transit transportation focused
- Reuse and minimization of waste
- Renewable and efficient electric
- People and community focused

Kaloko Makai will implement, to the extent feasible and practicable, measures to promote energy conservation, sustainable design, environmental stewardship and protection of the natural and cultural resources into the project. These actions are in part, based on the recommendations noted in the following sustainability programs and plans.



Kona Community Development Plan (Kona CDP)

One of the vision statements for Kona's future in the Kona CDP is "A more sustainable Kona characterized by a deep respect for the culture and the environment and residents that responsively and responsibly accommodate change through an active and collaborative community."

In order to achieve this vision, eight Guiding Principles were derived and are the foundation for the goals, policies and implementation actions.

These principles include:

1. Protect Kona's natural resources and culture
2. Provide connectivity and transportation choices
3. Provide housing choices
4. Provide recreation opportunities
5. Direct future growth patterns toward compact villages
6. Provide infrastructure and essential facilities concurrent with growth
7. Encourage a diverse and vibrant economy
8. Promote effective governance

These foregoing eight Guiding Principles are consistent with the principles of "smart growth" and "sustainability." As noted in the Kona CDP, Smart Growth refers to the management of growth to make it possible "for communities to grow in ways that support economic development and jobs; create strong neighborhood with a range of housing, commercial, and transportation options; and achieve healthy communities that provide families with a clean environment."

The following 10 smart growth principles are incorporated into the Kona CDP's Guiding Principles:

1. Protect and preserve open space, natural beauty, agricultural lands, cultural and environmental resources;
2. Utilize compact building design;
3. Create a range of housing opportunities and choices;
4. Create walkable communities;
5. Foster distinctive, attractive communities with a strong sense of place;
6. Mix land uses;
7. Strengthen and direct development towards existing communities;
8. Provide a variety of transportation choices;
9. Make development decisions predictable, fair and cost effective; and
10. Foster community and stakeholder collaboration in development decisions.

The term "sustainability" has special meaning in an island context, where our resources are limited and the consequences of our actions have a more immediate impact. Sustainability in Hawai'i means achieving a quality of life that achieves the following goals:

- It emphasizes respect for the culture, character, beauty and history of our state's island communities.
- It strikes a balance between economic prosperity, social and community well-being, and environmental stewardship.
- It meets the needs of the present community without compromising the ability of future generations to meet their own needs.

Smart Growth Network

In 1996, the U.S. Environmental Protection Agency joined with several non-profit and government organizations to form the Smart Growth Network. The Network was formed in response to increasing community concerns about the need for new ways to grow that boost the economy, protect the environment, and enhance community vitality.

Smart growth refers to the management of growth to make it possible "for communities to grow in ways that support economic development and jobs; create strong neighborhood with a range of housing, commercial, and transportation options; and achieve healthy communities that provide families with a clean environment." (Smart Growth Network)

There are 10 accepted principles that define Smart Growth

1. Mix land uses
2. Take advantage of compact building design
3. Create a range of housing opportunities and choices
4. Create walkable neighborhoods
5. Foster distinctive, attractive communities with a strong sense of place
6. Preserve open space, farmland, natural beauty, and critical environmental areas
7. Strengthen and direct development towards existing communities
8. Provide a variety of transportation choices
9. Make development decisions predictable, fair, and cost effective
10. Encourage community and stakeholder collaboration in development decisions

SmartCode

The SmartCode is a form-based code that incorporates Smart Growth and New Urbanism principles. It is a unified development ordinance, addressing development at all scales of design, from regional planning on down to the building signage.

The SmartCode is also a transect-based code. A "transect" is usually seen as a continuous cross-section of natural habitats for plants and animals, ranging from shorelines to wetlands to uplands. It is based on the rural-to-urban transect rather than separated-use zoning, thereby able to integrate a full range of environmental techniques.

The SmartCode is a model transect-based planning and zoning document based on environmental analysis. It addresses all scales of planning, from the region to the community to the block and building. The SmartCode is distributed by the nonprofit Center for Applied Transect Studies (CATS.) SmartCode principles have been incorporated into the Kona CDP.

Kaloko Makai has incorporated the SmartCode principles and transects into its layout and design.

Hawai'i 2050 Sustainability Plan (Hawai'i 2050)

The Hawai'i State Plan, embodied in Chapter 226, Hawai'i Revised Statutes (HRS), serves as a guide for goals, objectives, policies, and priorities for the State.

The Hawaii State Planning Act (HRS 226) states that the State shall strive to improve the quality of life for Hawaii's present and future population through the pursuit of desirable courses of action in six major areas of statewide concern which merit priority attention: economic development, population growth and land resource management, affordable housing, crime and criminal justice, quality education and principles of sustainability.

In 2005, the legislature authorized the creations of a task force to review the Hawaii state plan and the State's planning process and to prepare the Hawai'i 2050 Plan. The creation of the Hawaii 2050 sustainability plan raises questions about the long-term limits of growth in the State and highlights the need to begin planning and acting to assure Hawaii's future. Thus, the objectives of the Hawaii 2050 sustainability plan focuses on the revitalization of the State's long-term planning process to better guide the future development of Hawaii.

The Plan offers detailed strategic actions and indicators to serve as a guide towards meeting the Plan's sustainability goals. The Plan incorporates tangible targets and benchmarks. Priority actions for 2020, to be addressed immediately, include:

1. Increase affordable housing opportunities for households up to 140% of median income.
2. Strengthen public education.
3. Reduce reliance on fossil (carbon-based) fuels.
4. Increase recycling, reuse and waste reduction strategies.
5. Develop a more diverse and resilient economy.
6. Create a sustainability ethic.
7. Increase production and consumption of local foods and products, particularly agriculture.
8. Provide access to long-term care and elderly housing.
9. Preserve and perpetuate our Kanaka Maoli and island cultural values.

In 2011, the State established sustainability as a state priority by incorporating the Hawaii 2050 sustainability plan definitions, guiding principles and goals, into chapter 226, Hawaii Revised Statutes (the Hawaii state planning act).

"Sustainability" definition was added to the Planning Act as: "achieving the following:

(1) Respect of the culture, character, beauty, and history of the State's island communities;
(2) Striking a balance between economic, social, community, and environmental priorities; and
(3) Meeting the needs of the present without compromising the ability of future generations to meet their own needs."

The Act also added "principles of sustainability" as one of the six major areas of statewide concern which merit priority attention, economic development, population growth and land resource management, affordable housing, crime and criminal justice, quality education and principles of sustainability."

OEQC's Sustainable Building Design Guidelines

The Environmental Council, as part of a "Planner's Checklist," adopted Guidelines for Sustainable Building Design in Hawai`i (October 13, 1999.) These guidelines do not constitute rules or law. A sustainable building is built to minimize energy use, expense, waste and impact on the environment. It seeks to improve the region's sustainability by meeting the needs of Hawai`i's residents and visitors today without compromising the needs of future generations. Compared to conventional projects, a resource-efficient building project will:

1. Use less energy for operation and maintenance
2. Contain less *embodied* energy (i.e. locally produced building products often contain less *embodied* energy than imported products because they require less energy-consuming transportation.)
3. Protect the environment by preserving/conserving water and other natural resources and by minimizing impact on the site and ecosystems
4. Minimize health risks to those who construct, maintain and occupy the building
5. Minimize construction waste
6. Recycle and reuse generated construction wastes
7. Use resource-efficient building materials (e.g. materials with recycled content and low embodied energy, and materials that are recyclable, renewable, environmentally benign, non-toxic, low VOC (Volatile Organic Compound) emitting, durable, and that give high life cycle value for the cost.)
8. Provide the highest quality product practical at competitive (affordable) first and life cycle costs.

In the design and construction of Kaloko Makai, SCD – TSA Kaloko Makai, LLC will seek to implement feasible measures to conform to these general guidelines.

Hawaii BuiltGreen Program

The Hawaii BuiltGreen Program is a statewide program to "incentivize" the designing and building of energy and resource efficient homes in Hawaii. Originally developed in 2000 by a public/private partnership between the State Dept. of Business, Economic Development & Tourism (DBEDT), USDOE and five other partners. Now promoted by the State, BIA, Hawaii utility companies and other organizations.

Hawai'i BuiltGreen is a self-certification program administered by the Building Industry Association of Hawai'i, which is a professional trade organization affiliated with the National Association of Home Builders. This is a local initiative based on homegrown knowledge of professionals familiar with the unique conditions of Hawaii. The Hawaii BuiltGreen program focuses on design choices through:

- Protecting Site Features and Functions
- Energy Performance and Comfort
- Health and Indoor Air Quality
- Durability and Materials Conservation
- Environmentally-Friendly Home Operations

US Green Building Council
Leadership in Energy and Environmental Design (LEED)

The US Green Building Council's Leadership in Energy and Environmental Design (LEED) program is a voluntary green building certification system, providing third-party verification that a building or community was designed and built using strategies aimed at improving performance across all the metrics that matter most: energy savings, water efficiency, CO_2 emissions reduction, improved indoor environmental quality, and stewardship of resources and sensitivity to their impacts.

Specific LEED programs include: (from Kona CDP)

- Homes
- Neighborhood Development
- New Commercial Construction and Major Renovation projects
- Existing Building Operations and Maintenance
- Commercial Interiors projects

LEED for Homes is a voluntary rating system that promotes the design and construction of high performance "green" homes. A green home uses less energy, water and natural resources; creates less waste; and is healthier and more comfortable for the occupants.

LEED for Neighborhood Development is a collaboration between the U.S. Green Building Council, the Congress for the New Urbanism and the Natural Resources Defense Council. The LEED for Neighborhood Development Rating System integrates the principles of smart growth and green building into the first national standard for neighborhood design. LEED for Neighborhood Development recognizes development projects that successfully protect and enhance the overall health, natural environment and quality of life of our communities. The rating system encourages urban smart growth best practices, promoting the design of neighborhoods that reduce vehicle miles traveled and communities where jobs and services are accessible by foot or public transit.

ENERGY STAR Program

ENERGY STAR is a joint program of the U.S. Environmental Protection Agency and the U.S. Department of Energy.

In 1992, the US Environmental Protection Agency (EPA) introduced ENERGY STAR as a voluntary labeling program designed to identify and promote energy-efficient products to reduce greenhouse gas emissions. Computers and monitors were the first labeled products. Through 1995, EPA expanded the label to additional office equipment products and residential heating and cooling equipment. In 1996, EPA partnered with the US Department of Energy for particular product categories.

The ENERGY STAR label is now on major appliances, office equipment, lighting, home electronics, and more. EPA has also extended the label to cover new homes and commercial and industrial buildings.

National Institute of Building Sciences
Whole Building Design Guide (WBDG)

The goal of 'Whole Building' Design is to create a successful high-performance building by applying an integrated design and team approach to the project during the planning and programming phases. The WBDG program is a collaborative effort among federal agencies, private sector companies, non-profit organizations and educational institutions. In buildings, to achieve a truly successful holistic project, these design objectives must be considered in concert with each other:

- Accessible: to address the specific needs of disabled people.
- Aesthetics: the physical appearance and image of building elements and spaces
- Cost-Effective: weighing options during concepts, design development and value engineering
- Functional/Operational: spatial needs and requirements, system performance durability and efficiency
- Historic Preservation: whereby building elements and strategies are classifiable into preservation, rehabilitation, restoration or reconstruction.
- Productive: physical and psychological comfort—including air distribution, lighting, workspaces, systems, and technology.
- Secure/Safe: physical protection of occupants and assets from man-made and natural hazards.
- Sustainable: Pertains to environmental performance of building elements and strategies.

Land Use and Development Practices - Low Impact Development (LID)

Land use practices can improve air quality, reduce stormwater runoff, increase energy efficiency and reduce greenhouse emissions to improve the quality of life for citizens. LID is a land development approach that allows land to be developed but in a manner that helps lessen potential environmental impacts. LID employs principles such as preserving and recreating natural landscape features, minimizing effective imperviousness to create functional and appealing site drainage that treat stormwater as a resource rather than a waste product.

By implementing LID principles and practices, water can be managed in a way that reduces the impact of built areas and promotes the natural movement of water within an ecosystem or watershed. LID has been characterized as a sustainable stormwater practice by the Water Environment Research Foundation and others.

In general, implementing integrated LID practices can result in enhanced environmental performance while at the same time reducing development costs when compared to traditional stormwater management approaches. LID techniques promote the use of natural systems, which can effectively remove nutrients, pathogens and metals from stormwater.

Conservation designs can be used to minimize the generation of runoff by preserving open space. Examples of Conservation Design include:

- Cluster development
- Open space preservation
- Reduced pavement widths (streets, sidewalks)
- Shared driveways

One Planet Living

One Planet Living is a vision of a sustainable world, in which people everywhere can enjoy a high quality of life within the productive capacity of the planet, with space left for wildlife and wilderness. Organizations around the world are using the one planet living approach to take measurable steps towards genuine sustainability. From zero carbon buildings to procurement policies that support the green economy, one planet living solutions are cost-effective, creative, inspirational and replicable.

- Zero Carbon - Making buildings more energy efficient and delivering all energy with renewable technologies
- Zero Waste - Reducing waste, reusing where possible, and ultimately sending zero waste to landfill
- Sustainable Transport - Encouraging low carbon modes of transport to reduce emissions, reducing the need to travel
- Sustainable Materials - Using sustainable and healthy products, such as those with low embodied energy, sourced locally, made from renewable or waste resources
- Local and Sustainable Food - Choosing low impact, local, seasonal and organic diets and reducing food waste
- Sustainable Water - Using water more efficiently in buildings and in the products we buy; tackling local flooding and water course pollution
- Land and Wildlife - Protecting and restoring existing biodiversity and natural habitats through appropriate land use and integration into the built environment
- Culture and Heritage - Reviving local identity and wisdom; supporting and participating in the arts
- Equity and Local Economy - Creating bioregional economies that support fair employment, inclusive communities and international fair trade
- Health and Happiness - Encouraging active, sociable, meaningful lives to promote good health and well being

Complete Streets

Complete Streets are designed and operated to enable safe access for all users. Pedestrians, bicyclists, motorists and transit riders of all ages and abilities must be able to safely move along and across a complete street. Complete Streets make it easy to cross the street, walk to shops and bicycle to work. They allow buses to run on time and make it safe for people to walk to and from train stations.

By adopting a Complete Streets policy, communities direct their transportation planners and engineers to routinely design and operate the entire right of way to enable safe access for all users, regardless of age, ability or mode of transportation. This means that every transportation project will make the street network better and safer for drivers, transit users, pedestrians and bicyclists – making your town a better place to live.

Natural and Cultural Resources

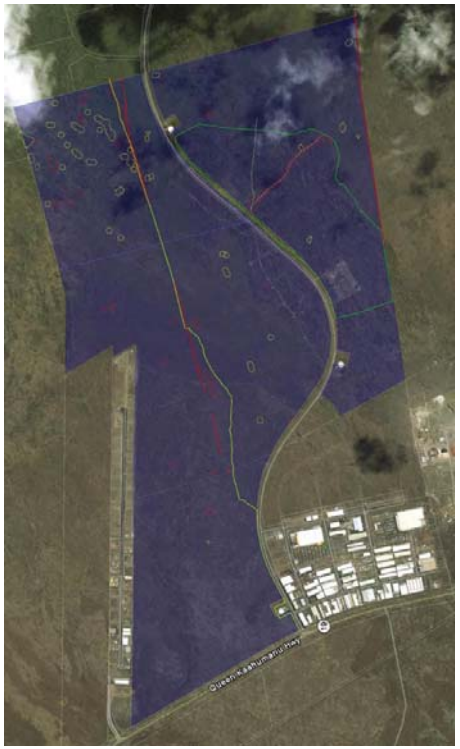
The preservation of the natural and cultural resources is essential for a prosperous and sustainable future. Kaloko Makai holds respect for the culture and the environment and will interlink natural features and cultural features as core components of the community. Significant natural, archaeological and cultural sites at Kaloko Makai, which include archaeological preservation areas, historic trails and native forest, will be integrated into the master plan. Archaeological and cultural sites will be protected and maintained with appropriate treatment and buffers from adjacent uses, as necessary.

Archaeological/Cultural Sites

A total of 341 archaeological sites were identified in the course of the archaeological inventory survey work for Kaloko Makai. Sites in the project area include permanent and temporary habitation structures, agricultural features, at least 65 burials located in approximately two dozen burial sites, ahu (stone markers), trails, petroglyphs, ahupua`a boundary walls, papamū (traditional gaming site) and others.

Of the 341 sites, eighty (80) sites are subjected to a program of data recovery to address scientific and informational concerns and a total of seventy-two (72) sites be preserved (a majority of the preservation sites are burials or probable burials.) The remaining 189 sites are not recommended to undergo further research.

There are a total of sixty-five (65) confirmed burials at more than thirty sites. All of the confirmed and suspected burials will be preserved pursuant to a burial treatment plan prepared in consultation with recognized descendants and the Hawai'i Island Burial Council. The other preservation sites will be treated in accordance with a preservation plan submitted to and approved by State Historic Preservation Division (SHPD) prior to final subdivision approval. There were no specific ongoing traditional cultural practices identified relative to the land within the project area.



Kaloko Makai Noting Various Preservation Areas

Kohanaiki Trail

The historic Kohanaiki Trail (Road to the Sea) runs through (mauka-makai) the entire length of the project; it will be restored and will interconnect the communities within the project.

The trail parallels the nearby Kaloko/Kohanaiki ahupuaʻa wall. Kaloko Makai will incorporate the Kohanaiki Trail as an integral component of the project. Kaloko Makai has located two school sites and multiple parks near the trail. Likewise, Kaloko makai will also be incorporating two trails that run through the dryland forest (one also connects to another school site and park – these will connect through the project to the Kohanaiki Trail).

The trail entirely traverses pāhoehoe and is generally well defined throughout the eastern portion of the parcel, except near the *makai* parcel boundary where extensive bulldozing and grading has nearly destroyed the ahupuaʻa wall and eliminated any definitive sign of the trail.

Whenever possible, pāhoehoe will be embedded in the roadway paving as the means to mark where the original trail footprint is located. To the extent practical, pāhoehoe retrieved from other areas within Kaloko Makai shall be used in the paving.

Whenever existing rock walls must be removed, the rocks from these walls will be set aside and reused in the construction of new screen, buffer and retaining walls built within Kaloko Makai. Whenever feasible, rocks from Kaloko Makai will be used for such walls (minimize importation of rock from offsite).

Where the Kohanaiki Trail intersects with Hina Lani Drive, Kaloko Makai will realign the remaining lower portion of the Trail from that point to run parallel with and adjoining the Hina Lani Street right-of-way down to Queen Kaʻahumanu Highway. Since the integrity of the historic trail is lost at that point, due to Hina Lani road construction, the adjoining industrial subdivision and the water tank, Kaloko Makai will realign the trail and have it run down the southern boundary of the property (fronting Hina Lani,) from the point of intersection with Hina Lani down to Queen Kaʻahumanu Highway. This alignment gives the users of the trail easy access to cross Queen Kaʻahumanu or Hina Lani at the bottom, as there are crosswalks with crossing signals at that point.

Kaloko Makai will incorporate the Kohanaiki Trail as an integral component of the project. The trail and buffers will be approximately 30-feet wide. Kaloko Makai will also incorporate two trails that run through the dryland forest.

Greenbelts

According to the Kona CDP, Greenbelts are undeveloped areas that surround the developed areas. Greenbelt is a strategic planning tool to prevent urban sprawl by keeping land permanently open. The purpose of the Greenbelt is to prevent urban sprawl of the TODs/TNDs, prevent neighboring towns from merging into one another, and to preserve the setting and the character of the TODs/TNDs.

Greenbelts are also used to set aside and protect important features. Significant archaeological sites are found in the northwest section of the property. In order to preserve and protect these features, the area will be left in a natural state, with pockets of low-density residential interspersed in the area. This open space also helps to serve as a mauka greenbelt (GB1) to the Kaloko Makai TOD.

From Ane Keohokālole Highway down to Queen Ka`ahumanu Highway, Kaloko Makai will set aside a 100-foot buffer that fronts Hina Lani Street. This open space also helps to serve as a greenbelt (GB1) to the Kaloko Makai TOD.

Dryland Forest

The Hawaiʻi County General Plan designates a 150-acre portion of the Kaloko Makai site as "Conservation." This area is identified as a dryland forest area.

The Kaloko Makai development is home to one of the largest remaining areas of dryland forest in the Hawaiian Islands. The Kaloko dryland forest is unique in that it has not been heavily impacted by ungulates, and therefore, has minimal impact from alien plant species.

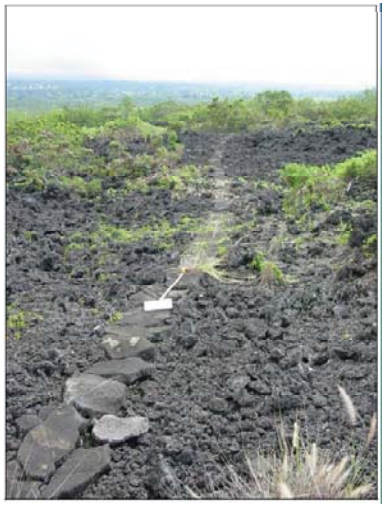
The 150-acres Kaloko Makai Dryland Forest Preserve contains the best habitat for reproduction of native species and is one of the last remaining Dryland Forest ecosystems on the island.

The 150-acres will be set aside and preserved as a Dryland Forest preserve in perpetuity, thus ensuring the continuation of this Dryland Forest ecosystem.

Kaloko Makai has determined that the Kaloko Makai project will not take any listed plant species. The project layout has been revised and buffers included so that the two listed species present on site, outside of the Dryland Forest Preserve, (ʻaiea and hala pepe) will not be impacted and will in incorporated into appropriate landscaping.

The preservation of these 150-acres is the single most important step in preserving the Dryland Forest ecosystem at Kaloko Makai.

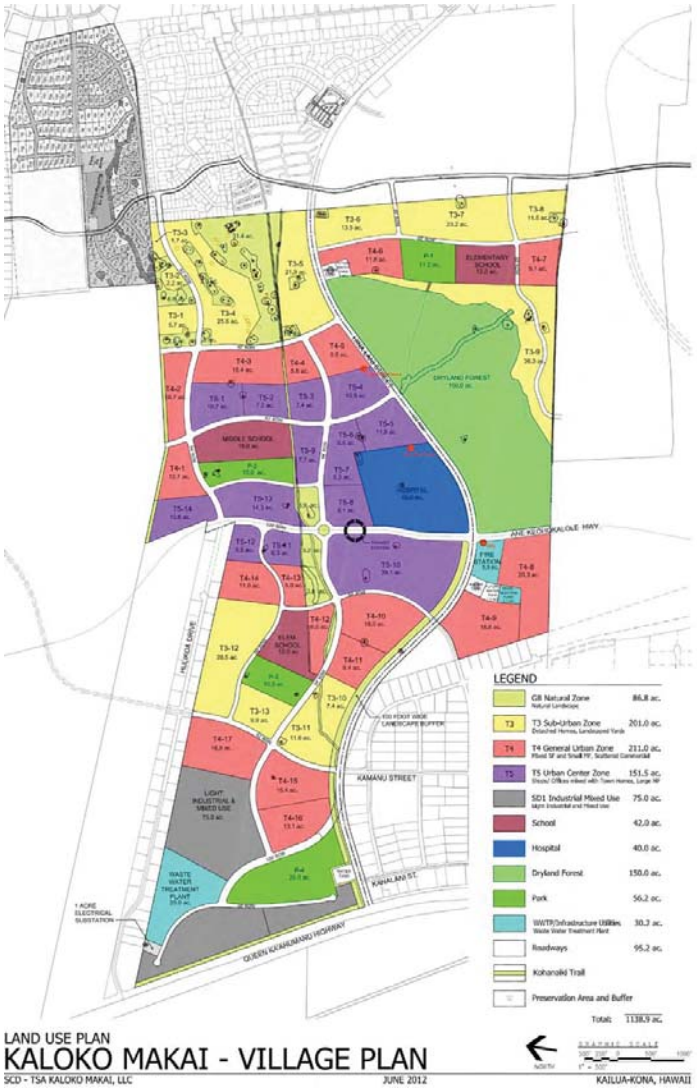
Preservation of the 150-acre Dryland Forest will also result in the preservation of two additional listed species (maʻoloa and uhiuhi) which are found within the Dryland Forest Preserve.



Kaloko Makai will also incorporate two trails that run through the dryland forest (one noted above)

Since the Kaloko Makai Dryland Forest Preserve will border housing developments, building setbacks will be developed to keep housing an appropriate distance from the Dryland Forest Preserve. Kaloko Makai has planned single-family uses to adjoin the Kaloko Makai Dryland Forest Preserve. It is believed that this use has less risk compared to multi-family or commercial uses. Appropriate landscaping will also be employed within the housing developments to act as a barrier if fire was to occur.

Significant archaeological and cultural sites, which include historic trails, and preservation and greenbelt areas will be integrated into the master plan. Archaeological and cultural sites and natural resources will be set aside with appropriate treatment and buffers from adjacent uses, as necessary.



Consistency with Regional Land Use Planning

Consistency with local land use planning documents is an essential element of sustainability. The local plans articulate and illustrate the community's vision. Without consistency with that vision, a development project cannot be sustainable.

With respect to local planning in Kona, the Hawai'i County Planning Department recognized that only with broad public input can the Kona residents take ownership of this plan, by which they may embrace the vision and commit to a better future.

Initiated in September 2005, the Kona Community Development Plan (Kona CDP) is the result of an extensive public process, culminating in County Council's adoption of the Plan in 2008.

Mapping the Future Workshop, February 2006.

First meeting of the 109 small group meetings. *Soteru Agoof*

March 2006 Charrette.

June 2006 Charrette

Images from the Kona CDP

Two primary planning documents address land use development in Kona, the Hawai'i County General Plan and the Kona CDP. Following are brief summaries of each.

Hawai'i County General Plan (General Plan)

The Hawai'i County General Plan is the policy document for the long-range comprehensive development of the island of Hawai'i. The General Plan provides the direction for the future growth of the County. It brings into focus the relationship between residents and their pursuits and institutions, offering policy statements that embody the expressed goals for present and future generations.

The purposes of the General Plan are to:

- Guide the pattern of future development in this County based on long-term goals;
- Identify the visions, values, and priorities important to the people of this County;
- Provide the framework for regulatory decisions, capital improvement priorities, acquisition strategies and other pertinent government programs within the County organization and coordinated with State and Federal programs.
- Improve the physical environment of the County as a setting for human activities; to make it more functional, beautiful, healthful, interesting and efficient.
- Promote and safeguard the public interest and the interest of the County as a whole.
- Facilitate the democratic determination of community policies concerning the utilization of its natural, man-made, and human resources.
- Effect political and technical coordination in community improvement and development.
- Inject long-range considerations into the determination of short-range actions and implementation.

The General Plan represents the first level and encompasses long-range goals, policies and standards for the entire County. The General Plan also provides the legal basis for all of the other elements of the County's planning structure. As such, the General Plan is the highest order, or "umbrella" plan. It establishes the outer limits or boundaries within which the County must operate.

The General Plan designation for the Kaloko Makai site is "Urban Expansion" and Conservation (for the area of the dryland forest.) The "Urban Expansion Area "allows for a mix of high density, medium density, low density, industrial, industrial-commercial and/or open designations in areas where new settlements may be desirable, but where the specific settlement pattern and mix of uses have not yet been determined".

Kaloko Makai is consistent with the Hawai'i County General Plan.

Kona Community Development Plan (Kona CDP)

The County of Hawai'i General Plan section 15.1 (February 2005, as amended) established and called for the preparation of Community Development Plans (CDPs) to translate broad General Plan goals, policies, and standards into implementation actions as they apply to specific geographical regions around the Island. The General Plan requires CDPs be adopted as an "ordinance," giving the plans force of law.

On September 25, 2008, *Mapping the Future: Kona Community Development Plan Volume 1* (Kona CDP) was adopted by the County Council (Ordinance 08-131,) subject to later amendments. The planning area for the Kona CDP encompasses the judicial districts of North and South Kona.

The Kona CDP is a long term plan with a planning horizon to year 2020, consistent with the General Plan. The plan consists of two volumes—Volume 1 is adopted by County Council; Volume II contains more detailed or technical material for informational purposes.

The purposes of the Kona CDP are to:

- Articulate Kona's residents' vision for the North and South Kona districts
- Guide and accommodate regional growth and development
- Provide a feasible plan to improve existing infrastructure and support future growth
- Direct growth to appropriate areas
- Create a partnership plan of action where to improve the quality of life in Kona
- Monitor the progress and effectiveness of the plan

The Kona CDP responds to the effects of rapid growth in the community. Encompassing the North and South Kona districts, the Kona CDP addresses the need to plan better to deal with traffic congestion, affordable housing and loss of open space. Residents taking part in the planning process repeatedly voiced these needs.

The eight guiding principles of the Kona CDP were derived from public meetings and working groups. These principles are the foundation for the goals, objectives, policies and implementing actions.

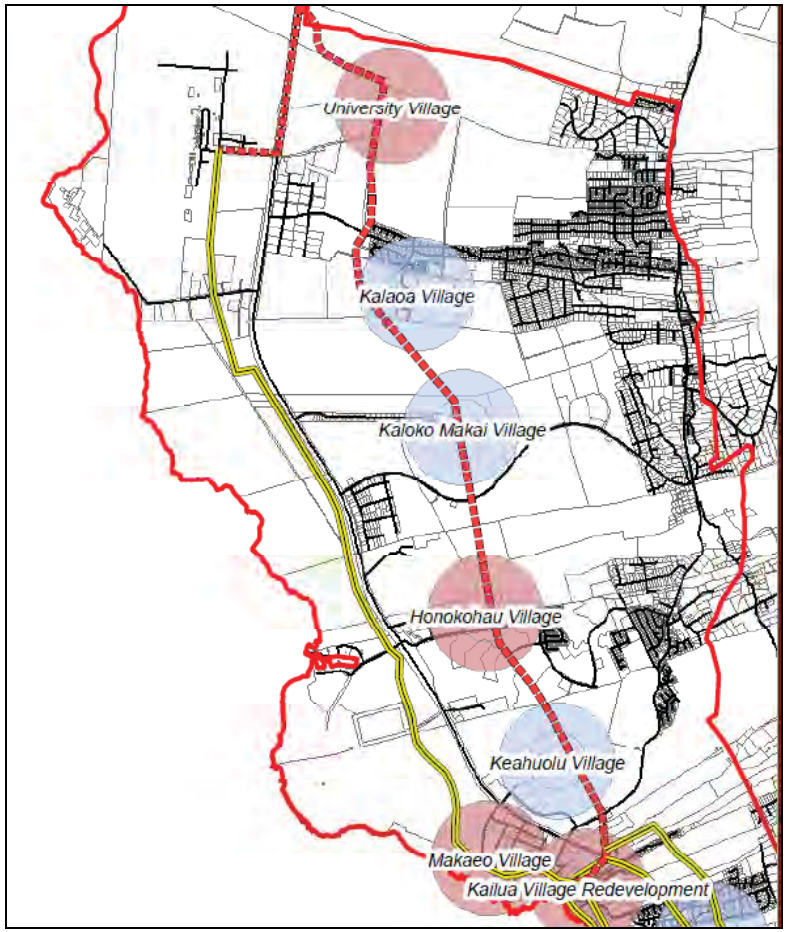
1. Protect Kona's natural resources and culture
2. Provide connectivity and transportation choices
3. Provide housing choices
4. Provide recreation opportunities
5. Direct future growth patterns toward compact villages
6. Provide infrastructure and essential facilities concurrent with growth
7. Encourage a diverse and vibrant economy
8. Promote effective governance

The Land Use section of the Kona CDP serves as policy guide for County decisions regarding physical development. It establishes a physical framework for future growth by identifying the County's major policies concerning the type and location of future development in order to meet the goals and objectives of the Kona CDP.

Most of the future growth in Kona will be directed to the Urban Area (UA.) Within this Kona Urban Area, growth would be directed to compact villages located along proposed transit routes or to infill areas within, or adjacent to, existing development. The general locations of these villages are within the Transit-Oriented Developments (TODs). The Official Kona Land Use Map defines the Kona Urban Area and the general locations, spacing and type of TOD Villages.

Transit-Oriented Development (TOD) is defined in the Kona CDP as the development of compact, mixed-use villages that would integrate housing, employment, shopping and recreation opportunities. Villages would be designed around transit stations/stops that would reduce the need for daily trips and financially support the expanded transit system. TOD Urban Villages are located a minimum of one mile apart, between major transit stations, along Keohokālole Highway trunk route in order to preserve the transit efficiency of this route.

To encourage growth towards the Transit-Oriented Developments (TODs,) the Kona CDP promotes Design Flexibility, Streamlined Permit Processing, Increased Range of Permitted Uses and Densities, prioritized Essential Infrastructure, Public Financing of Infrastructure, Concurrency Requirements and Vested Rights. (As an incentive, the TODs substantially increase the permitted uses and densities.)



Portion of the Kona CDP "Official Land Use Map" Noting a TOD Designation for Kaloko Makai

The Kona CDP incorporates several "official" maps: Official Kona Land Use Map, Official Concurrency Map, Official Transportation Network Map (Proposed Roads and Transit, Pedestrian and Bike Paths) Official Public Facilities and Services Map (Public Safety, Community Facilities and Waste Management. The "official" maps distinguish "policy" layers from "information" layers and are meant to be legally binding.

Per the Kona CDP, most of the future growth in Kona will be directed to the Urban Area (UA) – this is generally the area from Kailua-Kona to the Kona International Airport. Within this Kona Urban Area, growth would be directed to compact villages located along proposed transit routes or to infill areas within, or adjacent to, existing development. The general locations of these villages are within the Transit-Oriented Developments (TODs) or Traditional Neighborhood Developments (TNDs.) The Official Kona Land Use Map defines the Kona Urban Area and the general locations, spacing and type of TOD Villages.

TODs and TNDs are compact mixed-use villages, characterized by a village center within a higher density urban core, roughly equivalent to a 5-minute walking radius (1/4 mile), surrounded by a secondary mixed-use, mixed-density area with an outer boundary roughly equivalent to a 10-minute walking radius from the village center (1/2 mile).

TODs and TND's are further organized by Transect Zones. Transect Zones organize the density, complexity, and intensity of the land use within the TND or RCD village. The operating principle is that there is an urban core with a main center focus such as a transit station and plaza.

This urban core area, which is spatially defined based on walkable distances called Pedestrian Sheds, has the highest density, complexity and intensity of uses. Land use density is specific to spatial proximity to the urban core area; the further from the urban core, the more land use density is reduced.

The Transect Zones that correspond to the urban core, secondary area, and greenbelt referred to in the Kona CDP are as follows:

1. Urban Core
    a. T-5 Urban Center
    b. T-4 General Urban
2. Secondary Area: T-3 Suburban
3. Greenbelt: GB Greenbelt
4. Special District: SD1 Mixed Use Industrial

The development of compact, mixed-use villages integrates housing, employment, shopping and recreation opportunities. Villages are designed around transit stations/stops that will reduce the need for daily trips and financially support the expanded transit system.

TODs/TNDs may be surrounded by more auto-oriented, lower-density areas called "Secondary Areas." The Secondary Areas are within a half-mile of the TOD/TND urban core. These Secondary Areas take advantage of the services within the Urban Core through an interconnected street system with easy access to transit by foot, bike or car.

Secondary Areas will be primarily comprised of standard single-family and multi-family neighborhoods. These areas may also provide more land-extensive uses that serve TOD/TND residents, such as schools and community parks. Because of their proximity to the Urban Core, Secondary Areas are ideal for bicycle travel.

The Greenbelt is an undeveloped area surrounding the Secondary Area. The Greenbelt is a strategic planning tool to prevent urban sprawl by keeping land permanently open. The purpose of the Greenbelt is to prevent urban sprawl of the TODs/TNDs, prevent neighboring towns from merging into one another, and to preserve the setting and the character of the TODs/TNDs. The Greenbelt may also serve multi-purpose uses, such as for drainage (e.g., flow ways or retention basins), sensitive resource preserves or wildfire protection buffers.

The Kaloko Makai site is designated as one of the Neighborhood TODs on the Official Kona Land Use Map of the Kona Community Development Plan (Kona CDP). As noted, Kaloko Makai also proposes to incorporate a regional hospital into the development. Consistent with the Kona CDP economic policy ECON-1.1, the Neighborhood TOD at Kaloko Makai would automatically be designated a Regional Center TOD, upon receiving a commitment by a hospital developer/operator.

Transit-Oriented Development (TOD) is defined in the Kona CDP as the development of compact, mixed-use villages that would integrate housing, employment, shopping and recreation opportunities. Villages would be designed around transit stations/stops that would reduce the need for daily trips and financially support the expanded transit system. TOD Urban Villages are located a minimum of one mile apart, between major transit stations, along Keohokālole Highway trunk route in order to preserve the transit efficiency of this route.

Kaloko Makai will be a compact, mixed-use village that integrates diverse housing offerings, mixed-use commercial and retail growth and employment opportunities, and a range of community services and facilities (inclusive of medical, lodging, and civic uses as well as recreational opportunities).

Kaloko Makai will be a "Transit Oriented Development" (TOD) and "Traditional Neighborhood Design" (TND) community consistent with the Guiding Principles and Elements of the Kona Community Development Plan.

The central TOD village is designed around a transit station and made up of three neighborhoods, centered on venues of community-wide importance (such as the potential regional hospital and/or schools/parks). An additional mauka TND neighborhood is linked to the TOD through interconnecting roads and trails. A Special District light industrial area is at the makai portion of the property.

Kaloko Makai has also been planned to conform to the County of Hawaii's draft Kona Village Design Guidelines, with its compact residential settings in a transit-ready, mixed-use community. As noted, the urban core of this community would be centered on the new "mid-level" Ane Keohokālole Highway, and residential densities and other specific development characteristics have been developed in conformance to the various "transect zones" define in the Design Guidelines.

Kaloko Makai is consistent with the Kona CDP. In later sections of the Kaloko Makai Sustainability Plan, specific sustainability themes from the Kona CDP will be further reviewed.

Sustainable Design Features

Thoughtful planning of site, neighborhood and improvements design, incorporating mixed-use land uses, walkable streets, encouraging walking, bicycling and public transportation, and respect for the natural and cultural features creates opportunities for more environmentally-responsible and sustainable development. These sustainable neighborhoods are beneficial to the community, the individual and the environment.

Several sustainability programs and plans (noted previously in Chapter 2) identify and address a wide variety of design features that may be incorporated into a development project to enhance its sustainability. These items design features include:

- **Site Planning**
  - Respect for the Land – Work with topography
  - Siting - Proximity to mass transit, shopping, employment centers, recreation, schools
  - Interconnectivity – Connection with neighbors, Multi-modal transportation (to be discussed in another section of this Plan)
  - Intensity of Layout – Village Center; Clustering into compact villages
  - Natural/Cultural Resources – Protection of natural and cultural resources (to be addressed in another section of this Plan)

- **Improvements Planning**
  - Alternatives – Provide a range of housing options at various price levels (to be discussed in another section of this Plan)
  - Orientation – Ventilation; Take advantage of natural air flow
  - Shading – Eve overhang; Vegetation
  - Landscaping – Native plants; Low irrigation
  - Energy Efficiency – (to be discussed in another section of this Plan)

The objectives of Kaloko Makai are to create an attractive master-planned residential community with a variety of housing opportunities and mixed uses, as well as abundant recreational resources.

<u>Site Planning</u>

As a mixed-use community, the objectives of Kaloko Makai are to:

- Create a diverse, sustained community of mixed uses, including residential, retail and commercial spaces, light industrial areas, recreational spaces, and open space.
- Cultivate intrinsic respect for the land and natural surroundings, develop an inherent Hawaiian sense of place and nourish a sustaining living environment.
- Provide housing for the working families of Hawai'i nearby areas of workforce demand, resultantly improving overall quality of life through the reduction of commuting and facilitation of everyday function.
- Openly embrace a diversity of people and activities through offering mixed uses and housing types.
- Contribute to the social fabric of the community by providing infrastructure and facilities, and by including school, hospital, recreational, and civic sites.
- Engender and incorporate intelligent, planned sustainability by design.
- Emphasize non-vehicular transit for mainstream community-wide travel

Kaloko Makai is strategically located along the major regional traffic corridor Queen Ka'ahumanu Highway, between the town of Kailua-Kona and the Airport. Likewise, it is centrally located on Ane Keohokālole Highway, also known as the Mid-Level Road, which will run through the development; this is the major transit corridor called for in the Kona CDP. The area also has a long-standing and growing residential base.

This area will continue to be the focus of such development as the Island's population grows, given its proximity to the Airport and other existing infrastructure. This region is also the commercial and industrial heart of West Hawaii, serving the Airport and the needs of the visitor, agriculture, ranching, technology and other industries of the western half of the Island.

The project is designed support non-vehicular travel (key elements of the Kona Community Development Plan). Project objectives include developing health care facilities in Kona that provide a range of health care services and creating opportunities for on-site employment in retail, commercial, light industrial uses to reduce peak hour traffic impacts and provide higher quality of life for Kaloko Makai residents.

Kaloko Makai is a compact, mixed-use, master-planned community offering a wide range of housing types and affordability, and a variety of businesses and employment opportunities, focused around an initial urgent care medical facility with land available for a new Kona regional hospital. Kaloko Makai has been designated as a Neighborhood Transit Oriented Development (TOD) in the Official Kona Land Use Map of the *Kona Community Development Plan* (County Ordinance No. 08-131, September 2008).

Kaloko Makai will be a residential community, with supporting retail, commercial, hospital, lodging, light industrial, infrastructure, educational, recreational and open space uses.

Kaloko Makai will include the proposed development of up to 5,000 new single- and multi-family residential lots and units at a variety of densities, centralized commercial and neighborhood centers, recreational facilities (e.g. parks, trails, open spaces), urgent care medical facility, hospital, lodge and business center, three school sites, and associated infrastructure (e.g., new roadways, utilities, drainage, wastewater and potable water distribution systems). Affordable housing will be provided in accordance with County of Hawai`i requirements.

The properties' soil class ratings of Class VIIs and Class VIII mean that the soils are not suitable for cultivation and use is generally restricted to non-agricultural use. Additionally, the project area is rated D, E and unclassified by the LSB Detailed Land Classification. With only 6 percent of the project site designated "Other" and the remainder of the project site not classified in the ALISH system, Kaloko Makai will not have an impact on agriculturally significant lands and will not reduce the inventory of agricultural significant lands.

Construction of the proposed development will involve grading, excavation and trenching of presently undeveloped areas within the project site. The project will require alteration of existing landforms to create more efficient land development areas. Appropriate engineering, design and construction measures will be undertaken to minimize potential erosion of soils during construction.

Mitigation measures will be instituted following site-specific assessments, incorporating structural and non-structural BMPs such as minimizing soil exposure and implementing erosion control measures such as silt fences and sediment basins.

Following construction, erosion is anticipated to decrease since the soils will have been graded, built over, paved over or landscaped. Landscaping in turn will provide erosion control. Mass grading of the development areas will be in compliance with the County of Hawai'i's grading ordinance requirements and will require NPDES permit from the State DOH for storm water construction activities, including BMPs to minimize off-site impacts.

Kaloko Makai will be transit-ready and is located along Ane Keohokālole Highway, a key alignment for regional transportation. Ane Keohokālole Highway will function as the primary transit route connecting Kailua Village with the Kona International Airport and constitutes a significant influence on the shaping of Kaloko Makai; a transit station will be incorporated into the TOD village near the central part of the property.

As the primary transit route, there will be future allowance for dedicated transit-way and a transit station will be located within the TOD. Internal roads, trails and paths will interconnect within the various neighborhoods and will allow residents, whether in vehicles, pedestrians and on bicycles, a variety of choices in travelling throughout the project.

In addition, multiple interconnections with adjoining properties are included in the Kaloko Makai master plan. At the request of the Hawai'i Department of Transportation, the project layout and uses on the makai side of the property allow for future development of an interchange intersection with Queen Ka'ahumanu Highway.

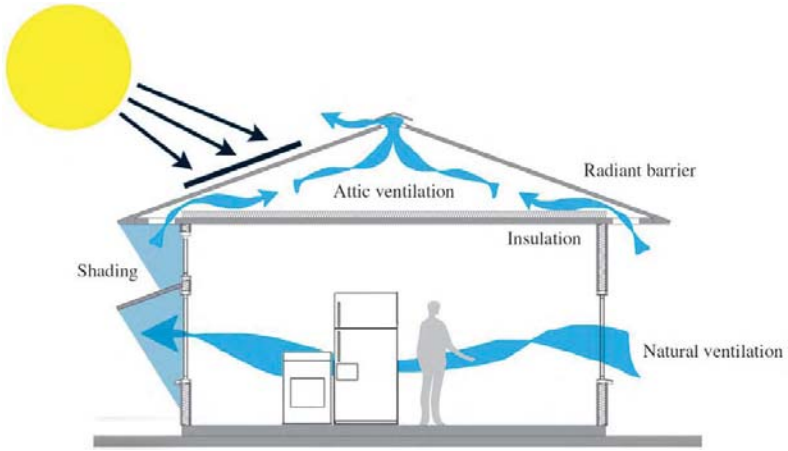
Improvements Planning

There are three major sources of unwanted heat in homes: direct solar impacts on a building and through windows and skylights; heat transfer and infiltration, of exterior high temperatures, through the materials and elements of the structure; and the internal heat produced by appliances, equipment and inhabitants.

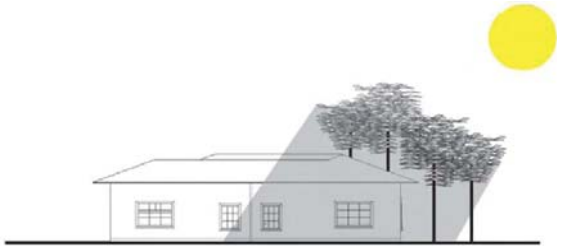
The DBEDT Field Guide for Energy Performance, Comfort and Value in Hawai'i Homes provides a number of recommended ways to incorporate effective design options to address home temperatures. These items to be considered in the development of Kaloko Makai are summarized and illustrated below:

Design for Comfort and Value

A. Control Heat Gain: Use strategies to reduce solar heat gain through roofs, walls and windows.
   1. Orient and arrange building to control heat gain
   2. Landscape and design outdoor surfaces to reduce air temperatures and glare; minimize paving area and use grassed and planted areas to provide lowered site temperatures, shade and evaporative cooling
   3. Shade roofs, walls and windows with:
      a. Architectural elements such as eaves, awnings and carports, and
      b. Window treatments such as blinds and shutters
   4. Use insulation and/or radiant heat barriers in roofs and walls exposed to the sun
   5. Use high performance windows (Low-e, spectrally selective, or tinted glazing) to keep solar heat out of interior spaces while admitting daylight
   6. Use light colored roofing and wall finishes
   7. Shade or insulate materials with high thermal mass, such as concrete floors, to avoid heat build-up and uncomfortably hot surface temperatures



B. Use Natural Ventilation: Provide ample fresh air ventilation for living spaces and areas where hot air and humidity accumulate, such as attics, high ceiling spaces, kitchens, bathrooms and laundry areas.
   1. Orient buildings to maximize the cooling potential of prevailing winds and minimize morning and afternoon heat gain
   2. Design floor plans and opening placement and type to provide effective cross ventilation with good air circulation throughout room areas and at body level
   3. Provide generous screened openings well protected from the rain
   4. Use architectural design elements such as vents and casement windows to improve interior air circulation
   5. Enhance natural ventilation with fans as needed:
      a. Use ceiling and whole house fans to provide comfort on warm, humid or still days
      b. Use solar powered attic vent fans when appropriate and economically feasible



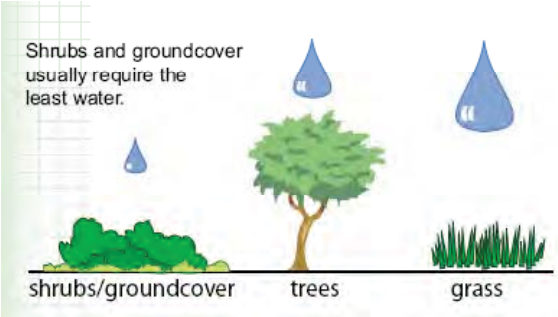
Shaded areas stay cooler

Consistent with the principles and recommendations noted in the DBEDT publication *Hawaii Homeowner's Guide to Energy, Comfort & Value*, to the extent feasible and practical, Kaloko Makai will incorporate the following:

Site Planning and Landscaping
Orientation of homes is important. Try to minimize the area of east- and west-facing walls and windows because they are difficult to shade from the sun.

Landscaping and the design of outdoor surfaces can reduce air temperatures and glare. Landscaping minimizes paving area provides lowered site temperatures, shade and evaporative cooling.

Low impact landscaping
Selection and distribution of plants must be carefully planned when designing a functional landscape. Aesthetics are a primary concern, but it is also important to consider long-term maintenance goals to reduce inputs of labor, water and chemicals. Properly preparing soils and selecting species adapted to the microclimates of a site greatly increases the success of plant establishment and growth, thereby stabilizing soils and allowing for biological uptake of pollutants. Dense, healthy plant growth offers such benefits as pest resistance (reducing the need for pesticides) and improved soil infiltration from root growth. Low impact landscaping can thus reduce impervious surfaces, improve infiltration potential and improve the aesthetic quality of the site.



Protect and retain existing landscaping and natural features. Select plants that have low water and pesticide needs, and generate minimum plant trimmings. Use compost and mulches. This will save water and time.

<u>Examples of Low Impact Landscaping</u>
- Planting native, drought tolerant plants
- Converting turf areas to shrubs and trees
- Reforestation
- Encouraging longer grass length
- Planting wildflower meadows rather than turf along medians and in open space

Control Heat Gain
By using strategies to reduce solar heat gain through roofs, walls and windows, a house can stay cool. Roofs, walls, windows and outdoor flooring can be shaded with architectural elements such as eaves, awnings and carports, and shutters.

Walls

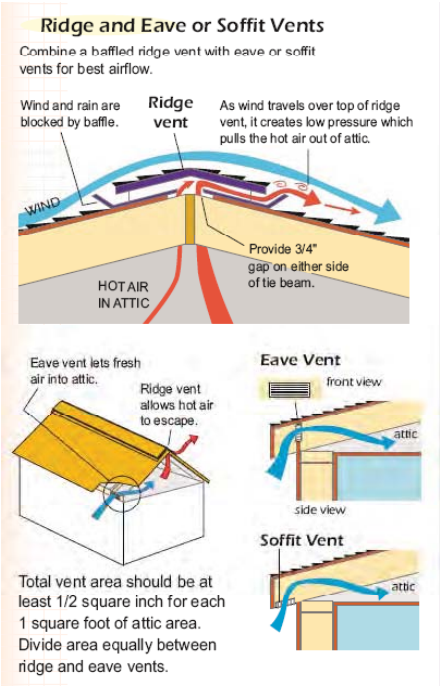
Unshaded walls can get very hot and make your home uncomfortable. The best "cool wall" strategy is shading with overhanging eaves, lanais, or landscaping. If complete shade isn't feasible, use insulation or radiant barriers in the exposed walls. Use a white exterior finish to improve cool wall performance.

Windows

The use of high performance windows (Low-e, spectrally selective, or tinted glazing) helps keep solar heat out of interior spaces while admitting daylight. Overhangs, awning and trees can keep the sun from striking windows directly.

Roofs and Roofing Material

A cool roof is essential for a comfortable home. Insulation keeps roofs and homes cool by blocking heat on the roof thus, the attic, the ceiling and the rest of the house stay cool and comfortable. Installing a white roof will keep a home cooler.



Ventilation is another tool for keeping homes cool. For houses with attics good ventilation is recommended. Ridge and Eave or Soffit Vents work as well. If a ridge vent is not feasible, use a solar powered vent fan in combination with eave or soffit vents, to push warm air out of the house and attic.

Solar Water Heating

Minimizing the energy required for water heating is the most important energy saving step for a Hawaii home. Conventional water heating is a big expense and accounts for about 40% of the utility bill in a Hawaii house.

Hawaii was the first state in the nation to require solar water heaters in new home construction. Act 204 SLH 2008, requires all building permits for single-family homes issued after Jan. 1, 2010, to include solar water heaters. Exceptions are allowed where homes have poor sunlight; if it is cost-prohibitive after 15 years; when the dwelling has a substitute renewable energy source; or if there is an approved tankless water heater and another appliance, both powered by gas.

Additionally insulating hot water supply lines and pipes with at least ½" foam or 1" fiberglass insulation and setting heater thermostats adjustable for 120˚ F or less, can add additional energy savings to a homeowner.

Photovoltaic systems

Consider alternative energy sources such as photovoltaics and fuel cells that are now available in new products and applications. Renewable energy sources provide a great symbol of emerging technologies for the future.

Lighting

Energy Efficient Light Design

Energy efficient light design features help minimize electric lighting energy demand and heat gain. An efficient lighting system uses fluorescent lamps as the primary light source and may selectively use incandescent (also halogen, a type of incandescent) for accent lighting and for applications where the light is usually off (like exterior lights on motion sensor controls). Modern fluorescent lighting can provide excellent color rendering and be free of flicker and hum. Additionally, start up is nearly instantaneous with electronic instant-start and rapid-start ballasts. Fluorescent lamps last 10 to 20 times longer than incandescents, saving energy all the while, so the lifetime cost is much lower and fluorescent lights do not emit as much heat as incandescents.

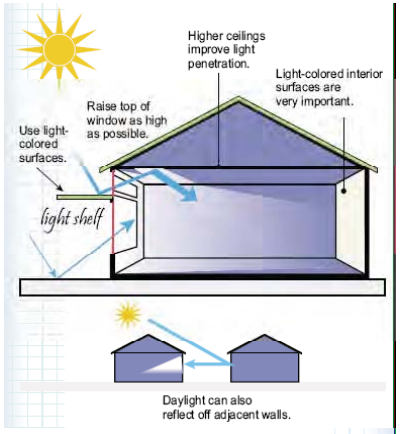
Providing controls such as timers, dimmers, sensors and separate fan/light controls to limit power use to the times and levels needed, also helps reduce lighting power consumption.

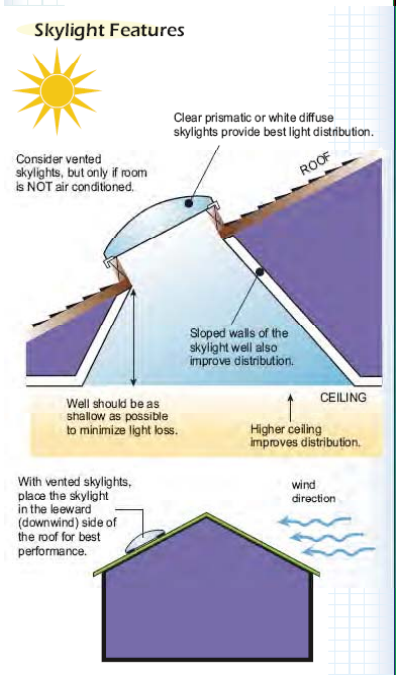
The use of solar powered landscape lighting when economically feasible is another energy saving design feature which can be used for both residential homes, as well as, business and civic buildings and spaces.

Daylighting

Daylighting is the use of natural sunlight to light interior spaces. Using controlled, filtered and indirect daylighting to light interior spaces reduces electric lighting loads. The effectiveness of daylighting can be increased with generous wall openings, open floor plans and light colored interior finishes.

Windows are usually a home's main source of daylight. Blocking direct sunlight and bouncing light on to the ceiling helps facilitate daylighting.





Additionally, minimizing areas of east- or west-facing windows and using blue or green glass help.

Skylights (traditional, vented, tubular) can provide significant daylighting opportunities.

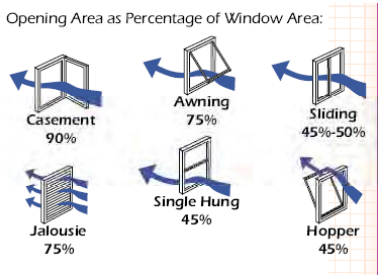
Light-colored interior finishes are critical for good light distribution thus, white ceiling is recommended.

Rooms with higher ceilings and narrow floor plans are easier to daylight. Consider several smaller skylights instead of one larger skylight for better light distribution.

Natural Ventilation

Kaloko Makai will optimize air-flow by designing homes that capture cooling breezes to keep homes comfortable. Utilizing natural ventilation also helps reduce health hazards such as mold and mildew.

Buildings should be oriented to maximize the cooling potential of prevailing winds and minimize morning and afternoon heat gain. Floor plan design will include effective cross ventilation with good air circulation throughout room areas and at body level.



Providing generous screened openings and using architectural design elements such as vents and casement windows will improve interior air circulation.

Ceiling fans are a great way to enhance natural ventilation. Use ceiling and whole house fans to provide comfort on warm, humid or still days.

Transportation

The Kona CDP notes that future growth should connect communities with movement alternatives such as sidewalks, trails and bike lanes. The community needs an efficient public transportation system for moving people. It should have comfortable and frequent service to key destinations, along prominent commuter routes, and at transfer points that offer connections to alternative modes of transportation.

There are several other major strategies that embody the Guiding Principles expressed in the Kona CDP. They relate to transportation, housing, land use and infrastructure that need to be integrated and incorporated into Kona's long-term transportation policies as Kona's population continues to grow in the years ahead. These strategies include the following:

1. **Mass Transit.** A major expansion of the County's public mass transit service in Kona would provide significant alternatives to individual automobile use.
2. **Multi-Modal Transportation.** Taking advantage of Kona's consistently mild climate, a network of interconnected bike lanes, trails and sidewalks within and outside road right-of-ways would provide a healthy and green alternative to automobile use.
3. **Transit-Oriented Development (TOD).** The development of compact, mixed-use villages that would integrate housing, employment, shopping and recreation opportunities. Villages would be designed around transit stations/stops that would reduce the need for daily trips and financially support the expanded transit system.
4. **Multi-Purpose Design.** Beyond getting us from one place to another, our transportation corridors are major public spaces that must safely accommodate uses other than vehicular travel.
5. **Safety and Aesthetic Qualities.** Safety and aesthetic qualities need to play a larger role in improving existing and designing future roadways, in order to contribute to Kona's quality of life and tourism appeal.
6. **Affordable Housing.** Affordable housing located near major employment centers would serve to decrease the number of people who fill the roadways commuting long distances to work every day. (to be addressed in another section of this Plan)

Kaloko Makai is committed to Transit-oriented, Interconnected and Concurrent Transportation for its residents and community.

Development of a Transit Station to Facilitate Mass Transit Use and Accessibility

Kaloko Makai has been designated as a Neighborhood Transit Oriented Development (TOD) in the Official Kona Land Use Map of the Kona Community Development Plan. A transit station and TOD community on Ane Keohokālole Highway is an integral part of the multi-modal transit corridor called for in the Kona CDP.

Kaloko Makai is strategically located along the major regional traffic corridor of Queen Ka'ahumanu Highway, between the town of Kailua-Kona and the Airport. Likewise, it is centrally located on Ane Keohokālole Highway, which will run through the development; this is the major transit corridor called for in the Kona CDP.

Consistent with the policies and goals stated in the Kona CDP, Kaloko Makai will utilize TOD and Traditional Neighborhood Development (TND) to promote transit-oriented and pedestrian oriented development, decreasing vehicular transit use and facilitating the management of traffic congestion.

A transit station and compact TOD Village on Ane Keohokālole Highway is an integral part of the multi-modal transit corridor called for in the Kona CDP

The County of Hawai'i Mass Transit Agency provides an island-wide public bus transit system called Hele-On Bus. The Hele-On Bus currently provides bus service along Queen Ka'ahumanu Highway.

Kaloko Makai will incorporate a transit station at the center of the Kaloko Makai TOD on Ane Keohokālole Highway. To enhance efficiency of the transit station and allowing the ease of flow of the transit buses, component parts of the transit station will be constructed on either side of Ane Keohokālole Highway (across from each other.) Placement near the Kohanaiki Trail and new mauka-makai road will enhance accessibility of residents within Kaloko Makai.

The mauka component of the transit station will serve north-bound transit on Ane Keohokālole Highway; it will be situated in the Middle School/Park Neighborhood in the TOD between the Kohanaiki Trail and the new mauka-makai road through the Kaloko Makai project.

The makai component of the transit station will serve south-bound transit on Ane Keohokālole Highway; it will be situated in the Makai Elementary School/Park Neighborhood in the TOD between the Kohanaiki Trail and the new mauka-makai road through the Kaloko Makai project. A pedestrian crossing or crosswalk will be incorporated into the intersection of the new mauka-makai road and Ane Keohokālole Highway as a designated point to assist pedestrians wishing to cross.

The transit station will be a structure where buses stop to pick up and drop off passengers. It will be larger than a typical bus stop. A Park and Ride facility will be incorporated into the vicinity of the transit station; this will include storage for bicycles. Since Kaloko Makai is not a designated transit hub (a hub includes a major park and ride facility for commuters (primarily resort workers,)) the Park and Ride will be a reduced scale.

The transit station will be designed to accommodate safe and easy access for the various methods people will use to use the station including, walking, biking, driving and parking, kiss and ride, and other transit. Since this is a core central place for residents within Kaloko Makai, as well as those travelling to and through the community, public open spaces will be incorporated into the design, including parks, squares and plazas, streets and sidewalks.

Multi-modal Interconnected Roads and Streets

The TOD and TND within Kaloko Makai are compact mixed-use villages, characterized by a village center within a higher-density urban core, roughly equivalent to a 5-minute walking radius (1/4 mile), surrounded by a secondary mixed-use, mixed-density area with an outer boundary roughly equivalent to a 10-minute walking radius from the village center (1/2 mile).

Kaloko Makai incorporates multiple road interconnections with neighbors and Kaloko Makai is committed to concurrent construction of the Ane Keohokālole Highway and Kamanu Street realignment/extension through the project.

Kaloko Makai will incorporate a system of interconnected roads that will provide residents alternative transportation routes within the project. The internal circulation pattern will provide safe and convenient choices for drivers, bicyclists and pedestrians. Neighborhoods will be interconnected to popular destination and neighborhood cores (such as the transit station, hospital, shopping, schools and parks,) as well as the surrounding secondary areas.

The transit station will be a structure where buses stop to pick up and drop off passengers. A Park and Ride facility will be incorporated into the vicinity of the transit station; this will include storage for bicycles. Additionally bike racks of uniform design may be placed around the development to encourage alternative transportation.

Through recent legislation, the State of Hawaii Department of Transportation (HDOT) and county transportation departments are required to ensure the accommodation of all users of the road, regardless of their age, ability, or preferred mode of transportation. In addition, the concept of "Complete Streets" is prioritized where:

> "(T)ransportation facilities ... are planned, designed, operated and maintained to provide safe access and mobility for all users, including bicyclists, pedestrians, transit riders, freight and motorists".

In addition to providing vehicle access, roadway networks are a vital part of the livability of our communities. Complete streets will provide an ease of use and access to destinations by providing an appropriate path of travel for all users, and enhance the ability to move people and goods throughout the state and its counties. Additionally, complete streets principles will help contribute to a clean and secure energy future for Hawaii by offering flexibility and better accommodation for safe transit, walking, bicycling and alternate fuel vehicles that together, will decrease demand for imported oil.

Complete Streets are streets for everyone. They are designed and operated to enable safe access for all users. Pedestrians, bicyclists, motorists and public transportation users of all ages and abilities are able to safely move along and across a complete street. Complete Streets make it easy to cross the street, walk to shops, and bicycle to work. They allow buses to run on time and make it safe for people to walk to and from train stations.

The Kaloko Makai master plan integrates the natural features of the area, including the preservation of a historic Kohanaiki Trail as an interconnecting neighborhood pedestrian way, which starts outside of the project area and traverses through the Kaloko Heights project, through Kaloko Makai, down to Queen Ka`ahumanu Highway. The historic trail runs in the east-west (mauka-makai) direction through the project area and is an integral component of the project. Two school sites and multiple parks are proposed near the trail. Kaloko Makai will also incorporate two trails that run through the dryland forest into the pedestrian access ways.

Economic Opportunities

Kaloko Makai provides significant, on-going economic and fiscal benefits for residents of Hawai'i, as well as for the County and State governments. Development of facilities would generate employment and consequent income and taxes. In addition, by attracting new residents to the Island of Hawai'i and generating additional real estate sales activity, the Project is expected to support long-term impacts, including additional consumer expenditures, employment opportunities, personal income and government revenue enhancement.

During its first 20 years, Kaloko Makai's development is estimated to generate employment for some 1,000 to 1,200 full-time equivalent (FTE) persons annually, including positions created directly and indirectly by its development activities. In the final eight years or so of the Project's build out, after most of its major infrastructure would have been completed, Kaloko Makai is expected to support 800 FTE development-related jobs per year. All of these jobs would be located throughout the State, with greatest concentration on Island of Hawai'i.

The new development-related positions are expected to be associated with total personal earnings of some $1.66 billion over the Project's initial build-out, or $49 to $68 million per year. The earnings represent an average of about $58,000 per FTE job, including direct construction-related jobs as well as indirect and induced opportunities created throughout the economy.

By the time of its expected completion in 2045, the Project could be expected to have generated some 4,200 direct FTE jobs on-site at its retail, office, industrial, lodge and medical-related facilities. Because these on-site jobs would all be supported at Project components, they are all direct impacts; there are assumed to be no indirect or induced employment impacts on-site.

Personal earnings from the new operational positions will increase over time as more facilities and establishments are opened. New personal earnings are projected to total about:

- $28 million per year from late 2012 to late 2022,
- $86 million per year from late 2022 to late 2032,
- $119 million per year from late 2032 to late 2040, and
- After 2040, some $115 million per year on an ongoing basis.

Opportunities created by Kaloko Makai, particularly its professional, technical and managerial career opportunities, will create incentives for some neighbor islanders or former Hawai'i residents to move back to the State and/or to the Island of Hawai'i.

In addition, some of Kaloko Makai's homes could be expected to attract some households that previously lived off-island or out-of-state. These could include retirees as well as younger households.

The influences described above are estimated to result in perhaps 360 persons living on the Island of Hawai'i who might not otherwise have lived on the island (in-migration to the County) by late 2022, or up to 1,040 after Project completion in late 2045. Of this total, some 280 and 760 persons, respectively, might be persons who had previously lived out-of-state.

On-Site Employment Generators

The purpose of the Kaloko Makai project is to create a compact, mixed-use, master-planned community offering a wide range of housing types and affordability, and a variety of businesses and employment opportunities, focused around an initial urgent care medical facility with land available for a new Kona regional hospital. A Lodge and Business Center will support the commercial needs within the Transit Oriented Development (TOD) including the Hospital.

Hospital

Policy ECON–1.1 of the Kona CDP states that a hospital serves as a stimulus for the healthcare industry. It further states that Kona needs a new hospital to replace its existing outdated and out-of-place facility, and that the hospital should be located on Keohokālole Highway (Mid-Level Road) for optimum accessibility by automobile or transit. The Kona CDP encourages the private sector to negotiate a site for the hospital by granting any TOD designated as a Neighborhood TOD, automatic Regional TOD status.

Kaloko Makai is strategically located to incorporate the new hospital into its master plan and is actively pursuing a hospital developer/operator for the new facility. The Kaloko Makai development seeks to have a hospital developed within the project on a 40-acre site along Ane Keohokālole Highway. The site will also have access to Queen Ka'ahumanu Highway via Hina Lani Street and interconnecting roads (possibly also through adjoining Kohanaiki Business Park). A new regional hospital for Kona is projected to need approximately 100-150 total beds (with 150 targeted - which will include between 50-70 beds for medical surgery) to serve the growing West Hawai`i population.

Lodge and Business Center

The 120-unit Lodge and Business center will encompass approximately 5-acres of land. The Lodge and Business Center will be located at the TOD village core and cater to the business market. It's location within the core provides convenient walking access to the uses and activities, including the transit station.

The Kaloko Makai Lodge and Business Center will provide accommodations, restaurant services and business services in conjunction with the general business/leisure demands generated by the uses in the Kaloko Makai TOD and the surrounding community.

In addition, families and friends of patients, as well as visiting physicians and others associated with the Hospital, will have easy and convenient access to lodging near the Hospital. This can include out-of-town visitors, as well as local residents who want to be immediately near their loved ones in the hospital.

Whether or not the hospital is located in Kaloko Makai, its uses are anticipated in the region and the Kaloko Makai Lodge and Business Center will serve its needs.

Commercial Area

Kaloko Makai proposes up to 600,000-square feet of gross leasable area of various commercial uses at Kaloko Makai, including retail and office. This will include spaces in shopping centers, retail and office uses and mixed-use developments; approximately 75-acres are proposed for industrial use. The first finished commercial or industrial building products are assumed to be available for use in about 2015.

In addition to the primary uses noted above (Hospital and Lodge,) Kaloko Makai proposes several areas for commercial uses that, ultimately, will serve to promote and provide a variety of job opportunities. Together, the proposed developments would create a substantial residential, civic and employment center, generating myriad opportunities for community life as well as employment in professional, business, service and retail fields for island residents.

Considering the Project's direct, indirect and induced impacts statewide, Kaloko Makai could alternatively be seen to have generated some 2,300 permanent, on-going FTE jobs. These are positions that might not have existed had the Project not been developed. These "net new" jobs could include shares of the professional, technical, managerial and other staff positions at the new hospital, other medical facilities, office and retail areas; sales and marketing positions supported by the on-going resales and releasing of property at the Project; positions generated at the business and kama`aina-oriented lodge; and myriad other positions generated throughout the economy.

Open Space and Parks

Kaloko Makai holds respect for the environment by interlinking natural features, open space and cultural features as core components of the community; the historic Kohanaiki Trail runs through the entire length of the project and will be incorporated as an integral component of the project, interconnecting the neighborhoods; a dryland forest preserve will protect and preserve endangered plants in perpetuity.

There will also be generous open space features including approximately 279-acres of parks and open space consisting of 72-acres of open space, 58-acres of parks, and preservation of the 150-acre Kaloko Makai Dryland Forest Preserve.

Numerous active and passive recreational areas are incorporated into the Kaloko Makai project. Neighborhood and District-scale parks provide opportunities within the residential-oriented TODs.

The residential-focused Kaloko Makai TOD neighborhoods are centered and focused on schools, each school site has its own DOE-scaled playground; in addition, approximately 10-acres of added recreational space adjoin each of the Kaloko Makai School sites. This additional area will be available for community recreation, meeting and other uses.

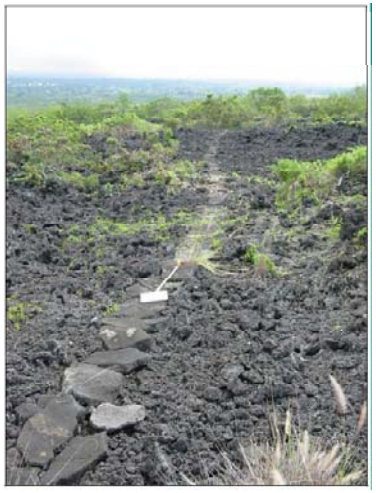
Varied active and passive uses include soccer fields, baseball fields, community meeting areas, tot lots, daycare centers, senior centers, among others will be included in these additional parks adjoining each school site.

To further complement the recreational opportunities, Kaloko Makai will include a makai district-scale park that will include playfields, multi-purpose building, courts (basketball, tennis, volleyball), tot lot, etc.

Approximately 58-acres of park space is planned, including the 30-acres of park space adjoining each of the Kaloko Makai school sites.

The Kaloko Makai master plan integrates the natural features of the area, including the preservation of a historic Kohanaiki Trail as an interconnecting neighborhood pedestrian way.

The historic Kohanaiki Trail starts outside of the project area and traverses through the Kaloko Heights project, through Kaloko Makai, down to Queen Ka`ahumanu Highway. The historic trail runs in the east-west (*mauka-makai*) direction through the project area.



Kaloko Makai will also incorporate two trails that run through the dryland forest (one is shown above)

Other significant archaeological features are found in the northwest section of the property. In order to preserve and protect these features, the area will be left in a natural state, with pockets of low-density residential interspersed in the area. This open space also helps to serve as a mauka greenbelt (GB1) to the Kaloko Makai TOD.

The Kaloko Makai master plan also integrates a 150-acre preservation area for a native dryland forest located on the southern portion of the project site. This open space will also serve as a southern greenbelt (GB1) to the Kaloko Makai TOD.

From Ane Keohokālole Highway down to Queen Ka`ahumanu Highway, Kaloko Makai will set aside a 100-foot buffer that fronts Hina Lani Street. This open space also helps to serve as a greenbelt (GB1) to the Kaloko Makai TOD.

Significant archaeological and cultural sites, which include historic trails, will be integrated into the master plan. Archaeological and cultural sites will be protected and maintained with appropriate treatment and buffers from adjacent uses, as necessary.

Water Management

As an overarching philosophy in all source alternatives, Kaloko Makai is committed to water conservation strategies to reduce consumption, conserve resources and minimize water use. The goal is to reduce the total water use through a combination of water saving equipment and strategies.

A number of measures may be implemented to facilitate end-user conservation, including water restrictions during drier periods, public education and more efficient landscaping practices. Consumption could be significantly reduced through end-user conservation.

Efficient fixtures and appliances will reduce indoor water use. The water distribution system will be maintained to prevent water loss and homeowners and businesses will be encouraged to maintain fixtures to prevent leaks. Landscaping will emphasize climate-adapted native and other appropriate plants suitable for coastal locations. Best management practices will be designed and implemented to minimize infiltration and runoff from daily operations.

WaterSense

WaterSense, a partnership program by the U.S. Environmental Protection Agency, seeks to protect the future of our nation's water supply by offering people a simple way to use less water with water-efficient products, new homes and services. WaterSense brings together a variety of stakeholders to:

- Promote the value of water efficiency.
- Provide consumers with easy ways to save water, as both a label for products and an information resource to help people use water more efficiently.
- Encourage innovation in manufacturing.
- Decrease water use and reduce strain on water resources and infrastructure.

The program seeks to help consumers make smart water choices that save money and maintain high environmental standards without compromising performance. Products and services that have earned the WaterSense label have been certified to be at least 20 percent more efficient without sacrificing performance.

If one in every 10 homes in the United States were to install WaterSense labeled faucets or faucet accessories in their bathrooms, it could save 6 billion gallons of water per year, and more than $50 million in the energy costs to supply, heat, and treat that water!

Water Efficient Fixtures

Water is a finite resource—even though about 70 percent of the Earth's surface is covered by water, less than 1 percent is available for human use. Each American uses an average of 100 gallons of water a day at home. We can all use 30 percent less water by installing water-efficient fixtures and appliances. The average household spends as much as $500 per year on their water and sewer bill and can save about $170 per year by installing water-efficient fixtures and appliances.

Water-efficient fixtures reduce water and sewer costs, reduce demand on water supplies and treatment facilities, and reduce heating energy consumption and associated greenhouse gas emissions.

High efficiency toilets: (HETs) reduce flush volumes by no less than 20% compared to conventional ultra-low flow (ULFT) toilets. Dual-flush HETs allow users to choose one of two flushes: liquids or solids. In actual operation, dual-flush HETs average about 1.2 to 1.4 gpf. Pressure-assist HETs use a pressurized tank that creates for a more forceful flush with less water.

Faucets: Water flow is reduced by ***Flow limiters*** which are built into the faucet or are installed as after-market fittings. Aerators or laminar flow devices are types of flow limiters.

- Aeration injects air into the stream of water, displacing much of the water content.
- Laminar flow uses multiple small diameter parallel streams of water that are not aerated.

Flow control valves can limit water flow down to 1.5 to 0.5 gpm per side (hot and cold).

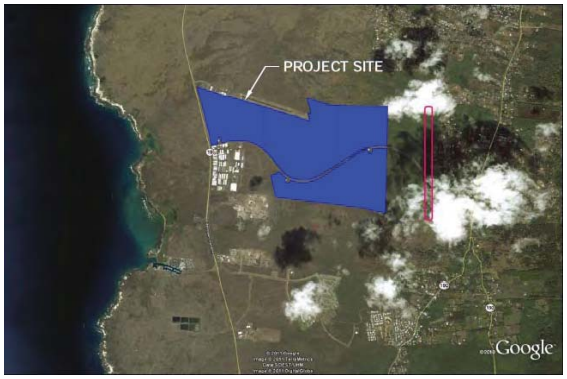
Showerheads: Federal law since 1994 mandates that all showerheads sold in the United States use 2.5 gpm or less. Despite this, some showerheads actually use much more than 2.5 gpm, and shower towers that include multiple showerheads or jets can total 12.5 gpm or more. A better option is a good quality low-flow showerhead designed to use 2.0 gpm or less while providing a satisfying shower.

Groundwater

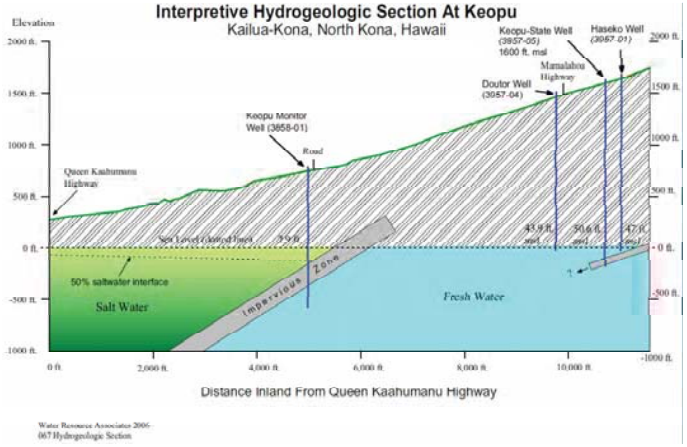
The preferred alternative for potable water for Kaloko Makai is via mid-elevation on-site wells situated at approximately the 750-foot elevation. These wells will be drilled to tap into freshwater that is found at depth, through the traditional basal lens, as well as through the underlying seawater below the brackish lens, to a layer of fresh water below these two layers.

An underlying fresh water layer was found in the State's monitor well, as well as apparent evidence from the recently drilled well at Kamakana Villages project, to the south of Kaloko Makai. In the event treatment is required, as an extension of the preferred alternative, an on-site treatment facility will desalinate the water to potable standards.

Three to four mid-level on-site wells will be drilled at an elevation of approximately 750-feet, on the project site. These wells will be drilled to tap into freshwater that is found at depth, through the traditional basal lens, as well as through the underlying seawater below the brackish lens, to a layer of fresh water below these two layers.



While potable water is expected from these on-site mid-level wells, in the event the water does not meet DOH standards for domestic use (i.e. too saline,) then the groundwater will be desalinated in an on-site desalination facility; this is an extension of the preferred alternative for water source for the Kaloko Makai project.



The proposed water system will be subject to regulation as a public water system and will meet conditions of the State Department of Health, including HAR Chapter 11-20, 11-21 and 11-25. The desalination water system will have no impact on potable or brackish groundwater. Likewise, it will not affect nearshore waters and will not affect groundwater used by neighboring projects or anchialine pools and fishponds in the area, including nearby Kaloko-Honokōhau National Park.

Storm and Surface Water Runoff

The project's proposed drainage system will be designed to minimize impacts to near shore coastal waters. Water quality treatment and detention basins will be built to prevent runoff and sedimentation from impacting groundwater resources.

Prior to the occupancy of any residential or commercial unit within the project, Kaloko Makai shall implement and maintain storm and surface-water runoff BMPs, subject to any applicable review and approval of the State DOH, designed to prevent violations of State water quality standards as a result of storm-water discharges originating from the project. These BMPs will be documented in a declaration of covenants, conditions and restrictions that will be recorded against the property and will run with the land.

The drainage system along Hina Lani Street consists of roadside swales with disposal in drywells. Kaloko Makai proposes a 100-foot wide natural greenbelt that will adjoin the north side of Hina Lani Street, from Ane Keohokālole Highway to Queen Ka'ahumanu Highway. In addition, the makai district-scale park may serve as a collection basin for any excess water.

Potential water quality impacts during construction of the project will be mitigated by adherence to State and County water quality regulations governing grading, excavation and stockpiling. The County's grading ordinance includes provisions related to reducing and minimizing the discharge of pollutants associated with soil disturbing activities in grading, grubbing and stockpiling.

Construction BMPs will be utilized in compliance with County ordinances pertaining to grading, grubbing, stockpiling, soil erosion and sedimentation during construction. BMPs will also be implemented for long term development and operation of activities occurring on the site as part of pollution prevention measures.

BMPs include storm water runoff and non-storm water sources control measures and practices that will be implemented to minimize the discharge of erosion and other pollutants from entering into the receiving State waters. The erosion control plan for the proposed project include temporary and permanent control measures BMPs that will be implemented in accordance with Chapter 10 of the Hawai'i County Code.

Post construction BMPs to prevent erosion and storm water runoff after construction is completed includes the installation of drain inlets and shallow drywells within the project site, and landscaping and grassing of disturbed areas.

Prior to occupancy, Kaloko Makai will implement and maintain storm and surface-water runoff BMPs, subject to any applicable review and approval of the DOH. Those BMPs will be designed to prevent violations of State water quality standards as a result of storm-water discharges originating from the Project.

Kaloko Makai will develop a pollution prevention plan ("PPP") that provides BMPs, including structural BMPs, for pollution prevention that address all categories of permitted uses within the project, and will address environmental stewardship and the non-point sources of water pollution that can be generated from any uses allowed within the Project.

There will be an emphasis on BMPs that prevent or limit pollutants arising out of the permitted uses within the Project from reaching the groundwater and ocean.

Kaloko Makai will be consistent with the Kona CDP Policy PUB–4.7: Urban Stormwater Management, by developing a Stormwater Management Program and Stormwater Management Guidelines that will regulate development and establish standards for public projects. The evolution of this program shall consider the following:

(a) a connected hierarchical overflow system where overflows from 10-year storm facilities (e.g., drywells) are directed to higher-capacity flood management systems, so that the total system can safely accommodate a 100-year storm;
(b) use of natural drainageways and retention areas to the extent possible to maximize infiltration (groundwater recharge), filtration, and settling;
(c) multi-purpose use of the higher-capacity (e.g., 25-year, 50-year, 100-year) flood management facilities for recreation or other uses since these areas will flood infrequently;
(d) engineered "natural" flow ways to direct the sheetflow runoff into more defined drainageways;
(e) onsite retention measures, such as rainwater harvesting methods;
(f) street standards that minimize runoff and transport of sediment and contaminants;
(g) watershed management system perspective;
(h) Based on the Stormwater Management Program, existing and proposed Stormwater management flow ways and facilities shall be shown on the Official Public Facilities and Services Map, especially those maintained by the County.

Wastewater

Kaloko Makai will construct and operate an on-site Wastewater Treatment Plant (WWTP) within the project. The WWTP will be designed to reduce the concentrations of the following compounds in the effluent of the Private WWTP to: Total Nitrogen ("TN") to a concentration of <5 mg/l, and Total Phosphorous ("TP") to a concentration of <2 mg/l (aerobic nitrification processes combined with anoxic/anaerobic sand filters to perform denitrification, or comparable technology). The WWTP will be subject to conditions of approval by the DOH, including any lower concentrations of TN and/or TP in the effluent, and HAR Chapter 11-62.

Effluent disposal for the Private WWTP shall be in accordance with all applicable laws. Monitoring of the WWTP will be pursuant to the annual reporting requirements of the DOH, Wastewater Branch, and shall include a monthly summary of concentrations of TN and TP in the effluent, the volume of recycled water used, the volume of recycled water stored, the volume and location of any recycled water spills, volume of any reject wastewater, and details on the irrigated areas including water budgets, precipitation, evaporation, application rates and monitoring of best management practices.

An on-site WWTP will be self-sufficient, water efficient and environmentally sound. The Kaloko Makai facility will treat the wastewater to provide recycled (R-1) water for general irrigation within Kaloko Makai and thus lessen demand for potable water for irrigation needs. This reuse of treated wastewater is consistent with the Kona CDP which has an action designating the area below Ane Keohokālole as a reclaimed wastewater zone (Action TRAN–3.3a: Designates the reclaimed wastewater zone (Wastewater Re-use Area) on Figure 4-10c Official Public Facilities and Services Map.)

Kaloko Makai will develop a groundwater monitoring plan, to detect contaminants in the groundwater below the Project. The groundwater-monitoring plan will include monitoring wells and a sampling and analysis plan.

Parameters to be analyzed will include pH, temperature, salinity, nitrate, ammonia, dissolved organic nitrogen, TDS, TN, phosphate, dissolved organic phosphorus and TP and any other parameters required by the DOH. The sampling frequency shall begin prior to the start grading activity, and shall be conducted quarterly for two years, or as required by the DOH.

Energy Management

At full build out, the annual electrical demand for Kaloko Makai is expected to reach a maximum of approximately 204 million kilowatt-hours. This is an estimated figure that does not account for potential demand reductions corollary to energy efficiency and conservation measures, such as the use of solar photo-voltaic systems.

HELCO has specified that the current nearby Kaloko substation will not satisfy the needs of the project, and the demands of the project will require an extension of an existing 69,000 volt transmission line along Queen Ka'ahumanu Highway to a new on-site substation. Further, on-site distribution line extensions and easements will be required to service the projects anticipated load. Kaloko Makai will collaborate directly with HELCO to determine, plan, and execute any facility expansion requirements. Subterranean electrical distribution systems are expected to be standard throughout Kaloko Makai.

Pursuant to Chapter 344 (State Environmental Policy) and Chapter 226 (Hawai'i State Planning Act), HRS, all Kaloko Makai activities, buildings and grounds will be designed with a significant emphasis on energy conservation and efficiency. Efficient design practices and technologies will be the cornerstone of Kaloko Makai's design phase.

Buildings within Kaloko Makai will further comply with the County of Hawai'i Energy Code (Hawai'i County Code, Section 5, Article 2). Furthermore, solar water heaters will be utilized as made requisite under Section 196-6.5, HRS. Kaloko Makai will confer with HELCO in regards to suggestions and proposals for customized demand-oriented management programs offering rebates for the installation of alternative energy efficient technologies and measures

Kaloko Makai is committed to renewable energy and energy efficiently as ways to reduce environmental harm and self sufficiency. Kaloko Makai will continue to improve programs and create new programs as the development is initiated.

Residents of the State of Hawaii pay the highest electricity rates in the US. The average American paid 10.5 cents/kWh in 2010. In the state of Hawaii, Oahu currently has the lowest residential electricity rates, while Lanai has the highest. Residential rates on Hawaii Island average between 37-40 cents/kWh. Hawaii relies on imported oil for approximately 76% of its total electricity production. The price variation across the state is largely a result of difference in power plant efficiencies, power purchasing agreement and other infrastructure.

The Hawaii Electric Light Company ("HELCO") is the sole electric utility on Hawaii Island. Its power grip is not connected with that of any other island but is part of the Hawaiian Electric Company (HELCO), which also owns the utilities on Oahu, Maui, Lanai and Molokai. HELCO provide electricity for approximately 77,000 customers on the island. Most of the system's electricity generation (69%) comes from fuel oil and naphtha.

Over 70% of electricity generation and virtually all transportation fuel currently use imported petroleum products. Gasoline prices are among the highest in the nation. Kona has one power plant, the Keāhole Power Plant, which currently uses imported petroleum diesel.

In 2009 the State Legislature codified the need for energy efficiency by enacting the statewide energy efficiency portfolio standard with a target of reducing energy consumption by 30% of forecasted energy consumption by 2030 (4,300 GWh) and beginning the process for separating efficiency from the existing renewable portfolio standard.

The Energy section of the Kona CDP identifies that objectives, policies and actions that will guide Kona toward energy sustainability. Energy is a key component for achieving a sustainable community, which is a guiding principle of the Kona CDP. In that regard, it supports other sections of the Kona CDP, particularly Housing; Transportation; Land Use; and, Public Facilities, Infrastructure and Services.

Energy policies have a pervasive influence on other related policies:

Housing

- Energy policies can lower residents' energy costs for housing and commuting, thereby providing more funds for home financing or renting;

Transportation and Land Use

- Transportation and Land use policies that reduce dependence on the automobile through compact, walkable, mixed use, villages and expansion of the transit system also reduce fuel consumption;

Environment

- Global warming - Energy policies that support energy conservation and replacement of fossil fuels with renewable energy sources reduce greenhouse gas emissions;
- Open space - Energy policies provide further justification to preserve forests and other natural open spaces that lower air temperature and remove ("sequester") carbon dioxide;

Economy

- Energy policies can stimulate new local business opportunities (e.g., solar water heater installers, 3rd party distributed energy providers). Additionally, savings from energy conservation measures translate into more disposable income for individuals and working capital for businesses. The dollars from new local businesses, disposable income spending, and working capital re-circulate in the local economy, thus creating more economic benefit than importing from foreign sources.

The overall strategy for the Kona CDP energy policies is to reduce per capita demand and move toward renewable energy sources. Kaloko Makai will support this strategy by employing the following where feasible:

Energy Efficiency in Transportation

- Creating compact, mixed use walkable communities which in turn reduce transportation fuel usage.
- Integrating mass transit station within the Kaloko makai development to help facilitate the expansion of the County's mass transit system.

Energy efficiency in homes and buildings

- Hawai'i Revised Statutes section 46-19.6 requires all county agencies to place a "priority on processing of permit applications for construction projects incorporating energy and environmental design building standards."

To reduce net energy consumption and demand, Kaloko Makai will consider the implementation of elements of the United States Environmental Protection Agency (EPA) Energy Star Program; including efficient insulation, high performance windows, compact construction, efficient ventilation systems, and energy efficient lighting elements and appliances. Kaloko Makai will furthermore seek to harness energy conservations and technologies to facilitate the possibility of net energy metering in building design to empower residents and tenants to reduce their electricity costs and provide energy back to the grid.

Energy conservation and efficiency measures will be implemented and emphasized where applicable in the design of Kaloko Makai. Energy-efficiency technologies to be considered include:

- Solar energy for water heating
- Photovoltaic systems, fuel cells, biofuels and other renewable energy sources
- Optimal utilization of daytime sunlight
- High efficiency light fixtures
- Roof and wall insulation, radiant barriers and energy efficient windows
- Optimized air-flow
- Installation of heat resistant roofing
- Intelligent Landscaping to provide for shading, dust control, and heat-mitigation
- Portable solar lighting (i.e. parking lots)

Health and Active Lifestyles

Through the layout and design of Kaloko Makai, there is an overall opportunity for a positive effect on the health of its residents. Communities that make it easy and safe to walk and ride bikes are opening the door to a wide range of health benefits for their residents. They are reducing barriers to being physically active and helping individuals integrate physical activity into their daily lives.

Active living is a way of life that integrates physical activity into daily routines. For individuals, the goal is to get a total of at least 30 minutes of activity each day by, for example, walking, bicycling, playing in the park, working in the yard, taking the stairs or using recreation facilities. For communities, the goal is to provide opportunities for people of all ages and abilities to engage in routine physical activity and to create places and policies that encourage better physical health.

The burden of physical inactivity:

The Problem:
- 25% of adults are sedentary
- 60% of adults not active enough

The Outcome:
- Obesity, cardiovascular disease, cancer, diabetes, depression
- Physical inactivity is a primary factor in over 250,000 deaths annually.
- Medical costs associated with physical inactivity and its consequences may exceed $76 billion annually. (hawaii.gov/health/healthy-lifestyles)

Walkable and bikable communities increase active living. Active living can improve health by:
- Reducing the risk of dying prematurely.
- Reducing the risk of dying from heart disease.
- Reducing the risk of developing diabetes, colon cancer and high blood pressure.
- Reducing feelings of depression and anxiety.
- Helping control weight.
- Helping build and maintain healthy bones, muscles and joints.
- Promoting psychological well being. (Michigan Department of Community Health)

Growing body of evidence:
- San Diego study: 70 minutes more physical activity/week among residents in walkable neighborhood; 35% vs. 60% overweight (Saelens, Sallis, et. al. 2003)
- 6 lb weight difference in sprawling vs. compact counties
- King County study: 5% increase in neighborhood's "walkability index" correlated with 32% increase in active transportation; 0.23 point reduction in BMI (Frank, Sallis, et. al. 2006) (hawaii.gov/health/healthy-lifestyles)

Community Design Policies Work! The Task Force on Community Preventive Services concluded that:
- Community-scale policies & design are effective
  - Zoning for compact, mixed-use development
  - Transit-oriented development
  - Policies related to street design & connectivity

- Street-scale policies & design are effective:
  - Traffic calming
  - Street lighting
  - Improving street crossings (hawaii.gov/health/healthy-lifestyles)

Health Care Facilities

Kona Community Hospital (KCH) is the primary health care facility serving West Hawai'i. KCH is a 94-bed full-service medical center; including 49-beds Acute, 34-beds Skilled Nursing/Long Term Care, and an 11-bed Psychiatric Unit. It is located in Kealakekua, Kona, 18 miles south of Kona International Airport.

KCH is part of the State of Hawai'i's public hospital system, operated by the Hawai'i Health Systems Corporation (HHSC). HHSC is a public benefit corporation governed by a 13-member Board of Directors whose responsibility is to develop policies, procedures, and rules necessary to plan, operate, and manage the 13 facilities included in the State's public hospital system.

KCH employs approximately 475 employees. There are a little over 60 active medical staff members representing a wide variety of medical specialties. Approximate annual workload consists of over 4,000 acute inpatient admissions, nearly 500 births and over 15,000 emergency room visits.

In 2010, KCH was designated a Level III emergency center. Under this program, first responders alert the emergency room to the arriving trauma patients; a trauma announcement is made at the hospital and team members assemble in the emergency room prior to the patient's arrival.

Another medical facility in the region is the North Hawai'i Community Hospital in Waimea. The hospital has 50 beds and provides a full spectrum of acute care services, including a 24-hour emergency room, medical/surgical care, obstetrical/gynecological care, cardiac care and long-term care.

Kaloko Makai has offered to provide 40 acres of land located along Ane Keohokālole Highway for the development of a regional hospital. Applicant will not be developing the hospital, but several entities have been approached to undertake the development. Applicant will continue to pursue a hospital developer, and will continue dialog with those entities on the potential development of the new regional hospital/medical center at Kaloko Makai.

The proposed project will increase the demand on the existing medical and emergency services in the North Kona region. Kaloko Makai is strategically located to incorporate the new hospital into its master plan and is actively pursuing a hospital developer/operator for the new facility. The Kaloko Makai development seeks to have a hospital developed within the project on a 40-acre site along Ane Keohokālole Highway. The site will also have access to Queen Ka'ahumanu Highway via Hina Lani Street and interconnecting roads (possibly also through adjoining Kohanaiki Business Park). A new regional hospital for Kona is projected to need approximately 100-150 total beds (with 150 targeted - which will include between 50-70 beds for medical surgery) to serve the growing West Hawai'i population.

Since the existing hospital in Kona (Kona Community Hospital) is under the direction and control of HHSC, Kaloko Makai representatives have been in regular discussions with management of that facility and leadership within HHSC. Kaloko Makai initiated discussion with HHSC because development and operation of a new hospital will affect the Kona Community Hospital.

The intent is to work with HHSC and Kona Community Hospital in a collaborative, rather than competitive, approach for the new Hospital. Kaloko Makai will continue dialog with Kona Community Hospital and HHSC leadership and others on the future planning for the new regional hospital/medical center at Kaloko Makai.

Part of these discussions led to a May 23, 2011 letter from Stanford Carr to Bruce Anderson, President and CEO of HHSC where land was offered to HHSC for a new hospital. In part, the letter states, "This letter is to confirm that SCD - TSA Kaloko Makai LLC is willing to convey to the State, HHSC or other appropriate entity, at no cost, 40-acres of land within the Kaloko Makai project for a new regional acute care Hospital."

The letter from Stanford Carr to Bruce Anderson, offering the land to HHSC, goes on to state: "As noted in the recently adopted Kona Community Development Plan (Kona CDP,) Kona needs a new hospital to replace its existing outdated and out-of-place facility. The Kona COP states that the new hospital should be located on the Ane Keohokālole Highway (midlevel road) for optimum accessibility by automobile or transit in this future growth area."

"Given Kaloko Makai's placement on Ane Keohokālole (the region's primary trunk transit corridor,) designation as a Transit Oriented Development (TOD) in the Kona CDP (with a rebuttable presumption of land use conformity,) available land for Hospital use, as well as available surrounding land that is planned for commercial office and related uses that can support a Hospital medical complex, the Kaloko Makai site is an excellent choice for a new Kona acute care Hospital."

"As was discussed with our representatives, the Kaloko Makai project layout positions the Hospital complex on Ane Keohokālole Highway. In addition, our proposed layout surrounds this site with supporting commercial uses. We have discussed these uses with the Hawai'i County Planning Department and others within the Kona Design Center and have received favorable comments regarding our project layout and proposed uses."

In response to this letter, HHSC CEO Bruce Anderson stated in a July 20, 2011 letter to Stanford Carr:

"On behalf of the Hawai'i Health Systems Corporation Board of Directors, I want to express our appreciation and assure you that we are taking your offer seriously and are excited about the prospect of a future new facility at Kaloko Makai."

"The need for a new facility is recognized in the West Hawai'i Region HHSC Strategic plan. The suggested start date for planning such a facility in this plan is 2012. The proposed site is also consistent with the Kona Community Development Plan. Therefore, pursuant to your offer, the HHSC West Hawaii Regional System Board has directed its Strategic Planning Committee to evaluate your offer and the proposed site for a new hospital."

"We agree with you that a new regional hospital at Kaloko Makai would likely replace some of the services that are presently provided at Kona Community Hospital. It is envisioned that the existing facility will remain open, transitioning from providing mostly acute care to long-term care, as well as providing other medical services to the South Kona community."

"We appreciate the time your staff has given us in describing the project and the proposed hospital site and we look forward to continued discussions on this exciting opportunity."

Kaloko Makai representatives have met with and presented information on the Kaloko Makai project to the HHSC West Hawai'i Regional Board and the West Hawai'i Regional Board Strategic Planning Committee. Those discussions are on-going.

Kaloko Makai will continue dialog with Kona Community Hospital and HHSC leadership and others on the future planning for the new regional hospital/medical center at Kaloko Makai.

The new hospital construction at Kaloko Makai will very likely be done in phases with the possibility of developing an urgent care/out-patient emergency center first, then phasing, over time, into a full hospital/medical center facility with associated medical services, including long-term care. Ultimate build-out and operation of a hospital will likely involve a public-private partnership.

Ultimately, Kaloko Makai intends to continue discussions with HHSC and KCH concerning the new hospital at Kaloko Makai. Any new hospital may impact the future operations of KCH. A transition plan needs to be developed for the ultimate use of the KCH.

A new regional hospital at Kaloko Makai will likely replace some of the services (primarily the acute care medical surgery) that are presently performed at KCH. It is envisioned that KCH will remain open, transitioning out of acute care and into a long-term care facility. In addition, the existing KCH emergency room, some outpatient services, oncology and imaging will remain at KCH.

Education

Schools servicing the project area include Kealakehe Elementary, Kealakehe Intermediate and Kealakehe High Schools located approximately two (2) miles to the southeast.

The elementary school's capacity is 1,064 students, and the 2009/2010 school year enrollment was 946 students (Department of Education, 2010a). Kealakehe Intermediate School, with facilities for 1,078 students, has an enrollment of 850 students (Department of Education, 2010b). Kealakehe High School opened in 1997, and currently has a student body numbering 1,610 (Department of Education, 2010c).

The proposed project will generate increased demand on student enrollment within the region. The Applicant will dedicate land to the DOE for three sites in selected locations, anticipated to be comprised of two elementary schools and one middle school, as well as provide for all required offsite infrastructure.

Based on the proposed components within the Kaloko Makai project, full build-out (after the 30-year development and marketing period) population estimates indicate that approximately 12,000 to 15,000 people will live at Kaloko Makai.

Applying DOE criteria for student generation estimates, after the 30-year build-out (the year 2040), the 5,000-units proposed in Kaloko Makai will generate an estimated stabilized student body of approximately 1,207 school-aged children. This is broken down as approximately 641-Elementary School, 275-Middle School and 291-High School students.

In 2009, the Board of Education adopted a policy on School Design Enrollment Guidelines. In that policy, the following enrollment and land area guidelines were established:

BOE Policy on School Design Enrollment Guidelines

School Type	Enrollment	Usable Land Area
Elementary (K-5)	400 - 750	8 - 15
Middle (6 - 8)	500 - 1,000	15 - 20
High (9 - 12)	800 - 1,000	50

Given these parameters, Kaloko Makai generates the need for an Elementary School but falls short of the BOE suggested guidelines for a Middle and/or a High School.

School campuses can and should be the center of a community. The core focus of the Kaloko Makai neighborhoods are its schools and adjoining parks which serve as civic spaces, neighborhood centers and gathering places for arts, culture, education and recreation.

Several schools are proposed within Kaloko Makai, each within the neighborhood pedestrian shed and easy walking distance for neighborhood residents. Kaloko Makai is setting aside approximately 42-acres for three schools, proposed to be two elementary schools and one middle school.

School sites include buildings and facilities, plus school-associated playgrounds It is envisioned that each school, in conjunction with the adjoining park, will serve as a draw to bring the community into a multi-generational learning center that provides life-long learning opportunities and interaction of the residents within the community.

Consistent with the policy on education within the Kona CDP (Public Facilities – PUB-6.3a,) Kaloko Makai will seek cooperation with the State Department of Education (DOE) for joint use of school facilities for recreational and community uses.

The goal is to draw all segments of the community to the school, throughout the day, rather than limit their use for the children during the weekday school hours.

Rather than stand-alone, children-based facilities that tend to serve only a portion of the population, Kaloko Makai schools will seek to encourage community access and use for all of the schools, after the DOE school day. This will make for more efficient use of limited public resources, as well as bring the community together into central, core facilities.

While the scale of fixtures and equipment in elementary schools may not be applicable for adult use, school cafeterias may serve a dual role as community gathering place and meeting halls. Likewise, school libraries and other meeting rooms may further drive wider community use.

Housing

Kaloko Makai is planned to respond to the market and demographic trends as well as the community needs across the region. It will serve a County population that is changing rapidly in terms of size, geographic dispersion, age profile and lifestyle. It will deliver needed homes in a diverse, planned community.

The majority of homes at Kaloko Makai would be offered in compact or multifamily settings, in adherence with the draft Kona Village Design Guidelines. The conceptual plan shows the maximum proposed inventory of 5,000 units, of which approximately 4,014 could be multifamily products and about 986 a range of single-family products.

Unit types and market focus include lots, single-family, live-work and multi-family, available to market, gap group, worker housing and affordable. The exact mix of units by type will be determined upon finalizing agreements with government agencies and during the years of build-out, as market conditions and preferences materialize.

The North Kona area is appropriately seeing urban infill development and proposals, consistent with the 2008 Kona Community Development Plan and the 2010 draft Kona Village Design Guidelines. Kaloko Makai is strategically located along the major regional traffic corridor Queen Ka'ahumanu Highway, between the town of Kailua-Kona and the Kona International Airport.

This rapidly developing area comprises the northwestern portion of the North Kona District and is the residential, commercial and industrial heart of West Hawai'i. The area has a long-standing and growing residential base and will continue to be the focus of residential and related development as the Island's population grows.

Currently entitled projects are estimated to yield up to 8,200 of the potential demand for 17,800 housing units in the market area by 2045, if they are built out within this time frame and developed to the maximum levels of their respective current plans and entitlements.

Despite an assumed strong and sustained rate of new home production, entitlements within the market area account for only about half the projected need. Therefore, without further land entitlement, the area could still face an approximately 9,600-unit shortage by 2045.

Kaloko Makai will include the proposed development of up to 5,000 new single- and multi-family residential lots and units at low- and medium-densities, centralized commercial and neighborhood centers, recreational facilities (e.g. parks, trails, open spaces), urgent care medical facility, two elementary schools, a middle school and associated infrastructure (e.g., new roadways, utilities, drainage, wastewater and potable water distribution systems). Affordable housing will be provided in accordance with County of Hawai'i requirements.

The project will serve a County population that is changing in terms of size, geographic dispersion, age profile and lifestyle. Over the course of approximately 30 years Kaloko Makai will deliver the anticipated needed homes in a diverse, planned community.

Furthermore, Kaloko Makai will respond to varying spectrums of demand for housing within the North Kona/South Kohala area by providing a wide range of housing opportunities inclusive of affordable housing alternatives. Kaloko Makai will seek to create and sustain a mixed-income community allowing for unparalleled social diversity.

The first residential product at Kaloko Makai is projected to be available for sale in 2015. Thereafter, it is anticipated that the 5,000 maximum proposed units, homes and lots could be absorbed over approximately 30 years at an average rate of 170 units per year.

The production and pricing of affordable units at the Project would be set in accordance with County and/or State guidelines to be determined in consultation with government agencies. The Project is expected to have 1,000 affordable for-sale housing units. The units would be priced with specific shares catering to households earning less than 80%, 80 to 100% and 100 to 120% of the County median income. Average affordable unit sales price (in 2010 dollars) would be $284,500.

The balance of homes at Kaloko Makai will be its 4,000 "market" homes, ranging from traditional single-family homes to mixed use, mid- and higher-density multifamily units. Average home sales price for market units (in 2010 dollars) would be $396,000.

Anticipated Buyer Markets

The proposed products respond to the market opportunities identified above as follows:

Entry-level markets – Those units designated as affordable units, as well as many of the multifamily market units are conceived to appeal to entry-level markets, typified by the rapidly increasing 25- to 34-year-old Echo Boom cohort in the 2010 to 2020 period.

Move-up markets – Kaloko Makai's single-family products could appeal to move-up markets and growing families.

- The first level move-up market, typified by persons aged 35 to 44, is projected to grow particularly rapidly in the 2020 to 2030 period as the Echo Boomers mature.
- A more affluent move-up market could also be attracted to the views, convenient location and lifestyle offerings at Kaloko Makai.

Downsizers – Kaloko Makai's more compact single-family and some of its multifamily units are seen to appeal to the Baby Boomer cohort that is looking to simplify its lifestyle, lessen homeowner commitments and enhance access to town amenities. This market may overlap with the retiree segment described below.

Retirement/senior markets – All of the multifamily units and some of the single-family product could appeal to retiree markets. The age 70+ population will be a rapidly increasing age classification especially towards the latter years of Kaloko Makai's marketing.

Based on the Project location, development concept and the comparison projects surveyed, some 75% of Kaloko Makai residents are anticipated to be long-term Island residents. However, some product types could also appeal to second home buyers, relocating retirees or others that may come from off-Island.

Social Sustainability

A community is composed of people, as well as places where they live; it is as much a social environment as a physical development. Thus, communities must not only be environmentally sustainable, they must also be socially sustainable.

A socially sustainable development supports more equitable distribution of resources, supports diversity within the community, meets the basic needs of residents and invests in social and human capital, thereby sustaining the quality of life and community livability for all residents into the future.

Socially sustainable development includes the following:

- recognizes, respects and values cultural and social diversity;
- preserve and maintains a high quality of life for all of its residents;
- meets basic needs of food, shelter, education, work, income and safe living and working;
- is equitable, ensuring that the benefits of development are distributed fairly across society;
- promotes education, creativity and the development of human potential;
- preserves our cultural and biological heritage, thus strengthening our sense of connectedness to our history and environment;
- is democratic, promoting citizen participation and involvement;
- promotes the context of "Live Aloha," with people living together harmoniously and in mutual support and respect for each other

We saved the concept of Social Sustainability for the end of the analysis, to serve as a summary of the many socially-focused actions suggested in prior sections of this Sustainability Plan. Following are just a few of the issues previously mentioned:

- Affordable housing will be incorporated within the development, allowing for a diversity and mix of housing types and options
- Complete streets with walkways and bile lanes, allowing for slow movement through the neighborhoods for easy social interaction
- Allocation for commercial spaces, affording project residents the opportunity to work near where they live
- Proximity to the elementary and middle schools affords multi-generational interaction and learning
- Project layout and design will create an opportunity for both residents and the community to have a positive effect on their health through walkable and bikable transportation options.
- Consistency with long range planning documents, implementing the community's vision for the future

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Appendix R

EISPN Comment and Response Letters

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122, Box 50088
Honolulu, Hawaii 96850

EM

In Reply Refer To:
2010-TA-0513

NOV 04 2010

OCT 29 2010

Mr. Earl Matsukawa, AICP
Project Manager
Wilson Okamoto Corporation
19070 South Beretania Street, Suite 400
Honolulu, Hawaii 96826

Subject: Environmental Impact Statement Preparation Notice for Kaloko Makai, North Kona, Island of Hawaii

Dear Mr. Matsukawa:

The U. S. Fish and Wildlife Service (Service) has reviewed the Environmental Impact Statement Preparation Notice (EISPN) for the Kaloko Makai project located north of Kailua-Kona on the island of Hawaii. We received your letter soliciting our comments on September 20, 2010. On October 18, 2010, Jeff Zimpfer, from my staff, asked for a one-week extension to provide comments. We thank you for granting us a one-week extension. At build-out, this master-planned community will have 5,000 single-family and multi-family residences, commercial centers, schools, community services and supporting infrastructure. This project will be located on 1,142 acres of land that is currently undeveloped. Through our involvement with the federally funded Ane Keohokalole Highway project in Kona, we have been working with representatives from Stanford Carr Development to develop measures to avoid and minimize impacts to listed and rare species in the vicinity of this project. We have reviewed the project information you provided and pertinent information in our files, including data compiled by the Hawaii Biodiversity and Mapping Program and the Hawaii GAP Program. The following endangered plants currently occur on the site of the proposed project: (1) aiea (*Nothocestrum breveflorum*); (2) uhiuhi (*Caesalpinia kavaiense*); (3) maoloa (*Neraudia ovata*); and (4) hala pepe (*Pleomele hawaiiensis*). The candidate taxon for listing, kookoolau (*Bidens micrantha* ssp. *ctenophylla*), also occurs occur on the site of the proposed project. The endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*) and Blackburn's sphinx moth (*Manduca blackburni*) are known to occur in the vicinity of the proposed project and may occur within the area proposed for development. We recommend you address potential project impacts to the sensitive native ecosystems and listed species discussed below, and include measures to minimize adverse impacts to these resources in your Draft Environmental Impact Statement (DEIS).

TAKE PRIDE IN AMERICA

General Comments

- Based on our discussions with representatives from Stanford Carr Development, 150 acres of dryland forest will be set aside for a preserve in perpetuity. In addition, the developer will work with the State of Hawaii to develop a Habitat Conservation Plan (HCP) for impacts to State-listed plants that occur on lands within the project footprint but are not included in the dryland forest preserve, specifically hala pepe. In addition to developing a HCP for hala pepe, we recommend that you include kookoolau in your HCP, as this candidate for listing may become federally and State listed before this project is completed. We understand that the developers of this project will also work to maintain and restore the ecological integrity of the dryland forest. We also understand that the developer will allow natural resource professionals and organizations access to the dryland forest to do appropriate conservation work. We recommend you prepare and implement a management plan for the dryland forest preserve that includes conservation actions such as fencing and invasive species control. A source of funding for the implementation of the management plan should also identified in the DEIS and offer our ongoing technical assistance.

- At build-out, this proposed project could potentially impact the Keauhou aquifer. The Service is concerned that the long-term demand for water from the Keauhou aquifer system would exceed the aquifer's sustainable yield and result in increased salinity of wetlands, fishponds, anchialine pools, and coastal waters in the Kaloko-Honokahau National Park. Three candidate species for listing, including two shrimp (*Metabetaeus lohena* and *Palaemonella burnsi*), and a damselfly (*Megalagrion xanthomelas*), and two endangered waterbirds, the Hawaiian stilt (*Himantopus mexicanus knudseni*) and Hawaiian coot (*Fulica alai*), depend on these aquatic ecosystems and may be adversely impacted by increases in salinity. The cumulative impacts of development in the area surrounding the Kaloko-Honokahau Park should be addressed in the DEIS.

- Hawaii's native ecosystems are heavily impacted by exotic invasive plants. Whenever possible we recommend using native plants for landscaping purposes. If native plants do not meet your landscaping objectives, we recommend that you choose species that are thought to have a low risk of becoming invasive. The following websites would be good resources to use when choosing landscaping plants: Pacific Island Ecosystems at Risk (http://www.hear.org/Pier/), Hawaii-Pacific Weed Risk Assessment (http://www.botany.hawaii.edu/faculty/daehler/wra/full_table.asp) and Global Compendium of Weeds (www.hear.org/gcw).

- To further minimize project impacts to listed species occurring in the project vicinity, we recommend prohibiting free movement of pets, implement public education to discourage the feeding of feral animals, especially cats, and install sturdy animal-proof garbage containers to prevent increases in the populations of house mice, rats, mongoose, and feral cats. These measures should also be incorporated into any Community Rules and Regulations instituted for the Kaloko Makai development.

- The proposed project is located on the dry leeward side of the island of Hawaii where wildland fires interdependent with the proposed project may affect federally listed upland

species. The West Hawaii Wildfire Management Organization was formed to support efforts to coordinate development of area firebreaks, a system of fire suppression helicopter dip-sites, and fire prevention materials to minimize impacts of fires associated with increases in the West Hawaii population. We recommend you contact this organization for further information regarding your project and potential wildland fire issues.

Specific Comments

Page 3-11 of the EISPN states:

> "The 150-acre native dryland forest is located within the southern portion of the project site and is one of the last dryland forests still relatively free of introduced, alien grasses and cattle. This patch of forest was home to at least four endangered plant species aiea (*Nothcocestrum breviflorum*), maoloa (*Neraudia ovata*), *Cyperus faurieri*, and hala pepe (*Pleomele hawaiiensis*). Twenty five native species were observed within the dryland forest, eleven of them endemic to Hawaii. Four of these (three found during previous surveys only and one during this survey) are Federally listed endangered species."

We would like to clarify that aiea, maoloa, and hala pepe do currently occur in the dryland forest on the project site. The aiea occurs in an area outside of the proposed dryland forest preserve and hale pepe occurs both inside and outside the proposed dryland forest preserve. In addition, uhiuhi also occurs in the proposed dryland forest preserve.

We appreciate the opportunity to provide technical assistance in your environmental compliance process for this project. If you have any questions regarding this letter, please contact Dr. Jeff Zimpfer, Fish and Wildlife Biologist, Consultation and Habitat Conservation Planning Program (phone: 808-792-9431; email: jeff_zimpfer@fws.gov).

Sincerely,

for Loyal Mehrhoff
Field Supervisor

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7469-01
July 25, 2011

Dr. Loyal Mehrhoff, Field Supervisor
U.S. Fish and Wildlife Service
Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122, Box 50088
Honolulu, HI 96850

Subject: Environmental Assessment (EA)/Environmental Impact Statement Preparation Notice (EISPN)
Kaloko Makai
Kaloko and Kohanaiki, North Kona, Hawaii
Tax Map Key: (3) 7-3-09: 017, 025, 026, and 028

Dear Dr. Mehrhoff:

Thank you for you letter dated October 29, 2010 (2010-TA-0513). We offer the following responses in the respective order of your comments:

1. We acknowledge that the following four federally listed endangered species, `aiea (*Nothocestrum breviflorum*), ma`oloa (*Neraudia ovata*), hala pepe (*Pleomele hawaiiensis*), and uhiuhi (*Caesalpinia kavaiensis)* are located within the 150- acre native dryland forest within Kaloko Makai project site. Additionally, ko`oko`olau (*Bidens micrantha* spp. *ctenophylla)* which is a candidate species for listing, is also present within the Kaloko dryland forest.

   Kaloko Makai has been working with the US Fish & Wildlife Service and the Department of Land and Natural Resources (DLNR) on the delineation and preservation of the 150 acre native dryland forest. In the future, we look forward to working with you to develop a management plans for the dryland forest.

   Kaloko Makai has determined that the project may cause the taking of two listed plant species (`aiea and hala pepe) and one candidate species (ko`oko`olau). In response to this, Kaloko Makai prepared a Habitat Conservation Plan (HCP) with the Department of Land and Natural Resources to address the short- and long-term management measures to protect these species. DLNR is presenting reviewing the HCP.

   A botanical survey was conducted and will be included in the Draft EIS.

2. We acknowledge that the Hawaiian hoary bat and Blackburn's sphinx moth are known to occur in the vicinity of the project area. Avifauna, mammalian, and invertebrate surveys were conducted and will be included in the Draft EIS.

3. We acknowledge that the Service has concerns about the long-term demand on the Keauhou Aquifer and impacts on coastal resources. Discussion of impacts and mitigation measures on groundwater and coastal resources will be included in the Draft EIS.

In addition, Kaloko Makai shall develop a pollution prevention plan (PPP) that provides Best Management Practices (BMPs), including structural BMPs, for pollution prevention that address all categories of permitted uses within the Project, and shall address environmental stewardship and the non-point sources of water pollution that can be generated from any uses allowed within the Project. Emphasis shall be given to BMPs that prevent or limit pollutants arising out of the permitted uses within the Project from reaching the groundwater and ocean.

4. Wherever possible, native plants will be used for landscaping throughout Kaloko Makai. We appreciate the referrals to resources regarding native plant species.

5. While prohibiting the free movement of pets could not be achieved at Kaloko Makai's discretion, a public education program will be developed to encourage confinement of pets, discourage the feeding of feral animals and promoting the installation of animal proof garbage containers to prevent increases in rodent populations.

6. We will consult with the West Hawaii Wildfire Management Organization to coordinate development of area firebreaks, wildland fire dip tanks, and fire prevention materials to minimize impacts of wildland fires.

7. As previously mentioned, we acknowledge that `aiea, ma`oloa, hala pepe, and uhiuhi are located within the 150-acre native dryland forest on the Kaloko Makai project site. The flora section will be revised to reflect this.

We appreciate your participation in the environmental review process.

Sincerely,

Earl Matsukawa, AICP
Project Manager

cc: Mr. Peter Phillips, Stanford Carr Development
Mr. Orlando Dan Davidson, State Land Use Commission

United States Department of the Interior
NATIONAL PARK SERVICE
Kaloko-Honokohau National Historical Park
73-4786 Kanalani St., Suite 14
Kailua-Kona, HI 96740

IN REPLY REFER TO:
L7621

October 22, 2010

Mr. Earl Matsukawa, AICP
Wilson Okamoto Corporation
1907 South Beretania Street, Suite 400
Honolulu, Hawaii 96826

RE: National Park Service Review of the EA/EIS Preparation Notice, Kaloko Makai Project, Kaloko, North Kona, Island of Hawaii

Dear Mr. Matsukawa:

Thank you for the opportunity to provide input to the preparation of an Environmental Assessment/Environmental Impact Statement (EISPN) for the proposed Kaloko Makai development. This proposed development will be a 1,142-acre, master-planned, mixed-use residential community with up to 5,000 new single and multi-family residential units, approximately 153 acres of light-industrial/commercial/retail, an urgent care medical facility with potential for a regional hospital, two elementary schools, a middle school, a wastewater treatment plant, associated roadways, utilities, drainage, and water source and distribution system. Kaloko-Honokohau National Historical Park is located immediately across Queen Ka'ahumanu Highway, from the proposed project site. A development of this magnitude upslope and essentially adjacent to the National Park will significantly, and irreversibly affect park resources. Therefore the National Park Service (NPS) requests that we be a formally consulted party during the EIS process.

The National Park Service is charged with preserving the nationally significant cultural and natural resources found within Kaloko-Honokohau National Historical Park. The National Park was established in 1978 "to provide a center for the preservation, interpretation, and perpetuation of traditional native Hawaiian activities and culture, and to demonstrate historic land use patterns as well as to provide a needed resource for the education, enjoyment, appreciation of such traditional native Hawaiian activities and culture by local residents and visitors." (Public Law 95-625). The authorization was based on a study and report by a congressional advisory commission comprised of Native Hawaiians. The study recommended that the site that is the Honokohau Settlement National Historical Landmark (designated in 1962) and its adjacent waters be preserved for the benefit of the Hawaiian people and the nation as part of the national park system. Water quality and quantity are critical to this mission and to the integrity of the Park. The National Park contains two large (11 and 15- acre) ancient Hawaiian fishponds both with associated wetlands, more than 185 known anchialine pools, and 627 acres of marine habitat. These waters define the National Park. They are significant cultural resources and

also provide habitat for ten threatened, endangered, and candidate species. The National Park and the National Historic Landmark share the same boundaries. Page 1-7 of the EISPN should be corrected to reflect the fact that all park lands are within the Honokohau Settlement National Historic Landmark.

The National Park water resources are fed by, and in the case of the anchialine pools are dependent upon, groundwater input. The anchialine pools support three known candidate endangered species. 'Aimakapa Fishpond receives significant groundwater inputs and is important foraging and nesting habitat for the endangered Hawaiian stilt and the Hawaiian coot, and is also an important habitat for migratory waterfowl. The US Fish and Wildlife Service considers 'Aimakapa to be a "core wetland" in the recovery of these species[1]. The EISPN incorrectly states in Section 3.4 (p. 3-6) that 'Aimakapa is separated from the ocean by a basaltic rock wall. 'Aimakapa is closed to the ocean by a sand berm, and receives significant groundwater inputs resulting in lower salinity waters.

The EISPN also incorrectly states (p. 3-6) that *"there are no wetlands located ... in the immediate vicinity of the project site."* Kaloko Fishpond is within ½ mile of the project site. The EISPN incorrectly omits on page 3-6 that Kaloko Fishpond has approximately eight acres of associated wetlands. 'Aimakapa Fishpond and wetlands are also within the immediate vicinity of the project site. Kaloko Fishpond is in the process of being restored for productive, traditional aquaculture use for human consumption as part of the Park's Cultural Live-in Center project and has open connection to the sea. Kaloko Fishpond is used by the Hawaiian stilt for foraging and occasional nesting attempts. The Park's marine waters are inhabited by resident juvenile green sea turtles (listed as "threatened"), and the endangered hawksbill sea turtle. The endangered Hawaiian monk seal is an occasional visitor to Park waters and rests on the shoreline. The candidate endangered Hawaiian false killer whale is known to utilize park waters, and endangered Humpback whales are seasonally within Park waters.

Surface Water Drainage, Non-point Source Pollution

The waters of the National Park will be the receiving waters of this development, during and following construction. Preservation of the quality of groundwater entering Kaloko-Honokohau National Historical Park is a significant concern. Traditional and customary Native Hawaiian practices within the National Park rely heavily on the quality and quantity of the groundwater. Studies completed by the US Geological Survey in the Park[2] indicate that water resources in the National Park are vulnerable to upslope ground-water contamination. Water quality directly affects cultural resources within the Park. Degradation of fishpond waters may affect the health of endangered waterbirds, and the abundance and/or health of fish, which are harvested for human consumption, potentially affecting human-health. Kahinihini'ula, and other culturally important anchialine pools could also be adversely affected by negative changes to water quality. Nonpoint source pollutants also affect the marine environment, coral populations, and coral

[1] U.S. Fish and Wildlife Service. 2005. Draft Revised Recovery Plan for Hawaiian Waterbirds, Second Draft of Second Revision. U.S. Fish and Wildlife Service, Portland, Oregon. 155 pp.
[2] Oki et al. 1999. Ground Water Resources in Kaloko-Honokohau National Historical Park, Island of Hawaii, and Numerical Simulation of the Effects of Ground-Water Withdrawals, U.S. Geological Survey Water-Resources Investigation Report 99-4070. U.S. Geological Survey, Honolulu, HI. 49 pp.

ecosystems in a variety of ways, including reducing the recruitment of new corals, interfering with coral reproduction, affecting coral calcification rates, and altering species composition.

Because of the high permeability of the site and the interconnection of surface activity and groundwater resources, polluted groundwater has the potential to have significant negative impacts to the National Park's water resources and the marine environment. However, Section 3.5 states "[a]*ny project impacts anticipated upon water quality will be subject to natural processes that occur based on vertical travel distance of the infiltrated water and horizontal distance to the ocean.*" This statement appears to suggest that simple, unenhanced infiltration will solely be relied upon to mitigate contamination to groundwater. In a highly permeable environment with little or no soil (see EISPN Section 3.3) such as the project site, this level of mitigation is unacceptable. According to the Environmental Protection Agency's 1993 Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters, one of the objectives of urban runoff management is "protection of ground water resources" (p. 4-5). The EPA Guidance says "infiltration systems [standard drywells, such as those used in West Hawaii] may not be appropriate where groundwater requires protection" (p. 4-14). This EPA Guidance remains an active, relevant document, issued by the EPA under the authority of Section 6217(g) of the Coastal Zone Act Reauthorization Amendments for application throughout the country, including Hawaii.

In 2001 the state Land Use Commission (LUC) recognized the potential adverse impacts of upslope development and the legal and constitutional obligation to protect and preserve the resources of the National Park.

The LUC expressly determined that:

> [N]ative Hawaiian rights and natural and cultural resources would be damaged or destroyed by the pollution of groundwater that reaches the National Park from surrounding areas, including proposed development at the Kaloko Industrial Park. Appropriate mitigation measures are, therefore, required under the Hawaii Constitution . . . in order to approve reclassification of the project area. (LUC 2002, Docket A00-732 Findings of Fact Conclusions of Law Decision and Order; Conclusion of Law ¶ 7)

The EIS should contain a thorough and rigorous analysis of potential impacts, direct and cumulative, to groundwater and groundwater-fed ecosystems from termiticides and pesticides used on houses, buildings, grounds, and common areas; added nutrients from irrigation and fertilized green spaces; potential releases of contaminants from commercial businesses in the light-industrial/commercial parks who generate hazardous wastes (e.g., metal finishing, photo-processing, automotive maintenance, dentistry, pesticide companies, printing, etc); potential releases of medical wastes, pathogens, and pharmaceuticals from the medical facilities; nutrients, pathogens, and pharmaceuticals carried in wastewater; contaminants associated with roadways and other impermeable surfaces including petroleum products, metals, pesticides, nutrients, and other pollutants. The EIS should discuss in detail how it will protect downslope park resources and receiving waters from these significant threats.

The EIS should include, as mentioned in the EISPN section 3.4, a full analysis of drainage construction techniques beyond what are required by the county and state, such as filtered drainage systems appropriately and specifically engineered to be effective in Kona's arid, low soil environment to reduce non-point source pollution to the groundwater and marine waters. We note that design specifications of drainage wells in compliance with the Hawaii County Public Works and State Department of Health standards do not inherently incorporate any structure or other design feature to remove petroleum, oil, nutrients, or any contaminants contained in runoff. Hawaii County codes for drainage wells do not address protection of significant environmental resources, but rather solely consider flood control and volume of runoff. There is no State law or County code currently in place to ensure that pollutants carried with surface runoff below the UIC line do not get into the environment through groundwater.

Water System

Section 3.17.1, Water System, states that the proposed project's water demand will require the construction of additional water sources. No estimate of the quantity of potable and irrigation water required for the project is provided and the location of the future water supply well is not identified. Additionally, there is discussion at 3.16.2 regarding Fire Protection but no discussion of the source of water for the system proposed (all appurtenances, hydrants and fire flow requirements).

The general effects of pumping groundwater in the area of Kaloko-Honokohau NHP will include a decline in water levels, a rise in underlying saltwater and eventually, a reduction in groundwater discharge to the ocean. The magnitude and timing of these effects on specific groundwater-dependent resources in the Park will depend upon the pumping rate and the location of the pumping wells.

If a standard of 400 gallons per day per housing unit is used, water demand for the proposed project could be as high as 2.0 million gallons per day. If higher elevation groundwater in the vicinity of the proposed project is to be the water source, then the water supply well may be located directly upgradient of the Park.

The Kaloko-Honokohau NHP ground-water study, referenced above, as well as one for the entire Kona area,[3] addresses the potential for decreased ground water levels because of increased water withdrawals. Changes in the level, temperature, and salinity of groundwater in the Park's fishponds, anchialine pools, and nearshore ecosystems have the potential to adversely affect the species that inhabit these areas. Native Hawaiians continue to rely on inland and nearshore waters for traditional and customary uses. Therefore, a reduction in groundwater discharge may also adversely affect the traditional uses of these natural/cultural resources within the Park.

Because an irrevocable commitment of groundwater resources will be made for this project, the planned groundwater resources and marine water quality assessment noted on page 3-9 should identify the potable and non-potable water demand for the proposed project and the source of

[3] Oki et al. 1999. Geohydrology and Numerical Simulation of the Ground-Water Flow System of Kona, Island of Hawaii; U.S. Geological Survey Water-Resources Investigations Report 99-4073. U.S. Geological Survey, Honolulu, HI. 70 pp.

this water, and should include a detailed analysis of the impacts, direct and cumulative, of these water withdrawals on groundwater dependent cultural and natural resources at the coast. A quantitative analysis of the potential changes to groundwater flow and quality within the aquifer system must be made to identify impacts on the National Park inland and nearshore marine waters. The EIS should detail how the project will incorporate water conservation.

Wastewater System

Park biological and cultural resources are affected by current development upslope of the Park because of inadequate systems for removing nutrients, pharmaceuticals, and contaminants from wastewater before they enter the groundwater system. The proposed wastewater treatment plant shown on Figure 2-1 located immediately across the highway from the National Park is not acceptable to the National Park Service. The proposed methods for dealing with wastewater treatment and effluent and the resulting direct and cumulative impacts should be analyzed in the EIS. Septic systems should not be considered for the proposed project. Additionally, methods of disposal of medical wastes and prevention of accidental releases of hazardous wastes from the medical facilities should be described in detail.

Roadway System and Traffic

The proposed Kaloko Makai development will create significant additional traffic and noise increases on Queen Ka`ahumanu Highway and at access points to the National Park and park headquarters. The EIS should analyze the effects of the increase in traffic, including direct, indirect, and cumulative impacts to visitors accessing the National Park, and the measures planned to alleviate traffic congestion, including a detailed discussion of the proposed interchange connecting Kaloko Makai with the Queen Ka`ahumanu Highway as mentioned on page 3-26 and shown in figure 2-1. Additional information in the EIS should update the status of current road widening projects, roadway expansion, and signalization.

Noise

An analysis of direct and cumulative increased noise generated by the project during both the construction and final build-out phase on the the soundscape within the National Park should be included in the EIS. The EIS should also discuss the impacts of the future development of the short austere runway at Keahole-Kona Airport. Additionally, there is a need to update and incorporate the Kona International Airport Master Plan and Part 150 Noise Compatibility Study Update, which is now completed and discusses increased noise, and night/day flight factors that will have an impact on the area and the proposed development.

Air Quality

Local air patterns and some pollution sources are described in the preparation notice. The prevalent wind system in the proposed project area is *mauka – makai*, nighttime and morning offshore winds changing to onshore during the day. Poor air quality resulting from volcanic emissions, airport emissions, highway traffic emissions, and fugitive dust from multiple ongoing construction sites and from quarries within a mile of the proposed site is not readily moved away from the area. Cumulative air quality impacts from the construction of this project as well as the additional cars residing in the final development, potentially 1.9 cars/household,[4] must be

[4] Bureau of Transportation Statistics 2001, www.bts.gov

considered in conjunction with the Queen Ka`ahumanu Highway expansion, expansion of the airport, addition of the short austere airfield runway and proposed military training routes over the area, and construction of multiple industrial parks in the area. A quantitative analysis of air quality and cumulative impacts should be made in the EIS. Because the volcanic emissions, which cannot be controlled, consistently degrade air quality in Kona, those new anthropogenic sources of PM2.5 (e.g. automobiles) must be controlled wherever possible. The EIS should discuss how new sources will be controlled and appropriate mitigations for improving post-construction air quality. As this area transitions into a larger population center, air quality and its effect on human health is an increasingly important issue that must be addressed.

Visual Resources

Changes to the viewshed, nightsky (light pollution), topography, and vegetation within the *ahupua`a* will adversely affect the cultural landscape of the National Park. The EISPN does not include in its Impacts and Mitigation Measures (page 3-19) any discussion of impacts to *mauka* views from the National Park. Hawaiian land-use developed and relied upon the *ahupua`a* concept of land tenure and stewardship. Cultural, natural and spiritual aspects of the ahupua'a are all critical components in the Park's mission to perpetuate the Hawaiian culture. The EIS should include a viewshed analysis from the National Park looking *mauka* to examine and analyze direct and cumulative impacts to cultural landscape, park viewshed, and nightsky, and a description of how these impacts will be mitigated. The EIS should also include a more detailed analysis of building designs that will minimize viewshed impacts and will blend the development into the landscape, as well as including discussion of appropriate plantings to reduce these visual impacts.

Archeological and Cultural Resources:

At Section 3.11, the listing of archeological and cultural resources, historic districts and sites should also include the Kaloko-Honokohau National Historic Landmark designation (Honokohau Settlement). In addition, there should be discussion in the EIS regarding early consultation and engagement with lineal descendants and the Native Hawaiian community specifically about the development plans and archeological/cultural resources, cultural landscapes, and potential places of significance within the proposed development area.

Preservation/Open Space and Connectivity to the National Park

Kaloko-Honokohau National Historical Park is connected culturally, and through natural processes, to the ahupua`a in which it sits. The EIS should describe how the proposed project will preserve and foster connectivity with the National Park and the Ala Kahakai National Historic Trail. The EISPN discusses preserving and protecting archeological sites, the Road to the Sea, establishing open space and preserving coastal dryland forest. These features are integral parts of the cultural landscape of the Park and the ahupua`a.

Impacts to Coastal and Recreational Resources

The proposed project will significantly increase pressure by people on recreational facilities and coastal resources in the area. The National Park is the closest coastal access for this community and will bear the majority of the pressure, particularly through the connectivity mentioned above. Section 3.16.5, Recreational Facilities Impacts and Mitigation Measures (page 3-22) does not mention analysis of impacts to coastal and recreational resources stemming from use by this

proposed community. The EIS should analyze direct and cumulative effects of 5000 additional resident families (potentially 20,000 people) utilizing the National Park and its coastal resources. This analysis should include direct, indirect, and cumulative impacts resulting from recreational uses on the National Park's law enforcement and visitor services, the park's future Cultural Live-in Center, archeological sites, fisheries, fish, coral, and protected species inhabiting nearshore waters and beaches.

Contextual Issues, Cumulative Impacts

Contextual issues and cumulative impacts are very important and should be thoroughly addressed in the EIS. The existing and proposed developments around the project have environmental review documents, including the EIS for the National Park. These documents should be consulted and the cumulative impacts of the proposed project in the context of these proposed or approved developments (e.g., airport expansion, Air Force military training routes and the short austere air field, Queen Ka`ahumanu Highway expansion, Queen Lili`uokolani Trust, The Shores at Kohanaiki, O`oma Beachside Village, West Hawaii Business Park, Kaloko Phases III and IV, Kaloko Heights, Honokohau Makai, Ane Keohokalole Highway, Kamakana Village, La`i`Opua Villages and others) should be analyzed with regard to the impacts cultural and natural resources, visitors, and cultural practitioners in the area. Cumulative, direct and indirect impacts that will affect Park resources, visitors and those engaged in traditional and cultural practices, particularly, traffic, noise, air pollution, nightsky light pollution, mauka viewshed, increased park visitation, coastal recreational use, and the quality and quantity of ground water resources, must be considered.

General Content and Map Presentation:

Public participation is the foundation of the Hawaii Environmental Protection Act. In order for the public to make informed decisions regarding this proposed project, they must be made fully aware of the resources at risk and their location. None of the figures in the EISPN display the national park boundary or its federal status. County and State zoning are not applicable on federal property whose title is held by the federal government. All maps and graphics in the EIS, including the conceptual land use maps, must accurately show the location of the legislated boundary of Kaloko-Honokohau National Historical Park, the National Historic Landmark boundary, and must include a federal land designation.

The County GIS correctly indicates the federal lands at Pu'uhonua O Honaunau NHP and Hawaii Volcanoes National Park; however the County zoning designation incorrectly shows the federal park-lands zoned as "Open." The State GIS also incorrectly shows the federal park-lands zoned as "Urban" and the park shoreline as "Conservation." These designations were zoned prior to federal ownership and no longer apply. All federal lands indicated in the EIS graphics should show federal lands designation and no zoning as County and State zoning are not applicable on federal property whose title is held by the federal government. State and private parcels encompassed within the authorized boundary of the National Park should be shown as such.

Additionally, we believe that the FEMA FIRM maps (page 7-6) have been updated more recently than April 2004. Likewise the EIS should reflect more current versions of the Hawaii County Data Book and U.S. Census information.

Thank you for the opportunity to provide these comments early in your environmental review process. To receive a copy of the national park boundary and federal lands GIS shapefiles, or if you have questions on these comments, please contact me at 808-329-6881 x1201, kathy_billings@nps.gov, or Sallie Beavers, Chief of Resources Management at x 1220, sallie_beavers@nps.gov.

Sincerely,

Kathy Billings

Kathy Billings
Superintendent

cc: Office of Environmental Quality Control
Stanford Carr Development, LLC
County of Hawaii Planning Department
County of Hawaii Department of Water Supply
Commission on Water Resources Management
State Office of Planning
Hawaii Department of Health
State of Hawaii Land Use Commission
State of Hawaii Historic Preservation Division
US Fish and Wildlife Service
National Marine Fisheries Service
Office of Hawaiian Affairs
Makani Hou o Kaloko-Honokohau
Na Kokua o Kaloko-Honokohau
NPS Pacific West Regional Office

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7469-01
July 25, 2011

Ms. Kathy Billings, Superintendent
U.S. National Park Service
Kaloko-Honokohau National Historic Park
73-4786 Kanalani Street, Suite 14
Kailua-Kona, HI 96740

Subject: Environmental Assessment (EA)/Environmental Impact Statement Preparation Notice (EISPN)
Kaloko Makai
Kaloko and Kohanaiki, North Kona, Hawaii
Tax Map Key: (3) 7-3-09: 017, 025, 026, and 028

Dear Ms. Billings:

Thank you for your letter dates October 22, 2010 (L7621). We offer the following responses in the respective order of your comments:

1. We acknowledge the Kaloko-Honokohau National Historical Park contains two large fishponds, 185 anchialine ponds, and 627 acres of marine habitat. Section 3.5 in the Draft EIS will include the information you provided.

2. Section 3.5 in the Draft EIS will state "Aimakapa is closed to the ocean by a sand berm…"

3. The Draft EIS will reflect the recommended changes to identifying resources located in the vicinity of the project site.

4. Surface Water Drainage, Non-Point Source Pollution: The Draft EIS will discuss drainage, non-point source pollution, and the potential impact to groundwater resources and the nearshore marine environment and mitigation measures. An analysis of potential impacts to groundwater and ground-water fed ecosystems needs to be based on evidence that such impacts are likely to occur. This analysis based on available data and understanding of the hydrology of the area will be provided in the Draft EIS.

   Based on the aforementioned analysis, appropriate mitigation measures will be recommended to minimize urban runoff and to protect groundwater resources.

5. Water System: Kaloko Makai's water demand will require development of additional water sources, storage and transmission facilities. Kaloko Makai is investigating several alternatives to address its potable water needs. The Draft EIS will discuss the proposed project's demands, alternative water sources and the potential impact to ground water resources and the nearshore marine environment associated with the development of the alternative sources.

   Estimates on potable water, non-potable water demand and irrigation will be included in the Draft EIS. Within the Kaloko Makai project, fire flow and fire protection shall be in accordance with UFC Section 10.301(c).

6. Wastewater System: In the event connection to a public wastewater system is not available, Kaloko Makai will construct and operate a Private Wastewater Treatment Plant (WWTP) within the project. The Kaloko Makai facility will treat the wastewater to produce reclaimed (R-1) quality water for general irrigation within Kaloko Makai, thus lessening the demand for potable water. The Draft EIS will discuss potential impacts on groundwater resources and mitigation measures, including additional requirements for treatment and disposal of medical wastes.

7. Roadway System and Traffic: The Draft EIS will include a Traffic Impact Assessment Report (TIAR) that will address access and traffic issues, as well as recommend mitigation measures for potential adverse impacts.

8. Noise: The Draft EIS will include a Noise Study that will address potential short-term and long-term noise impacts generated by the project, as well as proposed mitigation measures for any potential impacts. The findings of the Kona International Airport Master Plan and Part 150 Noise Compatibility Study Update will be considered.

9. Air Quality: The Draft EIS will include an Air Quality Study that will address potential short-term and long-term air quality impacts, as well as recommended mitigation measures for potential adverse impacts.

10. Visual Resources: We acknowledge the view plane along Queen Kaahumanu looking both mauka and makai is an area of natural beauty. The Draft EIS will include a discussion on visual impacts.

11. Archaeological and Cultural Resources: An Archaeological Inventory Study and Cultural Impact Assessment have been prepared and will be summarized in the Draft EIS.

    Kaloko-Honokohau National Historic Landmark will be added to the listing of archaeological and cultural resources in Section 3.11.

12. Preservation/Open Space and Connectivity to National Park: The Draft EIS will discuss how the proposed project will foster connectivity with the National Park and Ala Kahakai National Historical Trail. Several resources, such as the Dryland Forest and Kohanaiki Trail (Road to the Sea), are located within the project site and will be preserved. Impacts and potential mitigation measures will be discussed in the Draft EIS.

13. Coastal and Recreational Resources: The Draft EIS will include a discussion on potential impacts on coastal and recreation resources and potential mitigation measures. Certainly the Kaloko-Honokohau National Historic Park is an important recreational resource and the proximity to the Kaloko Makai development increases visitation to some degree. The project, however, will also provide opportunities for active and passive recreation. Unless the Kaloko-Honokohau National Historic Park significantly changes the type of recreational activity it offers, however, its relative attraction as a regional passive recreational resource in the area, would not change significantly.

14. Contextual Issues, Cumulative Impacts: The Draft EIS will include a discussion on current and/or proposed developments in the project area. Each topic/section provides information on existing conditions, its potential impacts, and mitigation measures. A section on cumulative, direct and indirect impacts will be included in the Draft EIS.

15. General Content and Map Presentation: Graphics will highlight Kaloko-Honokohau National Historical Park, where appropriate.

16. FEMA: The FEMA FIRM Map will be updated and the correct Community Panel Number will be referenced.

17. Data: The Draft EIS will reflect most recent version of the Hawaii County Book and US Census data.

We appreciate your participation in the environmental review process.

Sincerely,

Earl Matsukawa, AICP
Project Manager

cc: Mr. Peter Phillips, Stanford Carr Development
Mr. Orlando Dan Davidson, State Land Use Commission

United States Department of the Interior

NATIONAL PARK SERVICE
Ala Kahakai National Historic Trail
73-4786 Kanalani St., Suite 14
Kailua-Kona, HI 96740

IN REPLY REFER TO:
L7621

RECEIVED
OCT 27 2010

October 22, 2010

Mr. Earl Matsukawa, AICP
Wilson Okamoto Corporation
1907 South Beretania Street, Suite 400
Honolulu, Hawaii 96826

RE: National Park Service – Ala Kahakai National Historical Trail - Review of the EA/EIS Preparation Notice, Kaloko Makai Project, Kaloko, North Kona, Island of Hawaii

Dear Mr. Matsukawa:

Thank you for the opportunity to provide input to the preparation of an Environmental Assessment/Environmental Impact Statement (EISPN) for the proposed Kaloko Makai development. This proposed development will be a 1,142-acre, master-planned, mixed-use residential community with up to 5,000 new single and multi-family residential units, approximately 153 acres of light-industrial/commercial/retail, an urgent care medical facility with potential for a regional hospital, two elementary schools, a middle school, a wastewater treatment plant, associated roadways, utilities, drainage, and water source and distribution system.

The National Park Service (NPS) administers the Ala Kahakai National Historic Trail (NHT), which was added to the National Trails System by the U.S. Congress on November 13, 2000 (Public Law 106-509). The legislation authorizing the Ala Kahakai NHT identifies an approximately 175-mile portion of prehistoric *ala loa*, and other trails on or parallel to the seacoast extending from Upolu Point on the northern tip of Hawaii Island down the west coast of the island around South Point to the east boundary of Hawaii Volcanoes National Park. The Ala Kahakai National Historic Trail combines surviving elements of the *ala loa* with segments of later *alanui aupuni*, which developed on or parallel to traditional routes, *mauka-makai* trails, and more recent pathways and roads that created links between the historic segments. Natural and cultural resources and landscapes are vital to the mission of the Ala Kahakai National Historic Trail.

Ala Kahakai National Historical Trail is aware that Kaloko-Honokohau National Historical Park is commenting on the proposed Kaloko Makai development and echoes the concerns raised by the Park regarding: the impacts on the Honokohau Settlement National Historical Landmark, cultural and natural resources including trails, associated anchialine pools, fishponds, endangered

species, wetlands, and near-shore marine resources. Ala Kahakai NHT is also extremely concerned with how the project will mitigate impacts from surface water drainage, non-point source pollution, water system, wastewater system, roadway system and traffic, noise, air quality, visual resources, and the impacts to coastal and recreational resources.

Archeological and Cultural Resources:

The National Park Service supports the preservation of cultural and natural landscapes, including historic trails, wherever possible. Within the proposed Kaloko Makai development at least two *mauka-makai* trails exist, which historically connected the *mauka* communities with *makai* lands within Kaloko-Honokohau National Historical Park.

According to an abstract completed by the State of Hawaii, Na Ala Hele, Hawaii Trails and Access System (Appendix A), the two trails have been identified as being considered State owned under Chapter 264-1 (b) Hawaii Revised Statutes (HRS), or the Highways Act. The two trails:

1. "Trail to the Sea Coast" a.k.a "Road to the Sea". This trail is referred to as State Site 50-10-27-10714. This trail has been considered eligible for nomination to the State Register of Historic Places under criteria D and E (Title 13, Subtitle 8, Chapter 198 Hawaii Administrative Rules (HAR)).
2. "Trail to Honokohau". This trail passes diagonally through the SE corner of the project area in TMK: 7-3-009:028. is referred to as State Site 50-10-27-18099, in the ahupua'a of Honokohau Nui. This trail has been considered eligible for nomination to the State Register of Historic Places under criteria A, C, and D (Title 13, Subtitle 8, Chapter 198 Hawaii Administrative Rules (HAR)).

Both of these trails lead into Kaloko-Honokohau NHP and are an important piece of the area's history. The Kaloko Makai EISPN acknowledges only the "Road to the Sea" and needs to also recognize and incorporate the "Trail to Honokohau" within project planning and design.

Other trails that predate 1892 will also be identified in the upcoming archaeological inventory survey and should be preserved and incorporated into the planning and design for the project.

Thank you for the opportunity to provide these comments early in your environmental review process. To receive a copy of the Ala Kahakai NHT Comprehensive Management Plan, or if you have questions on these comments, please contact me at 808-326-6012 x101, aric_arakaki@nps.gov, or Rick Gmirkin, Archaeologist at x 102, rick_gmirkin@nps.gov.

Sincerely,

Aric Arakaki
Superintendent

Attachments:
Attachment A: Na Ala Hele regarding Kaloko Makai Development – 08/06/2008

cc: Office of Environmental Quality Control
Stanford Carr Development, LLC
County of Hawaii Planning Department
State Office of Planning
Hawaii Department of Health
State of Hawaii Land Use Commission
State of Hawaii Historic Preservation Division
National Marine Fisheries Service
Office of Hawaiian Affairs
Makani Hou o Kaloko-Honokohau
Na Kokua o Kaloko-Honokohau
National Parks Conservation Association
NPS Pacific West Regional Office

APPENDIX A

COPY

NA ALA HELE
Hawai'i Trail & Access System

August 6, 2008

Ref: H08:17 Kaloko Makai

TO: Clement Chang, Trails Specialist

FROM: Doris Moana Rowland, Abstractor DMR

THROUGH: Curt Cottrell, Program Manager

SUBJECT: Disposition of Trails through proposed Kaloko Makai Development designated as Tax Map Keys: 7-3-9-17, 25, 26 and 28, situate at Kaloko, North Kona, Island of Hawaii

The proposed Kaloko Makai Development Project is a 1,142 acre master planned community in Kaloko, North Kona, owned by Kaloko Properties Corporation and SCD Kaloko Makai LLC. Within the proposed development are located two historic trails considered to be state-owned pursuant to the Highways Act of 1892:

1) Trail to the Sea Coast, and
2) Trail to Honokohau

Both of these trails were identified in an abstract prepared in 2005 in response to the development of lands adjoining Kaloko Makai. This abstract filed as H04:15 Kohanaiki Road, discussed the aforesaid two historic trails crossing through Tax Map Keys: 7-3-9-19 and 32.

Abstract H04:15 Kohanaiki Road is attached in its entirety for your reference. There is no need to duplicate the research completed in 2005 since the history, alignment and status of the trails through Kaloko Makai are the same.

Therefore, it is recommended that a modern metes and bounds survey description of these trails within the proposed Kaloko Makai Devleopment be completed and all adjoining landowners and other interested parties be notified of any future management plans of these historic publicly owned features.

c: Pua Aiu, Historic Preservation

Division of Forestry & Wildlife • Dept. of Land & Natural Resources • 1151 Punchbowl Street, Room 224 • Honolulu, Hawaii 96813

NA ALA HELE
Hawai'i Trail & Access System

February 25, 2005

Ref: H04:15 Kohanaiki Road

TO: Irving Kawashima, Trails Specialist

FROM: Doris Moana Rowland, Abstractor DMR

THROUGH: Curt Cottrell, Program Manager CAC

SUBJECT: Disposition of Trails and Old Roads within the Y-O Project through Kohanaiki and Kaloko affecting Tax Map Keys: 7-3-9:19 and 32

The Y-O Project encompasses approximately 408 acres and is comprised of Tax Map Keys: 7-3-9:19 and 32 being portions of Grant 2942 issued to Hulikoa in 1863 and Royal Patent 8214, Land Commission Award 7715, Apana 11 issued to Lota Kamehameha in 1845. Grant 2942 lies entirely within the ahupuaa of Kohanaiki and Land Commission Award 7715:11 is situate within Kaloko. A reduced copy of the current tax map is included for easy reference.

The Y-O Limited Partnership conveyed its interest in parcels 19 and 32 (besides other lands) to Koloko Heights Associates, LLC, on November 30, 2004. This Limited Warranty Deed is filed in the Bureau of Conveyances as Document Number 2004-244541. For the purposes of this report the land will continue to be referred to as the Y-O Project.

Record research was conducted to establish the existence of trails and roadways prior to 1892 as identified in documents, maps, descriptions, and sketches. Government surveyor Joseph S. Emerson identified several trails that run in a mauka-makai direction through the subject parcels: Trail to Honokohau, Trail to Sea Coast, Road to Na Wahi Ahu and Kohanaiki Road. The following field notes and survey maps provide information about the location of each of these trails.

Trail to Honokohau and Trail to Sea Coast

Emerson compiled Registered Map Number 1280 titled "Kailua Section, North Kona," from data collected in 1882 and recorded in Field Book Number 253. On June 4, 1882, a sketch of the view up the slope of Hualalai on Page 69 (**Exhibit A**) of the field book is of importance as it delineates a portion of two trails to the sea coast from Kohanaiki mauka identified as "Trail to Honokohau" and "Trail to Sea Coast".

Both trails originate in the vicinity of Kohanaiki Village and connect to the mauka Government Road. The entire alignment of these trails is not depicted on this sketch, however Registered Map Number 1280 provides a complete view of the alignments. This portion of Registered Map Number 1280 has been reproduced and is attached as **Exhibit B**.

Registered Map Number 1280 delineates the two trails forking near Kohanaiki Church with one trail passing through a portion of Grant 2942 and terminating at the Kaloko Fishpond. This is most likely the trail identified in Field Book 253:69 as "Trail to Sea Coast." The second trail shown on Registered Map Number 1280 begins near Kohanaiki Church and goes makai through Kaloko and Honokohau with the terminus on the shoreline near the Aimakapaa Fishpond. This is probably the trail labeled "Trail to Honokohau" in Field Book 253:69.

Using an Auto CAD overlay of the current tax map (shown in red) and Registered Map Number 1280 (shown in green) it is possible to identify the two trails passing through portions of the Y-O Project lands (**Exhibit C**).

Road to Na Wahi Ahu

In September of 1888, Emerson prepared a map titled "Akahipuu Section, North Kona, Hawaii" on file at the State Survey Office as Registered Map Number 1449. The map shows a segment of trail running in a mauka-makai direction from the Triangulation Station labeled "Na wahi ahu" on the boundary of Kohanaiki within Grant 2942 and abruptly terminating just past Triangulation Station "Kumuohe" in Kaloko. (**Exhibit D**) Field Book 292:57-58 identifies this trail within the Kohanaiki Houselots as "Road to Na Wahi Ahu." (**Exhibit E**) This label indicates the trail was much longer than as shown on Exhibit D.

Kohanaiki Road

In 1889 Emerson prepared another map of the Akahipuu Section filed at the State Survey Office as Registered Map Number 1512. A reduced copy of this map is attached as **Exhibit F**. On this map Emerson identifies the trail

previously referred to as "Road to Na Wahi Ahu" as "Kohanaiki Road." This alignment is totally within Kohanaiki and may be the road noted in Field Book 291:71–72 as "…. a very straight road leading from Kohanaiki to the sea."

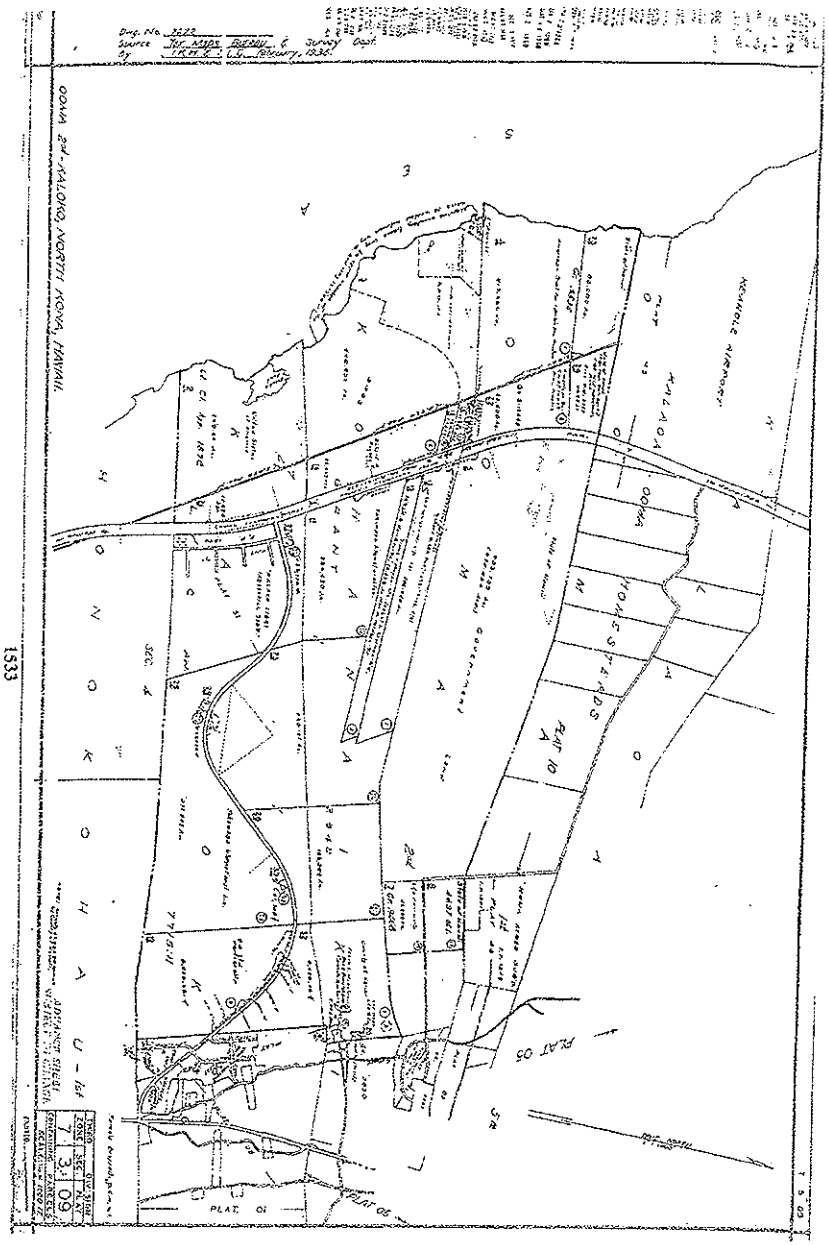
It is not clear if the Road to Na Wahi Ahu and Kohanaiki Road is the same feature because the map data is inconclusive. Registered Map Number 1449 suggests the Road to Na Wahi Ahu terminated on the boundary of Kaloko without providing access to the shoreline and the Lower Government Road. Similarly Registered Map Number 1512 does not illustrate if Kohanaiki Road continued to the sea.

Conclusion

The numerous land grants and Land Commission Awards within Kohanaiki and Kaloko indicate the presence of many residents who would require pedestrian access from the uplands to the coastline and adjoining ahupuaa. It is not known if any portions of these trails are discernable on the ground today or if they have evolved into vehicular access routes.

Based on the available evidence pursuant to the Highways Act of 1892, the State of Hawaii through its Board of Land and Natural Resources may claim a fee simple interest in the trails and roads described in this report. It is recommended that a modern metes and bounds survey description of these trails be completed and all adjoining landowners be notified of any future management plans of these historic publicly owned features.

c: Melissa Chinen, Historic Preservation
Peter Young, Chairman



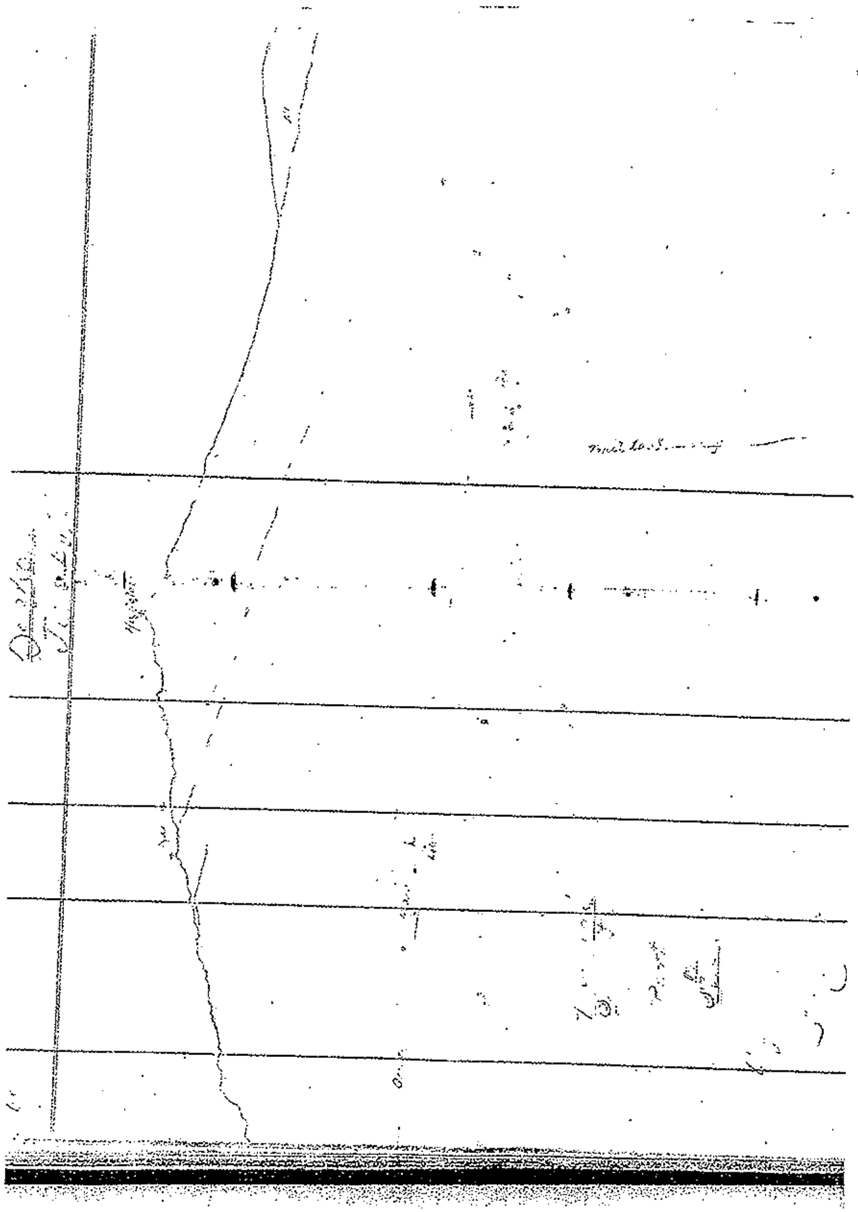


EXHIBIT A

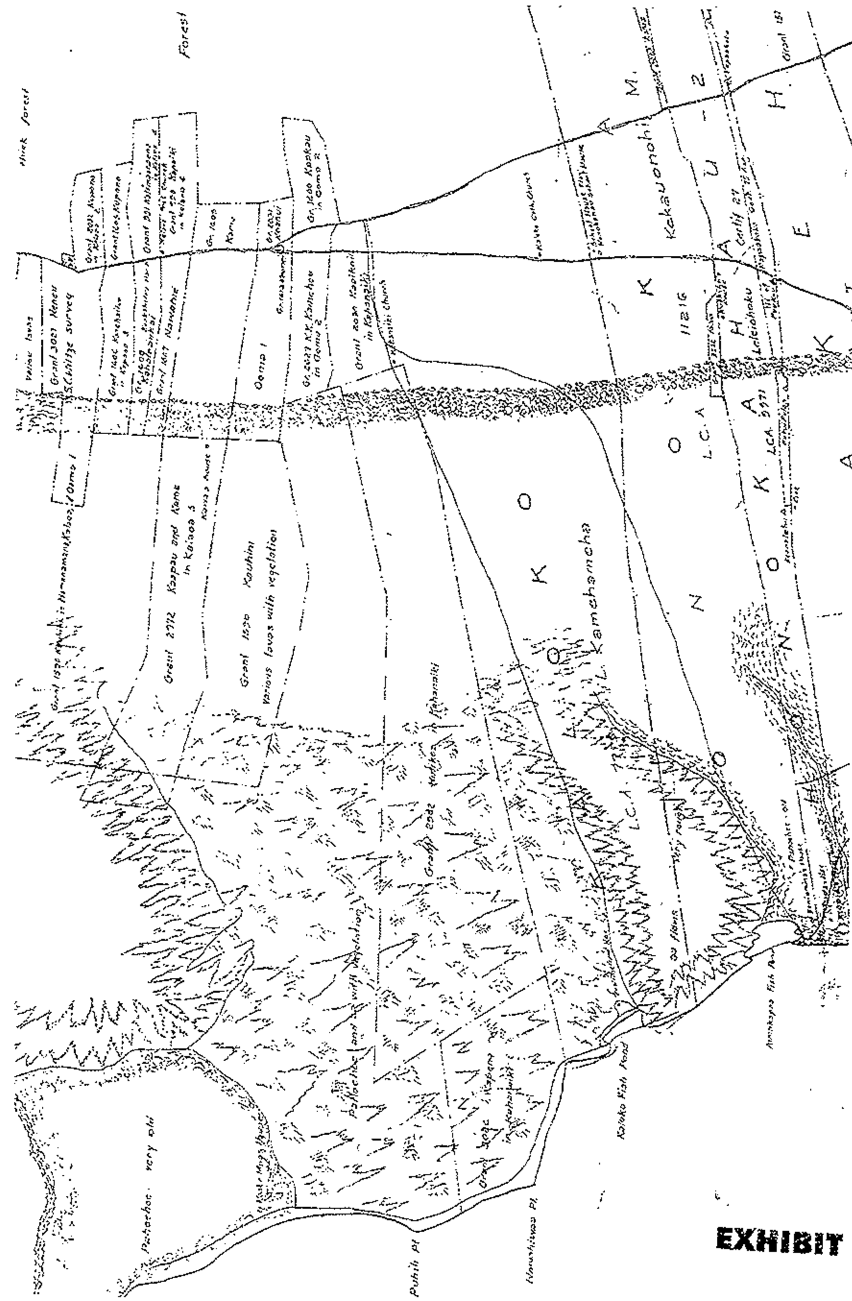


EXHIBIT B

EXHIBIT D

EXHIBIT C

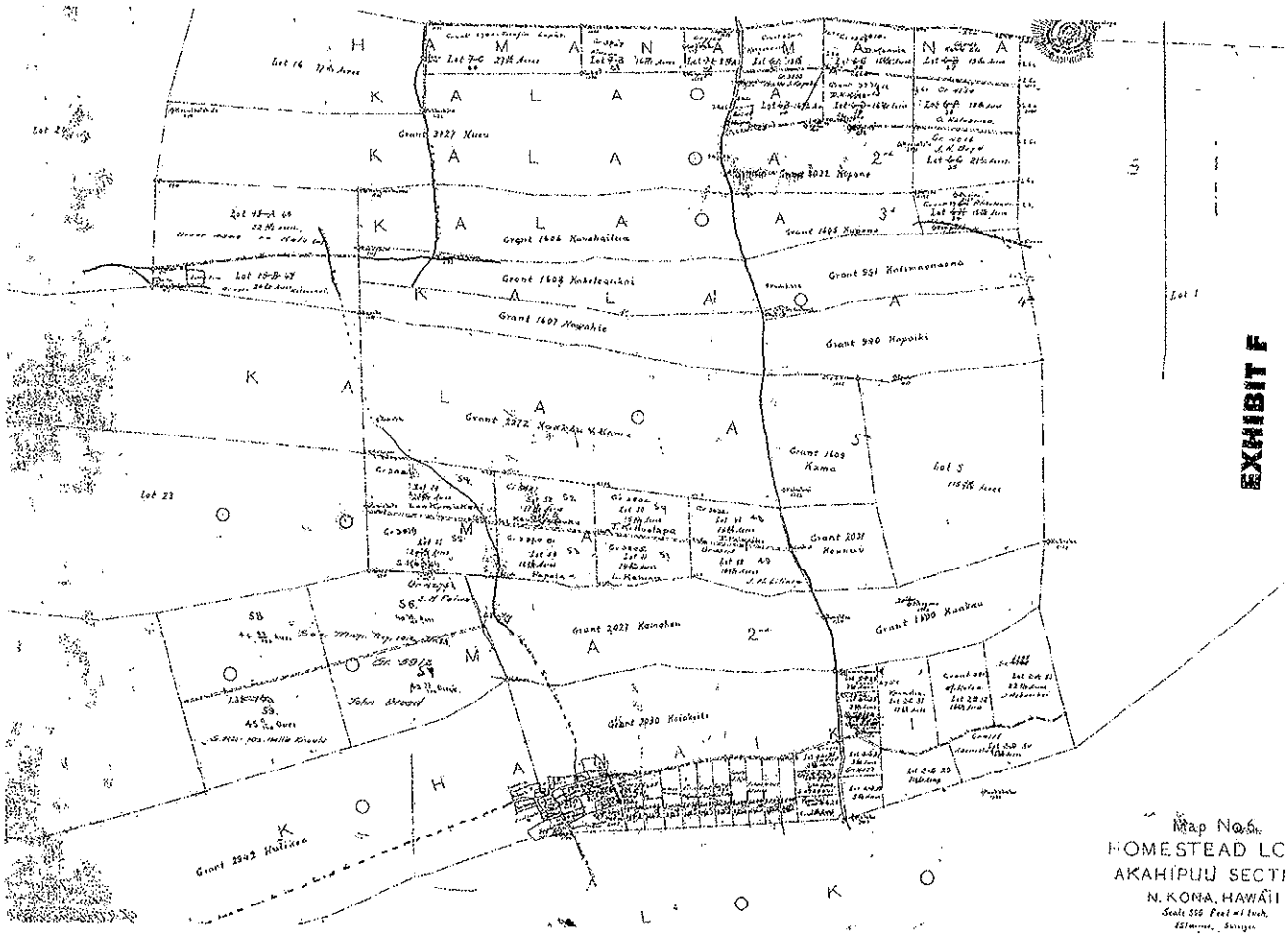


EXHIBIT F

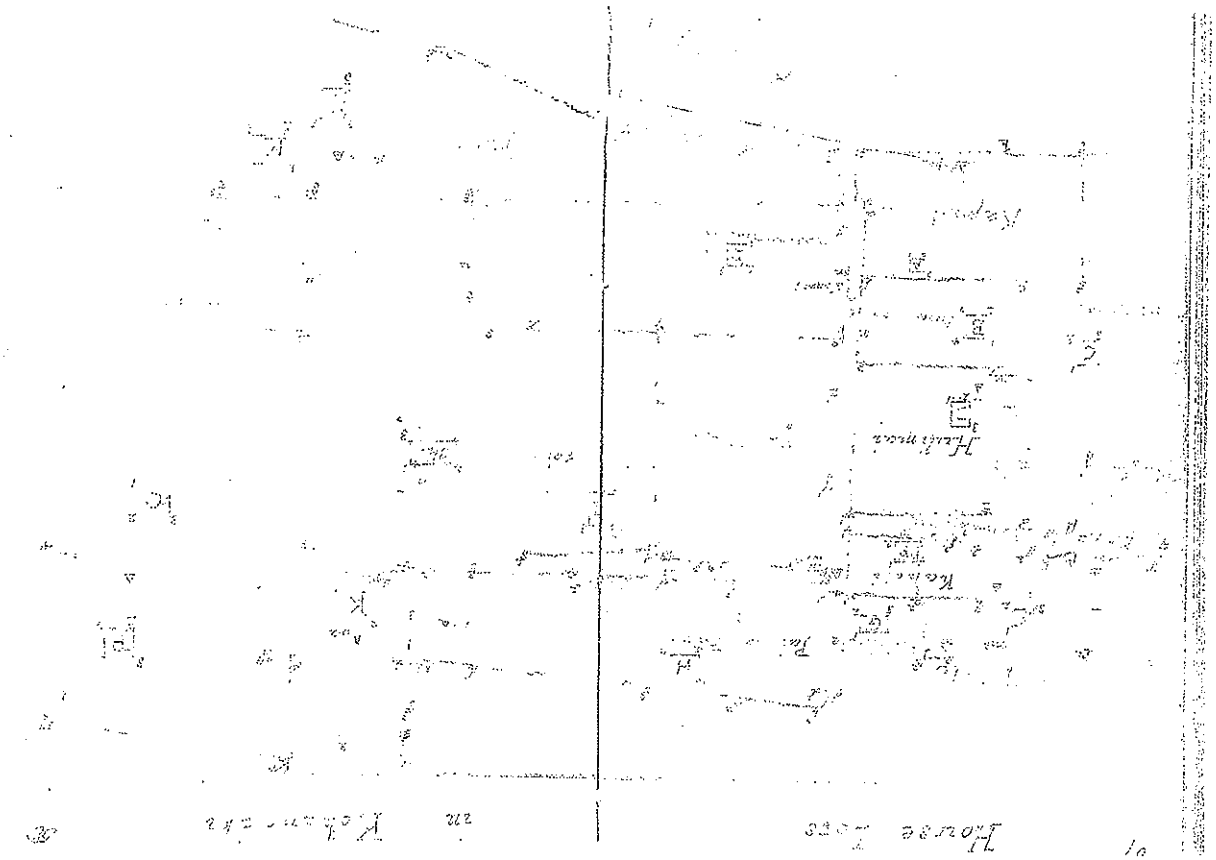


EXHIBIT E

WILSON OKAMOTO
CORPORATION
ENGINEERS | PLANNERS | CONSULTANTS

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Artesian Plaza, Suite 400
Honolulu, Hawaii, 96826 USA
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7469-01
July 25, 2011

Mr. Aric Arakaki, Superintendent
U.S. National Park Service
Ala Kahakai National Historic Trail
73-4786 Kanalani Street, Suite 14
Kailua-Kona, HI 96740

Subject: Environmental Assessment (EA)/Environmental Impact Statement Preparation Notice (EISPN)
Kaloko Makai
Kaloko and Kohanaiki, North Kona, Hawaii
Tax Map Key: (3) 7-3-09: 017, 025, 026, and 028

Dear Mr. Arakaki:

Thank you for your letter dated October 22, 2010 (L7621). We offer the following responses in the respective order of your comments:

1. We acknowledge your shared concerns with Kaloko-Honokohau National Historic Park, National Park Service, regarding the potential impacts on the landmark, cultural and natural resources, and coastal resources. The Draft EIS will include discussions on impacts from surface water drainage, non-point source pollution, water system, wastewater system, traffic, noise, air, etc. and impacts to coastal and recreational resources. Relevant studies are being prepared and will be included in the Draft EIS.

2. The Draft EIS will incorporate the information you provided on the Kohanaiki Trail (Road to the Sea) and the Honokohau Trail (it is of note that the Honokohau trail is not located on the subject property). We would like to continue to work with you in preserving these trails.

The Draft EIS will discuss the historic trails that traverse through the project site.

We appreciate your participation in the environmental review process.

Sincerely,

Earl Matsukawa, AICP
Project Manager

cc: Mr. Peter Phillips, Stanford Carr Development
Mr. Orlando Dan Davidson, State Land Use Commission

LINDA LINGLE
GOVERNOR
THEODORE E. LIU
DIRECTOR
ABBEY SETH MAYER
DIRECTOR
OFFICE OF PLANNING

DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM

OFFICE OF PLANNING

235 South Beretania Street, 6th Floor, Honolulu, Hawaii 96813
Mailing Address: P.O. Box 2359, Honolulu, Hawaii 96804

Telephone (808) 587-2846
Fax (808) 587-2824

EM

Ref. No. P-13158

November 3, 2010

NOV 04 2010

Mr. Earl Matsukawa, AICP, Project Manager
Wilson Okamoto Corporation
1907 S. Beretania Street, Suite 400
Honolulu, Hawai'i 96826

Dear Mr. Matsukawa:

Subject: LUC Docket A07-778, SCD Kaloko Makai, LLC
Kaloko Makai
Environmental Impact Statement Preparation Notice
TMK(s) (3) 7-3-009: 017, 025, 026, 028, 063, and 064
Kaloko and Kohanaiki, North Kona, Island of Hawai'i

The Office of Planning (OP) appreciates the opportunity to comment on the Environmental Impact Statement Preparation Notice (EISPN) for the above referenced proposal, for which the landowner has filed a petition to reclassify approximately 952.165 acres of land from the State Agricultural and Conservation Districts to the State Urban District. The petitioner proposes to develop a master-planned community on approximately 1,142.165 acres of land at Kaloko and Kohanaiki.

The Office of Planning will be coordinating the State's position on the petition with respect to areas of cross-cutting State concern. It is very important that the Draft Environmental Impact Statement (DEIS) fully identify and discuss potential impacts, including cumulative and secondary impacts of the proposed project, as well as recommendations for mitigating potential adverse impacts on the following areas of State concern.

1. **Groundwater and Surface Water Resources.** Water resource protection and water quality are critical State issues. The DEIS should discuss the water requirements of the proposed project and identify the proposed potable and non-potable water sources to be used for the project, as well as measures proposed to reduce water demand and promote water reuse in the project. This discussion should identify whether the proposed project is within a designated Water Management Area, the impact of the project on the sustainable yield of affected aquifers, and the impact of the project on projected water use and system improvements contained in the County's water use and development plan. The

DEIS should also discuss the cumulative impacts of planned development in this region on the proposed drinking water source.

As noted in the EISPN, groundwater withdrawal and potential recharge to the underlying groundwater resource from stormwater runoff, drainage, and wastewater effluent are of critical concern to the Kaloko-Honokōhau National Historical Park makai of the project area. The DEIS should discuss potential impacts on the Park's natural and cultural resources and how these impacts will be mitigated.

2. **Agricultural Lands.** The DEIS should identify the extent of existing agricultural activity in the vicinity of the project area, and discuss what impact the proposed development might have on any agricultural activity in the area.

3. **Cultural, Archaeological, and Historic Resources.** The DEIS should include a complete inventory of archaeological and historic sites found on the subject property, and identify the status of any monitoring and preservation plans being prepared for or approved by the State Historic Preservation Division. The DEIS should identify and describe any cultural resources and cultural practices, including visual landmarks, if applicable, on the subject property and within the ahupua'a in which the property is situated. The DEIS should discuss the impact of the proposed project on identified cultural resources and practices, alternatives considered, and proposed mitigation measures.

   OP recommends the DEIS include a map that overlays the Conceptual Land Use Map with identified sites and resources to enable the reviewer to visualize the relationship between proposed development and existing resources to be preserved and protected.

4. **Coastal Zone Management (CZM) Concerns.** The State oversees protection of natural, cultural, and economic resources within the coastal zone, which is defined as all lands of the State and the area extending seaward from the shoreline to the limit of the State's police power and management authority, including the United States territorial sea (§205A-1, Hawai'i Revised Statutes). The DEIS should note this definition of the coastal zone, and discuss how the proposed project will balance the competing values of economic development and preservation of coastal resources, including the following CZM objective areas:

   a. **Coastal and Ocean Resources.** The State has an affirmative duty to protect Hawai'i's nearshore waters. The DEIS should discuss important coastal and marine resources and ecosystems that may be impacted by the proposed project. The DEIS should discuss how wastewater and

stormwater generated by the project will be prevented from adversely impacting nearshore waters, species, and habitats.

The DEIS should discuss the impact of the project on existing site and offsite hydrology, and how the project will manage stormwater and runoff. OP recommends the use of green infrastructure, specifically the use of low impact development design and other best management practices (BMPs) that promote onsite infiltration and minimize runoff from storm events. More information on stormwater BMPs can be found at http://hawaii.gov/dbedt/czm/initiative/lid.php.

b. **Coastal and Other Hazards.** The DEIS should describe any hazard conditions that are relevant to the site, such as potential risk or harm from hurricane, wind, flooding from mauka areas, erosion, volcanic activity, earthquake, landslide, subsidence, and point and nonpoint source pollution. The DEIS should describe the measures that are proposed to mitigate any hazard impacts, and provide an update on the County's adoption of the International Building Code.

The DEIS should also include a discussion of whether wildfire hazard is a concern in the area and possible mitigation measures that might be required to address any potential threat from wildfires.

c. **Coastal Scenic Resources.** The DEIS should discuss the project's impact on scenic views to and from the coast and how these will be mitigated.

5. **Affordable Housing.** Increasing the supply of affordable housing is a critical State and County issue. The DEIS should specifically discuss how the Petitioner plans to meet the County affordable housing and workforce housing requirements, to include a discussion of how the project's proposed residential product types will be allocated among the market and various affordable housing target populations, and the expected price ranges for the different product types.

6. **Impact on State Facilities.** The DEIS should include a discussion of anticipated short- and long-term project impacts on State-funded facilities, including schools, highways, harbors, and airports, and document State agency concerns related to their respective State facilities and resources. The DEIS should cite the measures proposed to mitigate the project's impacts on State facilities and describe discussions held with State agencies to address their concerns.

7. **Energy Use and Impacts.** The DEIS should quantify the projected energy requirements of the project by type of use, and discuss measures to be taken to

reduce energy demand, promote energy efficiency, and to promote use of alternative, renewable energy sources, and otherwise advance State efforts to increase energy efficiency and alternative energy use under the Hawai'i Clean Energy Initiative. OP recommends the project's energy and resource use be evaluated with respect to the U.S. Green Building Council's (U.S. GBC) Leadership in Energy and Environmental Design (LEED) rating systems for new construction and neighborhood development. The DEIS should also identify any generating or transmission capacity constraints that may arise as a result of the proposed project and other projects planned for the region. The DEIS should also discuss the degree to which the project promotes transportation energy savings and reduces vehicular trips for project residents and users within the project and the region.

8. **Biota.** The DEIS should include an inventory of flora and fauna, including invertebrates, found on or in proximity to the project site and in any lava tubes and caves on the property. Flora and fauna of concern should not be limited to listed threatened or endangered species or those under consideration for listing. The applicant should also consult with the Database Manager at the Hawai'i Biodiversity and Mapping Program, Center for Conservation Research and Training, University of Hawai'i, (808) 956-8094, as to the potential for the presence of rare species in the project area. The DEIS should also discuss measures to be taken to protect rare, threatened or endangered species, or ecosystems of concern. Consideration should be given to conducting field observations in both wet and dry season surveys to capture the fullest range of flora and fauna.

The DEIS should provide an update on the delineation of the native dryland forest boundary and discuss specific recommendations made by the U.S. Fish and Wildlife Service and the Department of Land and Natural Resources for management of the dryland forest preservation area, including management of feral goats and pigs, if they are found in the updated biological surveys.

9. **Conformance with County Plan Designations and Urban Growth or Rural Community Boundaries.** Act 26, Session Laws of Hawaii 2008, reaffirmed the Land Use Commission's (LUC) duty to consider any proposed reclassification with respect to the Counties' adopted general, community, or development plans. Thus, the DEIS should discuss the proposed project's consistency with the County land use plans, including the following:

a. **Siting of regional hospital.** The DEIS should include a discussion of public and private efforts related to the siting of a new regional hospital in Kona, and any preliminary recommendations of these efforts. This will

assist the reader in better understanding whether the project site is the most suitable location for a regional hospital.

b. **Transportation concurrency.** The DEIS should identify any transportation improvements that may be required by the Kona Community Development Plan, prior to occupancy of units or development within the project area.

c. **Ane Keohokalole Highway.** The DEIS should discuss how the project intends to reconcile the creation and maintenance of a walkable, pedestrian-friendly village center with the mid-level road's function as a major, limited access arterial, when the planned arterial bisects the village center.

10. **Sustainability Analysis.** The adoption of sustainable building and development practices has long-term environmental, social, and economic benefits to Hawai'i's residents and communities. The EIS process is extremely valuable as a means to identify and discuss the specific sustainable design and development practices, including green building practices, which will be incorporated in the proposed project. The Office of Environmental Quality Control's, *Guidelines for Sustainable Building Design in Hawai'i*, and the U.S. GBC's LEED programs for new construction and its pilot program for neighborhood development (LEED-ND) offer guidelines and checklists for this purpose.

The LEED-ND rating system, in particular, is especially useful in profiling how a project protects and enhances the overall health, natural environment, and quality of life of communities. The rating system provides a range of development features and strategies that promote efficient water, energy, and resource use, including waste reduction, as well as location and design elements to reduce transportation impacts.

OP recommends that the DEIS includes an analysis of the project with respect to the LEED-ND system, and provide a discussion of the LEED elements that will or could be incorporated into the project. This information would greatly aid agencies, decision-makers, and the public in reviewing the project application.

11. **Wastewater Treatment and Disposal.** The DEIS needs to identify the proposed means of wastewater treatment and disposal, including the reuse and/or disposal of treated effluent and the disposal of waste solids, and the potential impacts and mitigation measures associated with the selected method of treatment and disposal. In addition, the DEIS should discuss how the project will implement

Policy PUB-4.6, Wastewater Reuse Area, of the Kona Community Development Plan.

12. **Solid Waste Management.** The DEIS should quantify the volume of solid waste likely to be generated by the project, and describe the impact the project will have on the County's existing and planned capacity for managing solid waste as represented in the County's solid waste management plan. The DEIS should discuss specific mitigation measures to be taken to reduce solid waste generation and to ensure that recycling and reuse are incorporated within the project area. Please also clarify what "waste diversion and reduction facilities" refers to on page 3-28 of the EISPN.

13. **Environmental Health Hazard.** If the project will have a potential to generate hazardous materials or result in the possible contamination of the air, soil, or water, please discuss how environmental and public health and safety will be protected, in particular, measures to be taken in areas planned for industrial use.

The DEIS should identify and discuss any potential health and environmental threats that may be present due to contamination from past or current use of the site, including findings from Phase I or Phase II environmental site assessments conducted at the project site. OP recommends that an ASTM 1527-05 Phase I Environmental Site Assessment or equivalent be conducted for the Master Plan area, if one has not already been conducted.

14. **Development Timetable.** The EISPN anticipates three phases of development, with major infrastructure completed by 2025. LUC requires that projects seeking reclassification be substantially completed within ten years or seek incremental approvals. The DEIS should reference LUC rules (Section 15-15-50, Hawai'i Administrative Rules) and provide a schedule of development for each phase of the total project and a map showing the location and timing of each phase or increment of development. This development schedule will be critical for the review of the petition for the proposed district boundary amendment.

15. **Miscellaneous Comments**

a. **Section 2.2, Project Need.** This section should provide a substantive discussion of the need for the proposed project in the context of other planned development in the region.

b. **Section 6, Alternatives to the Proposed Action.** This section needs to evaluate distinct alternatives to the proposed action, such as a smaller

footprint for the proposed new community and the potential for siting the proposed development package in another location/s on the Island.

c. **Section 6.1, No Action Alternative.** This discussion should be clarified: the no action alternative has no impact on existing tax revenues and does not reduce them. Similarly, the number of housing units and jobs are not reduced, although the opportunities for increasing housing and jobs are foregone under this alternative.

d. The list of permits/approvals should include those approvals required from the State Department of Health for new private wastewater treatment plants and possibly injection wells, should the private wastewater treatment system be pursued.

OP looks forward to receiving the DEIS with the potential impacts and mitigation measures for the above issues addressed. If you have any questions, please call Ruby Edwards of the Land Use Division at 587-2817.

Sincerely,

Abbey Seth Mayer
Director

c: Mr. Orlando Davidson, LUC

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7469-01
July 25, 2011

Ms. Mary Lou Kobayashi, Planning Program Administrator
Office of Planning
Department of Business, Economic Development and Tourism
State of Hawaii
P.O. Box 2359
Honolulu, HI 96804-2359

Subject: Environmental Assessment (EA)/Environmental Impact Statement Preparation Notice (EISPN)
Kaloko Makai
Kaloko and Kohanaiki, North Kona, Hawaii
Tax Map Key: (3) 7-3-09: 017, 025, 026, and 028

Dear Ms. Kobayashi:

Thank you for your letter dated November 3, 2010 (P-13158). We offer the following responses in the respective order of your comments:

1. Groundwater and Surface Water Resources: Kaloko Makai's water demand will require development of additional water sources, storage and transmission facilities. Kaloko Makai is investigating several alternatives to address its potable water needs. The Draft EIS will discuss the proposed project's demands, alternative water sources and the potential impact to ground water resources and the nearshore marine environment associated with the development of the alternative sources.

   The Draft EIS will also discuss water conservation to be achieved through the use of reclaimed wastewater.

2. Agricultural Lands: According to the ALISH, approximately 6 percent of the Petition Area is designated "other" and the remainder is not classified. Kaloko Makai will not have an impact on agriculturally significant lands. A discussion and maps on ALISH and LSB ratings and designations for the project site will be included in the Draft EIS.

3. Cultural, Archaeological, and Historic Resources: An Archaeological Inventory Survey and a Cultural Impact Assessment have been prepared for the project and will be summarized in the forthcoming Draft EIS. A graphic displaying sites and resources identified by these studies overlaid on the conceptual land use plan will be provided.

   The proposed project will comply with State and County laws and rules regarding the preservation or archaeological resources and historic sites. The archaeological inventory survey is presently under review by SHPD.

4. Coastal Zone Management: The Draft EIS will include a discussion on Coastal Zone Management and how the project conforms to the project.

   A discussion of potential impacts on coastal and ocean resources; coastal and other hazards; and coastal scenic resources will also be included.

5. Affordable Housing: Kaloko Makai is a master-planned community offering a wide range of housing types and affordability. Kaloko Makai will meet affordable housing requirements established by Chapter 11, Hawaii County Code Affordable Housing Ordinance, as well as applicable provisions of the Kona Community Development Plan.

6. Impact on State Facilities: The Draft EIS will include discussions of the proposed project's impacts on State facilities.

7. Energy Use and Impacts: Kaloko Makai will implement feasible measures to promote energy conservation and environmental stewardship, such as the standards and guidelines promulgated by the US Green Building Council, US EPA Energy Star Program, and other similar programs.

8. Biota: Flora and fauna surveys have been conducted and the respective reports will be summarized and included in the Draft EIS. Potential impacts and mitigation measures will be discussed.

   Kaloko Makai has been working with the US Fish & Wildlife Service and the Department of Land and Natural Resources on the delineation and preservation of the 150 acre native dryland forest. Kaloko Makai has determined that the project may cause the taking of two listed plant species (`aiea and hala pepe) and one candidate species (ko`oko`olau). In response to this, Kaloko Makai prepared a Habitat Conservation Plan (HCP) to address the short- and long-term management measures to protect these species.

9. Conformance with County Land Use: The Draft EIS will include a discussion on how the Kaloko Makai conforms with County land use plans, including the Kona Community Development Plan (CDP).

10. Sustainability Analysis: In the design and construction of Kaloko Makai, SCD – TSA Kaloko Makai, LLC will seek to implement feasible measures to conform to the Office of Environmental Quality Control's (OEQC) Building Design Guidelines and Leadership in Energy and Environmental Design (LEED) program.

11. Wastewater Treatment and Disposal: In the event connection to a public wastewater system is not available, Kaloko Makai will construct and operate a Private Wastewater Treatment Plant (WWTP) within the project. The Kaloko Makai facility will treat the wastewater to produce reclaimed (R-1) quality water for general irrigation within Kaloko Makai, thus lessening demand for potable water. Most of the project site is located within the Kona CDP Wastewater Reuse Area (Policy PUB 4.6). The Draft EIS will discuss potential impacts and mitigation measures associated with the method chosen.

12. Solid Waste Management: The Draft EIS will discuss potential impacts and mitigation measures associated with solid waste generation.

13. Environmental Health Hazard: Kaloko Makai is not expected to generate hazardous materials or result in the possible contamination of the air, soil, or water. Impacts on the quality of air, soil and water would be related to construction of the project. The proper mitigation measures will be undertaken.

    No prior uses of the project site suggestive of the need to prepare a Phase 1 environmental site assessment.

14. Development Timetable: A phasing plan will be included in the Draft EIS.

15. Miscellaneous Comments: An expanded discussion on project need, alternatives to proposed action, and list of permits/approvals will be included in the Draft EIS.

We appreciate your participation in the environmental review process.

Sincerely,

Earl Matsukawa, AICP
Project Manager

cc: Mr. Peter Phillips, Stanford Carr Development
Mr. Orlando Dan Davidson, State Land Use Commission

LINDA LINGLE
GOVERNOR OF HAWAII

LAURA H. THIELEN
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

EM

RECEIVED
OCT 25 2010
WILSON OKAMOTO CORPORATION

October 21, 2010

Wilson Okamoto Corporation
1907 South Beretania Street Suite 400
Honolulu, Hawaii 96826

Attention: Mr. Earl Matsukawa, AICP, Project Manager

Ladies and Gentlemen:

Subject: Environmental Assessment (EA)/Environmental Impact Statement Preparation Notice (EISPN) for Kaloko Makai

Thank you for the opportunity to review and comment on the subject matter. The Department of Land and Natural Resources' (DLNR), Land Division distributed or made available a copy of your report pertaining to the subject matter to DLNR Divisions for their review and comment.

Other than the comments from Division of State Parks, Division of Forestry & Wildlife, Land Division-Hawaii District, Engineering Division, the Department of Land and Natural Resources has no other comments to offer on the subject matter. Historic Preservation will be submitting comments through a separate letter. Should you have any questions, please feel free to call our office at 587-0414. Thank you.

Sincerely,

Russell Y. Tsuji
Administrator

LINDA LINGLE
GOVERNOR OF HAWAII

LAURA H. THIELEN
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

September 21, 2010

MEMORANDUM

TO: **DLNR Agencies:**
x Div. of Aquatic Resources
__Div. of Boating & Ocean Recreation
x Engineering Division
x Div. of Forestry & Wildlife
x Div. of State Parks
x Commission on Water Resource Management
x Office of Conservation & Coastal Lands
x Land Division –Hawaii District

FROM: Charlene Unoki, Assistant Administrator
SUBJECT: Environmental Assessment (EA)/Environmental Imapct Statement preparation Notice (EISPN)
LOCATION: Island of Hawaii
APPLICANT: Wilson Okamoto Corporation on behalf of SCD-TSA Kaloko Makai, LLC

Transmitted for your review and comment on the above referenced document. If you already received the document from Wilson Okamoto, we would appreciate your comments be submit by October 20, 2010.

Only 1 copy of the report available in Room 220.

If no response is received by this date, we will assume your agency has no comments. If you have any questions about this request, please contact my office at 587-0433. Thank you.

RECEIVED
LAND DIVISION
2010 SEP 30 A8:45
DEPT. OF LAND & NATURAL RESOURCES
STATE OF HAWAII

Attachments

( ) We have no objections.
( ) We have no comments.
(X) Comments are attached.

Signed:
Date: 9/29/10

DEPARTMENT OF LAND AND NATURAL RESOURCES
ENGINEERING DIVISION

LM/CharleneUnoki
REF.:EISPNKalokoMakai
Hawaii.488

COMMENTS

(X) **We confirm that the project site, according to the Flood Insurance Rate Map (FIRM), is located in Zone X. The Flood Insurance Program does not have any regulations for developments within Zone X.**

( ) Please take note that the project site, according to the Flood Insurance Rate Map (FIRM), is located in Zone____.

( ) Please note that the correct Flood Zone Designation for the project site according to the Flood Insurance Rate Map (FIRM) is ___.

( ) Please note that the project must comply with the rules and regulations of the National Flood Insurance Program (NFIP) presented in Title 44 of the Code of Federal Regulations (44CFR), whenever development within a Special Flood Hazard Area is undertaken. If there are any questions, please contact the State NFIP Coordinator, Ms. Carol Tyau-Beam, of the Department of Land and Natural Resources, Engineering Division at (808) 587-0267.

Please be advised that 44CFR indicates the minimum standards set forth by the NFIP. Your Community's local flood ordinance may prove to be more restrictive and thus take precedence over the minimum NFIP standards. If there are questions regarding the local flood ordinances, please contact the applicable County NFIP Coordinators below:

( ) Mr. Robert Sumitomo at (808) 768-8097 or Mr. Mario Siu Li at (808) 768-8098 of the City and County of Honolulu, Department of Planning and Permitting..

( ) Mr. Carter Romero at (808) 961-8943 of the County of Hawaii, Department of Public Works.

( ) Mr. Francis Cerizo at (808) 270-7771 of the County of Maui, Department of Planning.

( ) Ms. Wynne Ushigome at (808) 241-4890 of the County of Kauai, Department of Public Works.

( ) The applicant should include water demands and infrastructure required to meet project needs. Please note that projects within State lands requiring water service from the Honolulu Board of Water Supply system will be required to pay a resource development charge, in addition to Water Facilities Charges for transmission and daily storage.

( ) The applicant should provide the water demands and calculations to the Engineering Division so it can be included in the State Water Projects Plan Update

(X) Additional Comments: Please correct information on page 3-9, Item 3-6, Flood Hazard. The correct Community Panel Numbers are 1551660684C and 1551660703C (Panels not Printed). Copies attached.

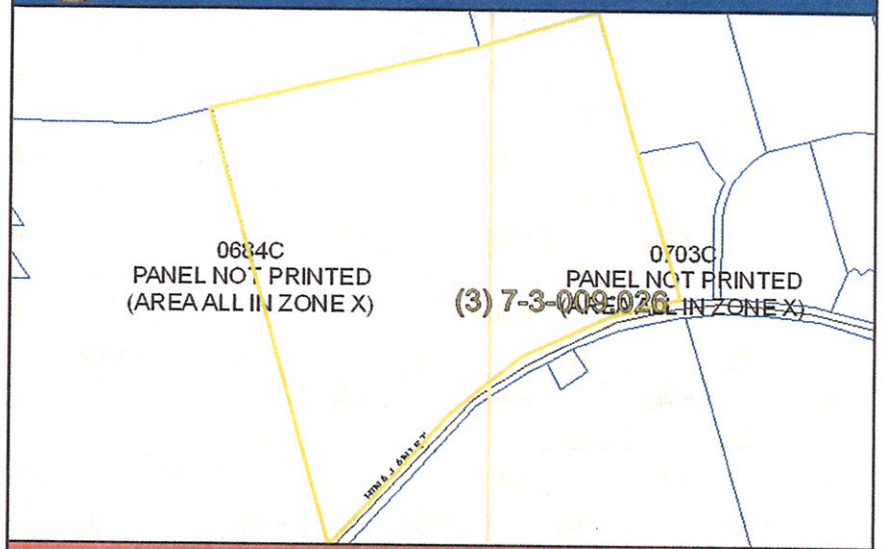
( ) Other: _____

Should you have any questions, please call Ms. Suzie S. Agraan of the Planning Branch at 587-0258.

Signed: _____
CARTY S. CHANG, CHIEF ENGINEER

Date: 9/29/10

State of Hawaii
FLOOD HAZARD ASSESSMENT REPORT



NATIONAL FLOOD INSURANCE PROGRAM

FLOOD ZONE DEFINITIONS

SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD – The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zone A, AE, AH, AO, V, and VE. The Base Flood Elevation (BFE) is the water-surface elevation of the 1% annual chance flood. Mandatory flood insurance purchase applies in these zones:

- **Zone A:** No BFE determined.
- **Zone AE:** BFE determined.
- **Zone AH:** Flood depths of 1 to 3 feet (usually areas of ponding); BFE determined.
- **Zone AO:** Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined.
- **Zone V:** Coastal flood zone with velocity hazard (wave action); no BFE determined.
- **Zone VE:** Coastal flood zone with velocity hazard (wave action); BFE determined.
- **Zone AEF:** Floodway areas in Zone AE. The floodway is the channel of stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without increasing the BFE.

NON-SPECIAL FLOOD HAZARD AREA – An area in a low-to-moderate risk flood zone. No mandatory flood insurance purchase requirements apply, but coverage is available in participating communities.

- **Zone XS (X shaded):** Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.
- **Zone X:** Areas determined to be outside the 0.2% annual chance floodplain.

OTHER FLOOD AREAS

- **Zone D:** Unstudied areas where flood hazards are undetermined, but flooding is possible. No mandatory flood insurance purchase requirements apply, but coverage is available in participating communities.

PROPERTY INFORMATION

COUNTY:	HAWAII
TMK NO:	(3) 7-3-009-026
PARCEL ADDRESS:	HINA LANI STREET
FIRM INDEX DATE:	APRIL 02, 2004
LETTER OF MAP CHANGE(S):	NONE
FEMA FIRM PANEL(S):	1551660703C - PANEL NOT PRINTED
	1551660684C - PANEL NOT PRINTED

PARCEL DATA FROM:	DECEMBER 2009
IMAGERY DATA FROM:	MAY 2005

IMPORTANT PHONE NUMBERS

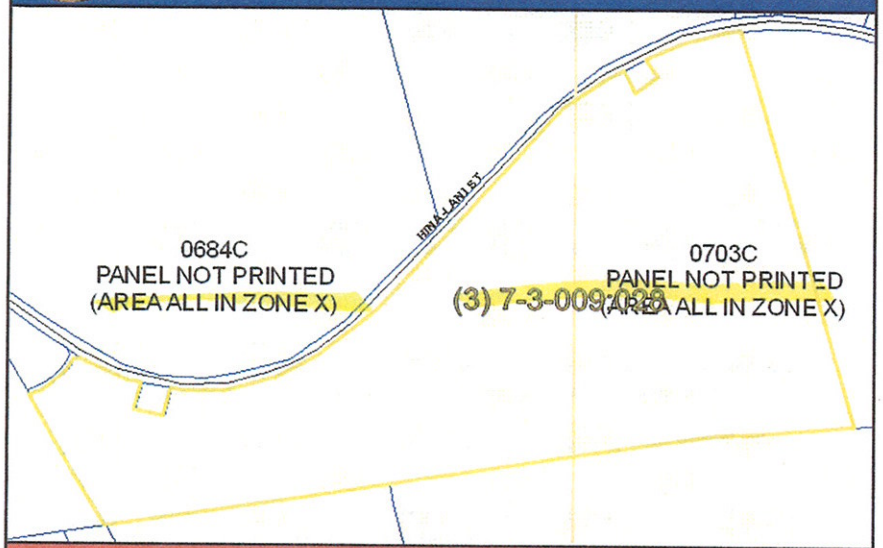
County NFIP Coordinator	
County of Hawaii	
Frank DeMarco, P.E., CFM	(808) 961-8042
State NFIP Coordinator	
Carol Tyau-Beam	(808) 587-0267

Disclaimer: The Department of Land and Natural Resources assumes no responsibility arising from the use of the information contained in this report. Viewers/Users are responsible for verifying the accuracy of the information and agree to indemnify the Department of Land and Natural Resources from any liability, which may arise from its use.

Preliminary DFIRM Disclaimer: If this map has been identified as "PRELIMINARY", please note that it is being provided for commenting purposes only and is not to be use for official/legal decisions or regulatory compliance.

State of Hawaii

FLOOD HAZARD ASSESSMENT REPORT



NATIONAL FLOOD INSURANCE PROGRAM

FLOOD ZONE DEFINITIONS

SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD – The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zone A, AE, AH, AO, V, and VE. The Base Flood Elevation (BFE) is the water-surface elevation of the 1% annual chance flood. Mandatory flood insurance purchase applies in these zones:

- **Zone A:** No BFE determined.
- **Zone AE:** BFE determined.
- **Zone AH:** Flood depths of 1 to 3 feet (usually areas of ponding); BFE determined.
- **Zone AO:** Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined.
- **Zone V:** Coastal flood zone with velocity hazard (wave action); no BFE determined.
- **Zone VE:** Coastal flood zone with velocity hazard (wave action); BFE determined.
- **Zone AEF:** Floodway areas in Zone AE. The floodway is the channel of stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without increasing the BFE.

NON-SPECIAL FLOOD HAZARD AREA – An area in a low-to-moderate risk flood zone. No mandatory flood insurance purchase requirements apply, but coverage is available in participating communities.

- **Zone XS (X shaded):** Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.
- **Zone X:** Areas determined to be outside the 0.2% annual chance floodplain.

OTHER FLOOD AREAS

- **Zone D:** Unstudied areas where flood hazards are undetermined, but flooding is possible. No mandatory flood insurance purchase requirements apply, but coverage is available in participating communities.

PROPERTY INFORMATION

COUNTY:	HAWAII
TMK NO:	(3) 7-3-009-028
PARCEL ADDRESS:	HINA LANI STREET
FIRM INDEX DATE:	APRIL 02, 2004
LETTER OF MAP CHANGE(S):	NONE
FEMA FIRM PANEL(S):	1551660703C - PANEL NOT PRINTED 1551660684C - PANEL NOT PRINTED
PARCEL DATA FROM:	DECEMBER 2009
IMAGERY DATA FROM:	MAY 2005

IMPORTANT PHONE NUMBERS

County NFIP Coordinator
County of Hawaii
Frank DeMarco, P.E., CFM (808) 961-8042
State NFIP Coordinator
Carol Tyau-Beam (808) 587-0267

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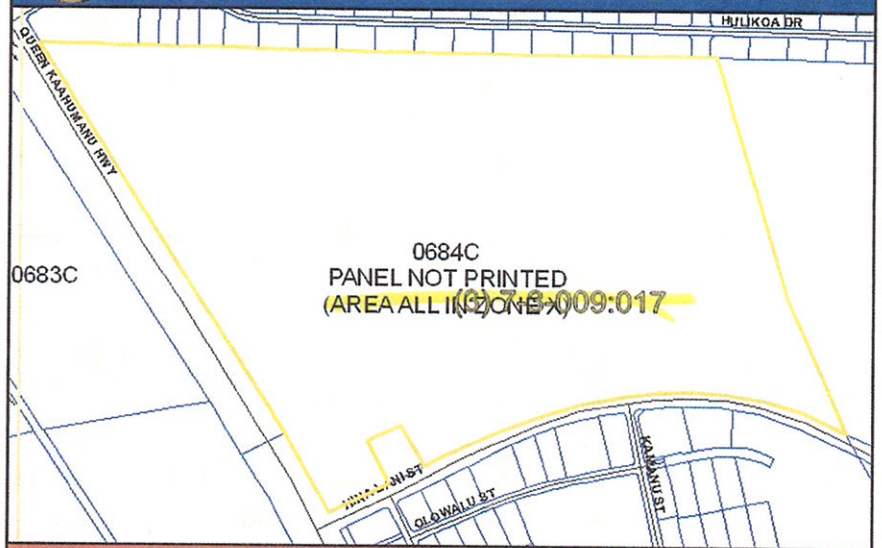
State of Hawaii

FLOOD HAZARD ASSESSMENT REPORT



NATIONAL FLOOD INSURANCE PROGRAM

FLOOD ZONE DEFINITIONS

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- **Zone A:** No BFE determined.
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- **Zone X:** Areas determined to be outside the 0.2% annual chance floodplain.

OTHER FLOOD AREAS

- **Zone D:** Unstudied areas where flood hazards are undetermined, but flooding is possible. No mandatory flood insurance purchase requirements apply, but coverage is available in participating communities.

PROPERTY INFORMATION

COUNTY:	HAWAII
TMK NO:	(3) 7-3-009-017
PARCEL ADDRESS:	QUEEN KAAHUMANU HIGHWAY
FIRM INDEX DATE:	APRIL 02, 2004
LETTER OF MAP CHANGE(S):	NONE
FEMA FIRM PANEL(S):	1551660684C
PANEL EFFECTIVE DATE:	PANEL NOT PRINTED
PARCEL DATA FROM:	DECEMBER 2009
IMAGERY DATA FROM:	MAY 2005

IMPORTANT PHONE NUMBERS

County NFIP Coordinator
County of Hawaii
Frank DeMarco, P.E., CFM (808) 961-8042
State NFIP Coordinator
Carol Tyau-Beam (808) 587-0267

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54319

LINDA LINGLE
GOVERNOR OF HAWAII

LAURA H. THIELEN
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

RECEIVED
STATE PARKS DIV

'10 SEP 22 A9:33

DEPT OF LAND &
NATURAL RESOURCES

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

September 21, 2010

MEMORANDUM

TO: **DLNR Agencies:**
x Div. of Aquatic Resources
__Div. of Boating & Ocean Recreation
x Engineering Division
x Div. of Forestry & Wildlife
x Div. of State Parks
x Commission on Water Resource Management
x Office of Conservation & Coastal Lands
x Land Division –Hawaii District

RECEIVED
LAND DIVISION
2010 SEP 29 A 11:23
DEPT. OF LAND &
NATURAL RESOURCES
STATE OF HAWAII

FROM: Charlene Unoki, Assistant Administrator
SUBJECT: Environmental Assessment (EA)/Environmental Imapct Statement preparation Notice (EISPN)
LOCATION: Island of Hawaii
APPLICANT: Wilson Okamoto Corporation on behalf of SCD-TSA Kaloko Makai, LLC

Transmitted for your review and comment on the above referenced document. If you already received the document from Wilson Okamoto, we would appreciate your comments be submit by October 20, 2010.

Only 1 copy of the report available in Room 220.

If no response is received by this date, we will assume your agency has no comments. If you have any questions about this request, please contact my office at 587-0433. Thank you.

Attachments

( ) We have no objections.
(✓) We have no comments.
( ) Comments are attached.

Signed:
Date: 9/28/10

LINDA LINGLE
GOVERNOR OF HAWAII

LAURA H. THIELEN
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

September 21, 2010

RECEIVED
LAND DIVISION
2010 OCT -4 P 3:28
DEPT. OF LAND &
NATURAL RESOURCES
STATE OF HAWAII

MEMORANDUM

TO: **DLNR Agencies:**
x Div. of Aquatic Resources
__Div. of Boating & Ocean Recreation
x Engineering Division
x Div. of Forestry & Wildlife
x Div. of State Parks
x Commission on Water Resource Management
x Office of Conservation & Coastal Lands
x Land Division –Hawaii District

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LOCATION: Island of Hawaii
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Only 1 copy of the report available in Room 220.

If no response is received by this date, we will assume your agency has no comments. If you have any questions about this request, please contact my office at 587-0433. Thank you.

Attachments

( ) We have no objections.
(✓) We have no comments.
( ) Comments are attached.

Signed: for BC
Date: 9/23/10

LINDA LINGLE
GOVERNOR OF HAWAII

LAURA H. THIELEN
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

September 21, 2010

RECEIVED
LAND DIVISION
2010 OCT -4 A 10: 29
DEPT. OF LAND & NATURAL RESOURCES STATE OF HAWAII

MEMORANDUM

TO: **DLNR Agencies:**
x Div. of Aquatic Resources
__Div. of Boating & Ocean Recreation
x Engineering Division
x Div. of Forestry & Wildlife
x Div. of State Parks
x Commission on Water Resource Management
x Office of Conservation & Coastal Lands
x Land Division –Hawaii District

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LOCATION: Island of Hawaii
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Attachments

( ) We have no objections.
(✓) We have no comments.
( ) Comments are attached.

Signed: _____
Date: 10·1·10

WILSON OKAMOTO CORPORATION
ENGINEERS | PLANNERS | CONSULTANTS
1907 South Beretania Street
Artesian Plaza, Suite 400
Honolulu, Hawaii, 96826 USA
Phone: 808-946-2277
FAX: 808-946-2253
www.wilsonokamoto.com

7469-01
July 25, 2011

Mr. Russell Y. Tsuji, Administrator
Land Division
Department of Land and Natural Resources
State of Hawaii
P.O. Box 621
Honolulu, HI 96809

Subject: Environmental Assessment (EA)/Environmental Impact Statement Preparation Notice (EISPN)
Kaloko Makai
Kaloko and Kohanaiki, North Kona, Hawaii
Tax Map Key: (3) 7-3-09: 017, 025, 026, and 028

Dear Mr. Tsuji:

Thank you for your letter dated October 21, 2010. We offer the following responses in the respective order of your comments:

Engineering Division

1. We acknowledge the project site is located in Zone X.
2. The Community Panel Number reference will be corrected in the Draft EIS.

Division of State Parks

We acknowledge the Division has no comments to offer at this time.

Division of Forestry and Wildlife

We acknowledge the Division has no comments to offer at this time.

Land Division, Hawaii District

We acknowledge the Division has no comments to offer at this time.

We appreciate your participation in the environmental review process.

Sincerely,

Earl Matsukawa, AICP
Project Manager

cc: Mr. Peter Phillips, Stanford Carr Development
Mr. Orlando Dan Davidson, State Land Use Commission

LINDA LINGLE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF AQUATIC RESOURCES
1151 PUNCHBOWL STREET, ROOM 330
HONOLULU, HAWAII 96813

LAURA H. THIELEN
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

PAUL J. CONRY
ACTING FIRST DEPUTY

LENORE N. OHIYE
ACTING DEPUTY DIRECTOR - WATER

AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
BUREAU OF CONVEYANCES
COMMISSION ON WATER RESOURCE MANAGEMENT
CONSERVATION AND COASTAL LANDS
CONSERVATION AND RESOURCES ENFORCEMENT
ENGINEERING
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
KAHOOLAWE ISLAND RESERVE COMMISSION
LAND
STATE PARKS

October 22, 2010

EM

RECEIVED
OCT 25 2010
WILSON OKAMOTO CORPORATION

Mr. Earl Matsukawa
Wilson Okamoto Corporation
1907 South Beretania St., Suite 400
Honolulu, HI 96826

Dear Mr. Matsukawa:

Subject: Environmental Impact Statement Preparation Notice (EISPN) for proposed Kaloko Makai project.

The Division of Aquatic Resources' comments on the above Preparation Notice relate to the potential deleterious effects the project may have on adjacent nearshore marine waters and coral reef communities. The proposed project's makai boundary is less than one mile from the ocean and associated coral reefs. Additionally, it is directly mauka of the northern portion of Kaloko-Honokōhau National Historical Park and Kaloko fishpond.

The project is also in an area with substantial submarine groundwater discharge (SGD). As documented in a recent U.S. Geological Survey Study of coastal waters adjacent to the project (Grossman et. al 2010), nearshore waters in this area are persistently influenced by brackish water plumes derived from submarine groundwater discharge. These plumes extend hundreds of meters offshore to depths of 5 m and may contain several million to hundreds of millions of gallons of brackish water. In essence, the nearshore areas directly makai of the project are estuarine.

As such, the project must be regarded as a coastal development with substantial potential to impact marine water quality and coastal ecosystems. As stated in the USGS report changes in groundwater discharge are expected to have significant impacts to the area's coastal ecosystems, including decreased freshwater outflow to brackish anchialine pools and coral reefs and increased nutrient and contaminant concentrations.

The EISPN notes that a ground water resources and marine water quality assessment will be conducted for the Draft EIS to determine the anticipated impacts of the proposed project. Given the highly sensitive location of the project, in addition to a one-off water quality assessment, a rigorous long term monitoring program must be developed and implemented. The following concerns should be addressed in any such program. In 2004, the County of Hawaii contracted the Marine Science Department at the University of Hawai'i Hilo to evaluate monitoring data from development projects in West Hawai'i. Monitoring reports from 13 development projects were reviewed to evaluate water quality, microbiological, biological, geological and physical data collected during these projects. According to the report only three of the projects (Waikoloa, Natural Energy Laboratory of Hawaii Authority (NELHA) and Hokuli'a, contained sufficient data over a sufficient duration to evaluate temporal trends for water quality (and compliance

with DOH water quality standards). None of the other developments had sufficient data for long-term analyses. For most of the developments we really don't know what environmental impacts may be occurring due to changes in water quality.

The UH researchers were thus forced to use water quality data only from Waikoloa, NELHA and Hokuli'a to evaluate effects of resort/residential development on coastal water quality. With regard to anchialine ponds which are easily affected by adjacent land use practices, nutrient concentrations in both the Waikoloa and Hokuli'a ponds were found to be often higher than concentrations measured in highly polluted rivers and estuaries. The researchers estimated that nutrient concentrations in the anchialine ponds at Waikoloa more than doubled since the resort's development. They noted that likely sources of the nutrients to these ponds were irrigation water enriched with treated sewage used to water development grounds (Waikoloa), dry fertilizers applied to golf courses (Waikoloa), and remnant nutrients from historical agriculture and cattle grazing (Hokuli'a).

They further found that historical nearshore water quality analyses from Waikoloa and Hokuli'a revealed that nitrogen parameters significantly increased at both developments over the past ten years. Specifically, total nitrogen (TN) and dissolved organic nitrogen (DON) concentrations increased 49% and 107% respectively, at Waikoloa from 1991 to 2002. At Hokuli'a, all nutrient parameters showed significant increases in concentrations from 1991 to 2001, with NO3 concentrations exhibiting the largest concentration increase of 410%. They state that results from the analyses are consistent with historical temporal trends for the sites, suggesting that conditions in West Hawai'i may be developing for extreme environmental degradation, possibly resulting in algal blooms like those in West Maui. We are already experiencing such degradation as evidenced by the unprecedented outbreak of cyanobacteria (blue-green alga) at Honaunau over the past couple of years.

We also know from additional work at nearby Honokōhau Bay (Parsons et al. 2008) that nutrient inputs have increased there over the years, and the early impacts of this increased nutrient loading are already evident in the coral reef community. It is predicted that at current nutrient-loading rates, the south sites of Honokōhau Bay will undergo further degradation in future years. If millions of additional gallons of wastewater are to be added to the outflow from the Kealakehe Wastewater treatment plant as proposed, the environmental impacts and mitigation of such need to be fully addressed in the Environmental Impact Statement (EIS).

Finally the EISPN is wholly deficient in addressing potential impacts of the project to coastal marine biological resources. As noted above such impacts may result from increased levels of nutrients and contaminants in nearshore waters. These may be either from the project area itself (e.g. irrigation) or wastewater effluent from the treatment plant's seepage pit directly above Honokōhau bay. Additionally, if and when the project is completed, there will be tens of thousands of people living in the area where now there are none. It is likely that a substantial number of these new residents will avail themselves of the ocean recreation opportunities, including fishing and harvesting, offered by the nearby coastal marine areas. The potential impacts of these activities on our marine resources are real and need to be fully considered and mitigated in the EIS.

Sincerely,

ROBERT T. NISHIMOTO, Ph.D.
Program Manager

WILSON OKAMOTO
CORPORATION
ENGINEERS | PLANNERS | CONSULTANTS

1907 South Beretania Street
Artesian Plaza, Suite 400
Honolulu, Hawaii, 96826 USA
Phone: 808-946-2277
FAX: 808-946-2253
www.wilsonokamoto.com

7469-01
July 25, 2011

Mr. Robert T. Nishimoto, Ph.D., Program Manager
Division of Aquatic Resources
Department of Land and Natural Resources
State of Hawaii
1151 Punchbowl Street, Room 330
Honolulu, HI 96809

Subject: Environmental Assessment (EA)/Environmental Impact Statement Preparation Notice (EISPN)
Kaloko Makai
Kaloko and Kohanaiki, North Kona, Hawaii
Tax Map Key: (3) 7-3-09: 017, 025, 026, and 028

Dear Mr. Nishimoto:

Thank you for your letter dated October 22, 2010. We offer the following responses in the respective order of your comments:

1. The forthcoming DEIS will include a discussion on groundwater impacts associated with the proposed project.

2. The forthcoming DEIS will include a discussion on nearshore and marine resources impacts associated with the proposed project.

3. Kaloko Makai will participate and develop a groundwater monitoring plan.

4. The Draft EIS will discuss the potential impact to ground water resources and the nearshore marine environment, including coastal marine biological resources.

We appreciate your participation in the environmental review process.

Sincerely,

Earl Matsukawa, AICP
Project Manager

cc: Mr. Peter Phillips, Stanford Carr Development
Mr. Orlando Dan Davidson, State Land Use Commission

LINDA LINGLE
GOVERNOR OF HAWAII

STATE OF HAWAI'I
DEPARTMENT OF LAND AND NATURAL RESOURCES
POST OFFICE BOX 621
HONOLULU, HAWAI'I 96809

LAURA H. THIELEN
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

PAUL J. CONRY
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ACTING DEPUTY DIRECTOR - WATER

AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
BUREAU OF CONVEYANCES
COMMISSION ON WATER RESOURCE MANAGEMENT
CONSERVATION AND COASTAL LANDS
CONSERVATION AND RESOURCES ENFORCEMENT
ENGINEERING
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
KAHOOLAWE ISLAND RESERVE COMMISSION
LAND
STATE PARKS

ref:OCCL:MC

Corr HA-11-60

RECEIVED
OCT 19 2010
WILSON OKAMOTO CORPORATION

OCT 18 2010

Earl Matsukawa
Wilson Okamoto Corporation
1907 South Beretania Street
Artesian Plaza, Suite 400
Honolulu, HI 96826

Dear Mr. Matsukawa,

SUBJECT: **ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE**
Kaloko Makai Planned Community
Kaloko, North Kona, Hawai`i
TMK (3) 7-3-009:017

The Office of Conservation and Coastal Lands (OCCL) has reviewed the Environmental Impact Statement Preparation Notice for the proposed Kaloko Makai development on the above subject parcels.

Approximately 224 acres of the project area is in the General Subzone of the State Land Use Conservation District; the applicant is proposing to reclassify them as Urban in order to proceed with the development of a master planned community.

HAR §13-5 states that the objective of the General Subzone is *to designate open space where specific conservation uses may not be defined, but where urban use would be premature.*

As stated in our earlier correspondences, OCCL would like to see the EIS more fully explain why the applicant feels that these objectives are no longer applicable to the parcel in question.

Please contact Michael Cain at 587-0048 should you have any questions on this matter.

Sincerely,

for Samuel J. Lemmo, Administrator
Office of Conservation and Coastal Lands

WILSON OKAMOTO CORPORATION
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Artesian Plaza, Suite 400
Honolulu, Hawaii, 96826 USA
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FAX: 808-946-2253
www.wilsonokamoto.com

7469-01
July 25, 2011

Mr. Samuel J. Lemmo, Administrator
Office of Conservation and Coastal Lands
Department of Land and Natural Resources
State of Hawaii
P.O. Box 621
Honolulu, HI 96809

Subject: Environmental Assessment (EA)/Environmental Impact Statement Preparation Notice (EISPN)
Kaloko Makai
Kaloko and Kohanaiki, North Kona, Hawaii
Tax Map Key: (3) 7-3-09: 017, 025, 026, and 028

Dear Mr. Lemmo:

Thank you for your letter dated October 28, 2010 (ref: OCCL:MC/Corr HA-11-60). We acknowledge that approximately 224 acres of the project area is designated Conservation District with a General Subzone designation. The Draft EIS will discuss how the project is in conformance with the Land Use Commission's decision-making criteria, Section 205-17, Hawaii Revised Statutes and Section 15-15-77, Hawaii Administrative Rules.

We appreciate your participation in the environmental review process.

Sincerely,

Earl Matsukawa, AICP
Project Manager

cc: Mr. Peter Phillips, Stanford Carr Development
Mr. Orlando Dan Davidson, State Land Use Commission

LINDA LINGLE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF HEALTH
P. O. BOX 3378
HONOLULU, HI 96801-3378

CHIYOME L. FUKINO, M.D.
DIRECTOR OF HEALTH

In reply, please refer to:
DOH/CWB

10005PSS.10

October 5, 2010

Mr. Earl Matsukawa
Wilson Okamoto Corporation
1907 South Beretania Street, Suite 400
Honolulu, Hawaii 96826

Subject: Comments on the Environmental Assessment/Environmental Impact Statement Preparation Notice for Kaloko Makai
Kaloko and Kohanaiki, North Kona, Island of Hawaii, Hawaii
TMK: (3) 7-3-009:017, 025, 026, and 028

Dear Mr. Matsukawa:

The Department of Health (DOH), Clean Water Branch (CWB) has reviewed the subject document and offers these comments on the project. Please note that our review is based solely on the information provided in the subject document and its compliance with Hawaii Administrative Rules (HAR), Chapters 11-54 and 11-55. You may be responsible for fulfilling additional requirements related to our program. We recommend that you also read our standard comments on our website at http://www.hawaii.gov/health/environmental/env-planning/landuse/CWB-standardcomment.pdf.

1. Any project and its potential impacts to State waters must meet the following criteria:

   a. Antidegradation policy (HAR, Section 11-54-1.1), which requires that the existing uses and the level of water quality necessary to protect the existing uses of the receiving State water be maintained and protected.

   b. Designated uses (HAR, Section 11-54-3), as determined by the classification of the receiving State waters.

   c. Water quality criteria (HAR, Sections 11-54-4 through 11-54-8).

2. You may be required to obtain a National Pollutant Discharge Elimination System (NPDES) permit for discharges of wastewater, including storm water runoff, into State surface waters (HAR, Chapter 11-55). For the following types of discharges into Class A or Class 2 State waters, you may apply for NPDES general permit coverage by submitting the applicable Notice of Intent (NOI) forms:

   a. Storm water associated with construction activities, including excavation, grading, clearing, demolition, uprooting of vegetation, equipment staging, and storage areas that result in the disturbance of equal to or greater than one (1) acre of total land area. The total land area includes a contiguous area where multiple separate and distinct construction activities may be taking place at different times on different schedules under a larger common plan of development or sale. An NPDES permit is required before the start of the construction activities.

   b. Storm water associated with industrial activities.

   c. Discharges of hydrotesting water.

   d. Discharges of construction activity dewatering.

   You must submit a separate NOI form for each type of discharge at least 30 calendar days prior to the start of the discharge activity, except when applying for coverage for discharges of storm water associated with construction activity. For this type of discharge, the NOI must be submitted 30 calendar days before the start of construction activities. The NOI forms may be picked up at our office or downloaded from our website at http://www.hawaii.gov/health/environmental/water/cleanwater/forms/genl-index.html.

3. For types of wastewater discharges not covered by an NPDES general permit or discharges to Class AA or Class 1 State waters, you may need an NPDES individual permit. An application for an NPDES individual permit must be submitted at least 180 calendar days before the commencement of the discharge. The NPDES application forms may be picked up at our office or downloaded from our website at http://www.hawaii.gov/health/environmental/water/cleanwater/forms/indiv-index.html. For your information, all waters within the Kaloko-Honokohau National Historical Park are classified as Class 1.

4. Please note that all discharges related to the project construction or operation activities, whether or not NPDES permit coverage is required, must comply with the State's Water Quality Standards. Noncompliance with water quality requirements contained in HAR, Chapter 11-54, and/or permitting requirements, specified in HAR, Chapter 11-55, may be subject to penalties of $25,000 per day per violation.

10005PSS.10

If you have any questions, please visit our website at http://www.hawaii.gov/health/environmental/water/cleanwater/index.html, or contact the Engineering Section, CWB, at (808) 586-4309.

Sincerely,

Joanna Alfeto

for ALEC WONG, P.E., CHIEF
Clean Water Branch

SS:ml

c: DOH-EPO #I-3345 [via e-mail only]

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7469-01
July 25, 2011

Mr. Alec Wong, Chief
Clean Water Branch
Department of Health
State of Hawaii
P.O. Box 3378
Honolulu, HI 96801-3378

Subject: Environmental Assessment (EA)/Environmental Impact Statement Preparation Notice (EISPN)
Kaloko Makai
Kaloko and Kohanaiki, North Kona, Hawaii
Tax Map Key: (3) 7-3-09: 017, 025, 026, and 028

Dear Mr. Wong:

Thank you for your letter dated October 5, 2010 (10005PSS.10). We offer the following responses in the respective order of your comments:

1. The Draft EIS will state that the proposed project will comply with HAR, Chapters 11-54 and 11-55, as applicable.

2. and 3. Kaloko Makai encompasses approximately 1,139 acres and is located approximately one mile east (mauka) of the shoreline. The coastal waters fronting the project site are classified as "AA" marine waters. Honokohau Bay, located immediately south of the project site is classified as "A" marine waters.

A National Pollutant Discharge Elimination System (NPDES) permit for discharges of wastewater, including storm water runoff, will be required for the proposed project. A NPDES Individual Permit will be required, as the coastal waters are classified as "AA."

NPDES for industrial activities, hydrotesting or dewatering is not anticipated. If one is needed, separate Notice of Intent (NOI) forms for each type of discharge will be submitted at least 30 calendar days prior to the start of discharge activity.

4. We acknowledge that all discharges related to the construction and operation activities must comply with the State of Hawaii Water Quality Standards.

WILSON OKAMOTO CORPORATION
ENGINEERS | PLANNERS | CONSULTANTS

We appreciate your participation in the environmental review process.

Sincerely,

Earl Matsukawa, AICP
Project Manager

cc: Mr. Peter Phillips, Stanford Carr Development
Mr. Orlando Dan Davidson, State Land Use Commission

EM

LINDA LINGLE
GOVERNOR OF HAWAII

CHIYOME L. FUKINO, M.D.
DIRECTOR OF HEALTH

STATE OF HAWAII
DEPARTMENT OF HEALTH
P.O. Box 3378
HONOLULU, HAWAII 96801-3378

In reply, please refer to:
File:

RECEIVED
OCT 27 2010
WILSON OKAMOTO CORPORATION

October 26, 2010

10-801A CAB

Mr. Earl Matsukawa, AICP
Wilson Okamoto Corporation
1907 S Beretania Street, Suite 400
Honolulu, Hawaii 96826

Dear Mr. Matsukawa:

SUBJECT: Kaloko Makai, EA/EIS Preparation Notice

A significant potential for fugitive dust emissions exists during all phases of construction. Proposed activities will occur in proximity to public areas and thoroughfares, thereby exacerbating potential dust problems.

We encourage the contractor to implement a dust control plan, which does not require approval by the Department of Health, and to comply with the provisions of Hawaii Administrative Rules, §11-60.1-33 on Fugitive Dust. Dust control measures, some of which are mentioned in your document, include, but are not limited to, the following:

a) Planning the different phases of construction, focusing on minimizing the amount of dust-generating materials and activities, centralizing on-site vehicular traffic routes, and locating potential dust-generating equipment in areas of the least impact;
b) Providing an adequate water source at the site prior to start-up of construction activities;
c) Landscaping and providing rapid covering of bare areas, including slopes, starting from the initial grading phase;
d) Minimizing dust from shoulders and access roads;
e) Providing adequate dust control measures during weekends, after hours, and prior to daily start-up of construction activities; and
f) Controlling dust from debris being hauled away from the project site.

If you have any questions, please contact Mr. Barry Ching of the Clean Air Branch at 586-4200.

Sincerely,

WILFRED K. NAGAMINE
Manager, Clean Air Branch

BC:smk

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7469-01
July 25, 2011

Mr. Wilfred K. Nagamine, Manager
Clean Air Branch
Department of Health
State of Hawaii
P.O. Box 3378
Honolulu, HI 96801-3378

Subject: Environmental Assessment (EA)/Environmental Impact Statement Preparation Notice (EISPN)
Kaloko Makai
Kaloko and Kohanaiki, North Kona, Hawaii
Tax Map Key: (3) 7-3-09: 017, 025, 026, and 028

Dear Mr. Nagamine:

Thank you for your letter dated October 26, 2010 (10-801A CAB). Air quality impacts during construction of the project will be mitigated by complying with Department of Health (DOH) Hawaii Administrative Rules (HAR), Title 11, Chapter 60, Air Pollution. The mitigation measures you recommended will be mentioned in the Draft EIS and will be implemented, as appropriate, during construction.

We appreciate your participation in the environmental review process.

Sincerely,

Earl Matsukawa, AICP
Project Manager

cc: Mr. Peter Phillips, Stanford Carr Development
Mr. Orlando Dan Davidson, State Land Use Commission

LINDA LINGLE
GOVERNOR

~~PATRICIA HAMAMOTO~~
~~XXXXXXXXXXXXXXXXX~~

KATHRYN S. MATAYOSHI
SUPERINTENDENT

STATE OF HAWAI'I
DEPARTMENT OF EDUCATION
P.O. BOX 2360
HONOLULU, HAWAII 96804

OFFICE OF THE SUPERINTENDENT

RECEIVED
OCT 19 2010
WILSON OKAMOTO CORPORATION

October 15, 2010

Mr. Earl Matsukawa
Wilson Okamoto Corporation
1907 South Beretania Street, Suite 400
Honolulu, Hawaii 96826

Dear Mr. Matsukawa:

SUBJECT: Environmental Assessment/Environmental Impact Statement Preparation Notice, Kaloko Makai, TMK (3) 7-3-09:017, 025, 026, and 028, Kaloko and Kohanaiki, North Kona, Hawaii

The Department of Education (DOE) has reviewed the Environmental Impact Statement Preparation Notice for the proposed Kaloko Makai project. The DOE has the following comments:

1. Impact and Impact Fees. Kaloko Makai will have a significant impact of the DOE's facilities in West Hawaii. Kaloko Makai is within the boundaries of the West Hawaii School Impact Fee District and will be subject to impact fees by the DOE. The fee amount will depend on the number of single-family and multi-family units in the project. The DOE requests additional information regarding the proposed mix of single-family and multi-family units.

2. School Sites. The conceptual land use plan for the project has two elementary school sites and one middle school site. However, as shown on the conceptual land use plan, a portion of the middle school site appears to be outside of the boundary of the project. Does the developer plan to acquire the portion of land outside the boundary of the project?

3. Phasing. The DOE would like to know any planned phasing for the project, and how that phasing relates to its school sites.

4. Discussion with Developer. The developer should meet with the DOE prior to the publication of the Draft Environmental Impact Statement to discuss and enter into an agreement regarding the school sites and impact fees.

Thank you for the opportunity to provide comments. If you have any questions, please call Jeremy Kwock of the Facilities Development Branch at 377-8301.

Very truly yours,

Kathryn S. Matayoshi
Superintendent

KSM:to

c: Art Souza, CAS, Honokaa/Kealakehe/Kohala/Konawaena Complex Areas

AN AFFIRMATIVE ACTION AND EQUAL OPPORTUNITY EMPLOYER

WILSON OKAMOTO CORPORATION
ENGINEERS | PLANNERS | CONSULTANTS

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7469-01
July 25, 2011

Ms. Kathryn Matayoshi, Superintendent
Department of Education
State of Hawaii
P.O. Box 2360
Honolulu, HI 96804

Subject: Environmental Assessment (EA)/Environmental Impact Statement Preparation Notice (EISPN)
Kaloko Makai
Kaloko and Kohanaiki, North Kona, Hawaii
Tax Map Key: (3) 7-3-09: 017, 025, 026, and 028

Dear Ms. Matayoshi:

Thank you for your letter dated October 15, 2010. We offer the following responses in the respective order of your comments:

1. Impact and Impact Fees: We acknowledge the proposed project will be subject to impact fees by the Department of Education (DOE). The Draft EIS will include information on the number of single-family and multi-family units.

2. School Sites: The conceptual land plan in the EISPN identified sites for two elementary schools and one middle school. Since the EISPN, the schools sites have been relocated to lie within the Kaloko Makai project boundary.

3. Phasing: Kaloko Makai will be developed in three phases over the 30 years. A phasing plan will be included in the Draft EIS.

4. Kaloko Makai met with DOE Planning staff on July 21, 2011 to consult with DOE and discuss appropriate school impact fees.

We appreciate your participation in the environmental review process.

Sincerely,

Earl Matsukawa, AICP
Project Manager

cc: Mr. Peter Phillips, Stanford Carr Development
Mr. Orlando Dan Davidson, State Land Use Commission

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

HRD10/3552D

October 21, 2010

Earl Matsukawa, Project Manager
Wilson Okamoto Corporation
1907 South Beretania Street, Suite 400
Honolulu, Hawai'i 96826

RE: Environmental Impact Statement Preparation Notice
Kaloko Makai Development Project
Kaloko and Kohanaiki, North Kona, Hawai'i Island

Aloha e Earl Matsukawa,

The Office of Hawaiian Affairs (OHA) is in receipt of your September 17, 2010 request for comments on an Environmental Impact Statement Preparation Notice (EISPN) for the proposed SCD-TSA Kaloko Makai, LLC Development Project (project).

The forthcoming draft environmental impact statement (DEIS) will be the primary support document for a petition to the State Land Use Commission (LUC) requesting a District Boundary Amendment (DBA) and the reclassification of 224.430 acres from State Conservation to Urban and 727.735 acres from Agricultural to Urban. The DEIS will also serve to support any future use of State or County lands or funds during the development of the project. The full extent of such uses is unknown at this time. The LUC will be the accepting authority for the DEIS.

The project area will be situated on 1,142 acres of land, which includes the 952.165 acre LUC petition area. The EISPN details that at full build out, Kaloko Makai is envisioned to be a low and medium density residential community consisting of up to 5,000 single and multi-family units with commercial retail centers, recreational facilities and open spaces (including a 150 acre forest preserve), archaeological and cultural preserves, schools, a medical facility and associated infrastructure. The project will include an affordable housing component developed pursuant to County of Hawai'i requirements.

OHA recognizes that in concept, this project supports the broad goals, policies and standards of the Hawai'i County General Plan and elements of the Kona Community Development Plan. OHA respectfully asserts that the laudable aspects of any development project that has the potential to provide much needed employment, affordable housing and public services must be carefully balanced with the long term impacts that development will have on regional infrastructure, cultural landscapes and the quality of life for those who live within a given community.

The geographic area between Lanihau and Kalaoa Ahupua'a has been subject to intense development in recent years with additional projects planned into the foreseeable future as the urban center of North Kona is shifted away from Kailua Town. While conceptually providing the potential for relief, each new development provides constant pressure on regional infrastructure, resources and public services. We look forward to seeing the DEIS comprehensively analyzing this issue and offering mitigation measures that contribute to a new development paradigm.

In general, OHA opposes LUC reclassifications which result in the loss of agricultural lands with the potential to be productive to urban development. One of the fundamental objectives of the State Agricultural Function Plan (1991) is to encourage and develop diversified agriculture throughout Hawai'i which will support our local economy and contribute to reducing our dependence on imported products. We firmly believe this objective can be obtained by protecting and prioritizing initiatives on agricultural lands with the highest potential for productivity.

The majority (73%) of the project area has received a Land Study Bureau Overall Productivity rating of "E", representing the lowest possible agricultural productivity rating. Nearly 94% of the project area is not classified as Agricultural Lands of Importance in the State of Hawai'i. With this in mind, OHA acknowledges that if approved this reclassification will not have a significant impact on agricultural endeavors in Hawai'i.

The DEIS should specifically discuss the impacts the reclassification the 224.430 acre parcel (parcel) from Conservation to Urban. This parcel is located directly across Queen Ka'ahumanu Highway from Kaloko-Honokohau National Historical Park and development has the potential to directly impact view planes and the water quality of Kaloko and Aimakapa fishponds. While the current classification of the 150 acres of land which will be designated as a forest reserve is unclear to us at this time, if it is currently Conservation, we urge consideration of allowing it to remain so. If the forest reserve area is not Conservation at this time, we urge consideration of classifying it as such via the pending LUC petition.

We are pleased to see that an archaeological inventory survey and cultural impact assessment will be conducted and incorporated into the DEIS. OHA applauds the developer for affording consideration to the preservation of cultural sites situated within and the historic trail which traverses the project area. OHA is aware that the preservation of the segment of this trail and cultural sites which are situated within the "Kaloko Heights" development (which is immediately adjacent to the project area) were major concerns to the Kona community. We look forward to seeing an archaeological inventory survey and appropriate mitigation plans reviewed

and approved by the Department of Land and Natural Resources- State Historic Preservation Division.

In addition to the agencies and parties listed as being consulted within Section 8 of the EISPN, we hope you will engage in a broad and proactive public outreach effort during the development of the DEIS. Thank you for the opportunity to provide comments and we look forward to reviewing the DEIS. Should you have any questions, please contact Keola Lindsey at 594-0244 or keolal@oha.org.

'O wau iho nō me ka 'oia'i'o,

Clyde W. Nāmu'o
Chief Executive Officer

C: OHA Trustee Robert K. Lindsey, Jr.
OHA- West Hawai'i Community Resources Coordinator

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7469-01
July 25, 2011

Mr. Clyde M. Namuo, Administrator
Office of Hawaiian Affairs
State of Hawaii
711 Kapiolani Boulevard, Suite 500
Honolulu, HI 96813

Subject: Environmental Assessment (EA)/Environmental Impact Statement Preparation Notice (EISPN)
Kaloko Makai
Kaloko and Kohanaiki, North Kona, Hawaii
Tax Map Key: (3) 7-3-09: 017, 025, 026, and 028

Dear Mr. Namuo:

Thank you for your letter dated October 21, 2010 (HRD10/3552D). We offer the following responses in the respective order of your comments:

1. According to the ALISH, approximately 6 percent of the project site is designated "other" and the remainder of the project site is not classified. Kaloko Makai will not have an impact on agriculturally significant lands. A discussion and maps on ALISH and LSB ratings and designations for the project site will be included in the Draft EIS.

   We acknowledge OHA's concurrence that the proposed project will not have a significant impact on agricultural lands and endeavors.

2. We concur that approximately 224 acres of the project area is designated Conservation District with a General Subzone designation. The Draft EIS will discuss how the project is in conformance with the Land Use Commission's decision-making criteria, Section 205-17, Hawaii Revised Statutes and Section 15-15-77, Hawaii Administrative Rules.

   Flora and fauna surveys have been conducted for the project site. The findings of these surveys will be summarized and reports reproduced in their entirety in the Draft EIS. Potential impacts and mitigation measures will be discussed.

   Kaloko Makai has been working with the US Fish & Wildlife Service and the Department of Land and Natural Resources on the delineation and preservation of the 150 acre native dryland forest. It has been determined that the project may cause the taking of two listed plant species (`aiea and hala pepe) and one candidate species (ko`oko`olau). As a result, Kaloko Makai has prepared a Habitat Conservation Plan (HCP) to develop short- and long-term management measures to protect these species.

3. An archaeological inventory survey and a cultural impact assessment have been prepared and will be included in the Draft EIS. Related impacts and mitigation measures will be discussed.

WILSON OKAMOTO CORPORATION
ENGINEERS | PLANNERS | CONSULTANTS

We appreciate your participation in the environmental review process.

Sincerely,

Earl Matsukawa, AICP
Project Manager

cc: Mr. Peter Phillips, Stanford Carr Development
Mr. Orlando Dan Davidson, State Land Use Commission

LINDA LINGLE
GOVERNOR
STATE OF HAWAII

KAULANA H. R. PARK
CHAIRMAN
HAWAIIAN HOMES COMMISSION

ANITA S. WONG
DEPUTY TO THE CHAIRMAN

ROBERT J. HALL
EXECUTIVE ASSISTANT

EM

STATE OF HAWAI'I
DEPARTMENT OF HAWAIIAN HOME LANDS
P.O. BOX 1879
HONOLULU, HAWAI'I 96805

RECEIVED
OCT 14 2010
WILSON OKAMOTO CORPORATION

October 7, 2010

Mr. Earl Matsukawa, AICP
Wilson Okamoto Corporation
1907 South Beretania Street, Suite 400
Honolulu, Hawaii 96826

Dear Mr. Matsukawa:

Subject: Environmental Assessment Preparation Notice, Kaloko Makai, Kaloko and Koanaiki, North Kona, Hawaii

Mahalo for your letter of September 17, 2010, providing an opportunity to comment on the subject project.

The department has major landholdings to the south (Kealakehe) and north (Kalaoa) of Kaloko and Koanaiki. The department is concerned about major infrastructure running north - south, serving this region, and recommend that the final Environmental Assessment include a discussion on:

1. Means of financing the Ane Keohokalole Highway which should be extended from Kealakehe to Kalaoa.

2. Improvements to the North Kona Water System may be needed to accommodate more growth. Kaloko Makai water improvements should be coordinated with other developers, including Hawaiian home lands at Kealakehe.

3. The wastewater plant at Kealakehe may require expansion to accommodate Kaloko Makai. The community has expressed concerns about odors from the wastewater plant. Discuss measures to be taken to eliminate this problem.

4. A major community and social services center is planned for Kealakehe which will serve the entire region. To the extent that Kaloko Makai will generate the need for more

Services, the developer should consider a community benefits package to support this effort.

If you have any questions, please contact Darrell Yagodich, Planning Program Manager, at 620-9481.

Aloha and mahalo,

Anita S. Wong

Kaulana H.R. Park, Chairman
Department of Hawaiian Home Lands

Cc: Bo Kahui, Laiopua 2020
Dora Aio-Leamons, Kaniohale at the Villages of Laiopua

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7469-01
July 25, 2011

Mr. Albert "Alapaki" Nahale-a Chairman
Department of Hawaiian Home Lands
State of Hawaii
PO Box 1879
Honolulu, HI 96805

Subject: Environmental Assessment (EA)/Environmental Impact Statement Preparation Notice (EISPN)
Kaloko Makai
Kaloko and Kohanaiki, North Kona, Hawaii
Tax Map Key: (3) 7-3-09: 017, 025, 026, and 028

Dear Mr. Nahale-a:

Thank you for your letter dated October 7, 2010. We offer the following responses in the respective order of your comments:

1. Ane Keohokalole Highway: Phase 1, Palani Road to Hina Lani is under construction. Kaloko Makai will construct Ane Keohokalole from Hina Lani to Hulikoa Road. We understand that further extension of Ane Keohokalole will be achieved through a combination of public and private funding.

2. North Kona Water System: Kaloko Makai's water demand will require additional water source, storage and transmission facilities, which will be privately constructed in conjunction with the project. These facilities will be developed in coordination with the County Department of Water Supply.

   Kaloko Makai is investigating several alternatives for its potable water needs. The Draft EIS will discuss water resources and the potential impact to groundwater resources and the nearshore marine environment.

3. Wastewater: In the event connection to a public wastewater system is not available, Kaloko Makai will construct and operate a private Wastewater Treatment Plant (WWTP) to serve the development within the project. It will treat the wastewater to produce reclaimed (R-1) water for general irrigation within Kaloko Makai, thus lessening demand for potable water. The Draft EIS will discuss potential impacts and mitigation measures associated with the wastewater treatment and reuse.

4. Community Benefits Package: Kaloko Makai will be setting aside land for a hospital, judiciary complex, three school sites, and fire/police station. In addition, Kaloko Makai will also be preserving the 150-acre dryland forest and historic trails. These proposed actions will benefit the surrounding community.

We appreciate your participation in the environmental review process.

Sincerely,

Earl Matsukawa, AICP
Project Manager

cc: Mr. Peter Phillips, Stanford Carr Development
Mr. Orlando Dan Davidson, State Land Use Commission

William P. Kenoi
Mayor

William T. Takaba
Managing Director

Walter K.M. Lau
Deputy Managing Director

County of Hawai'i
Office of the Mayor
25 Aupuni Street, Suite 2603 • Hilo, Hawai'i 96720 • (808) 961-8211 • Fax (808) 961-6553
KONA: 75-5722 Hanama Place, Suite 102 • Kailua-Kona, Hawai'i 96740
(808) 327-3602 • Fax (808) 326-5663

October 8, 2010

Mr. Earl Matsukawa
Wilson Okamoto Corporation
1907 S. Beretania Street, Suite 400
Honolulu, HI 96826

Subject: Environmental Assessment/Environmental Impact Statement Preparation Notice
Kaloko Makai
Kaloko and Kohanaiki, North Kona, Hawai'i
TMK: (3) 7-3-09: 017, 125, 026 and 028

Dear Mr. Matsukawa:

Thank you for the opportunity to review the EISPN for the Kaloko Makai project being proposed by Stanford Carr Development LLC. We have had the pleasure to work with SCD during the last six months on a feature of this property, the dryland forest preserve, which is adjacent to the Ane Keohokalole Highway, now under construction by the County of Hawai'i. SCD's commitment to the protection of this preserve is indisputable.

We have no comments at this time, but would like to reserve the right to comment when the draft environmental impact statement is issued for this project.

Aloha,

Billy Kenoi
MAYOR

County of Hawai'i is an Equal Opportunity Provider and Employer.

EM
TR

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OCT 12 2010
WILSON OKAMOTO CORPORATION

WILSON OKAMOTO CORPORATION
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Honolulu, Hawaii, 96826 USA
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www.wilsonokamoto.com

7469-01
July 25, 2011

Mr. William P. Kenoi, Mayor
Office of the Mayor
County of Hawaii
25 Aupuni Street
Hilo, HI 96720

Subject: Environmental Assessment (EA)/Environmental Impact Statement Preparation Notice (EISPN)
Kaloko Makai
Kaloko and Kohanaiki, North Kona, Hawaii
Tax Map Key: (3) 7-3-09: 017, 025, 026, and 028

Dear Mr. Kenoi:

Thank you for your letter dated October 8, 2010. We appreciate your past support and look forward continuing to work with the County, Department of Land and Natural Resources and US Fish & Wildlife Service in delineating and preserving the 150-acre native dryland forest. While you have no additional comments at this time, your further input as this project proceeds is welcome.

We appreciate your participation in the environmental review process.

Sincerely,

Earl Matsukawa, AICP
Project Manager

cc: Mr. Peter Phillips, Stanford Carr Development
Mr. Orlando Dan Davidson, State Land Use Commission

William P. Kenoi
Mayor

BJ Leithead Todd
Planning Director

Margaret K. Masunaga
Deputy Planning Director

County of Hawaii

PLANNING DEPARTMENT
Aupuni Center • 101 Pauahi Street, Suite 3 • Hilo, Hawaii 96720
Phone (808) 961-8288 • Fax (808) 961-8742

October 21, 2010

Post-it® Fax Note 7671	Date 3/30/11	# of pages ▸ 3
To Tracy Fukuda	From Deanne Bugado	
Co./Dept. Wilson Okamoto	Co. COH - Planning	
Phone #	Phone # 327-3770	
Fax # 944-2253	Fax # 327-3563	

Mr. Earl Matsukawa, AICP
Wilson Okamoto Corporation
1907 South Beretania Street, Suite 400
Honolulu, HI 96826

Dear Mr. Matsukawa:

Re: Preparation Notice for an Environmental Impact Statement (EIS)
Kaloko Makai
TMK: (3) 7-3-009:017, 025, 026 and 028

This is to acknowledge receipt of your September 17, 2010 letter requesting our comments on the proposed Kaloko Makai project. We have reviewed the EIS preparation notice for the Kaloko Makai project and have the following comments to offer:

1. Parcel 7-3-009:017 is designated Conservation by the State Land Use Commission. It is zoned Agricultural (A-5a) by the County. According to the Land Use Pattern Allocation Guide Map of the General Plan, the parcel is designated Urban Expansion.
2. Parcel 7-3-009:025 is designated Urban and Agricultural by the State Land Use Commission. It is zoned Agricultural (A-5a) by the County. According to the Land Use Pattern Allocation Guide Map of the General Plan, the parcel is designated Urban Expansion.
3. Parcel 7-3-009:026 is designated Agricultural by the State Land Use Commission. It is zoned Agricultural (A-5a) by the County. According to the Land Use Pattern Allocation Guide Map of the General Plan, the parcel is designated Urban Expansion.
4. Parcel 7-3-009:028 is designated Agricultural by the State Land Use Commission. It is zoned Agricultural (A-5a) by the County. According to the Land Use Pattern Allocation Guide Map of the General Plan, the parcel is designated Conservation and Urban Expansion.
5. This parcel is not located in the County's Special Management Area. Therefore, Special Management Area rules and regulations are not applicable.
6. The Kona Community Development Plan has designated the proposed parcels in the Kona Urban Area and have further designated a Transit Oriented Development for this area. The project falls within the KCDP's "C" Concurrency Zone.

Hawai'i County is an Equal Opportunity Provider and Employer

7. The Project Description states that a Hospital/Medical Center will be provided and there is an anticipated "upgrade" to a Regional Center designation for the project's Transit Oriented Development, however the Department cannot support such a change without a firm/written commitment with a medical service.
8. Special Permit No. 499 was issued to the Hawaii County Police Department in 1981 for a pistol shooting range within the property owned by Lanihau Properties (TMK 7-4-008:005) which is located just south of the Kaloko Makai project site. Please contact Lanihau Properties or the Police Department to determine if this shooting range is still in operation, as noise from it may negatively impact the residents of the proposed development.
9. Since March 2008, emissions of SO_2 from Halema'uma'u have increased significantly. Therefore, the air quality analysis being prepared for the EIS should use the most current State DOH air quality monitoring data
10. Will the historic trail (the Road to the Sea) be split by the mid-level road, or will there be a grade separation to allow pedestrians to walk its entire length?
11. The General Plan identifies the view plane along Queen Ka'ahumanu Highway going mauka and makai as an area of natural beauty because of its openness and expansiveness. The EIS should show how the proposed project will affect the sense of openness in this area by including photographic simulations of the project from various view points along the highway.
12. The TIAR should contain the information required in Zoning Code Section 25-2-46 (enclosed), and include an analysis of the proposed project on the regional roadway system. In addition, to provide the most accurate determination of level of service (LOS) at study intersections, the TIAR should include the following methods: take on-ground time delay studies, determine the queue lengths when traffic counts are taken, and adjust the saturated flow in the modeling software until the queue lengths and the time delay match the actual on-ground conditions.
13. Lastly, we recommend you consult with the State DLNR, Division of Forestry and Wildlife, Na Ala Hele Program regarding the historical trail that runs through the property.

Thank you for requesting our participation in the EIS preparation process. Please provide this office with a copy of the EIS upon its publication. Should you have questions, please contact Deanne Bugado at 327-3510.

Sincerely,

for BJ LEITHEAD TODD
Planning Director

DLB:dab
K:\Staff\Deanne\Letters\Prep-Notice EIS - Kaloko Makai.doc

Enclosure

cc: Mr. Daryn Arai, Planning Division
Planning Department- Kona

7469-01
July 25, 2011

WILSON OKAMOTO CORPORATION
ENGINEERS | PLANNERS | CONSULTANTS
1907 South Beretania Street
Artesian Plaza, Suite 400
Honolulu, Hawaii, 96826 USA
Phone: 808-946-2277
FAX: 808-946-2253
www.wilsonokamoto.com

Ms. Bobby Jean Leithead-Todd, Director
Planning Department
County of Hawaii
Aupuni Center
101 Pauahi Street, Suite 3
Hilo, HI 96720

Subject: Environmental Assessment (EA)/Environmental Impact Statement Preparation Notice (EISPN)
Kaloko Makai
Kaloko and Kohanaiki, North Kona, Hawaii
Tax Map Key: (3) 7-3-09: 017, 025, 026, and 028

Dear Ms. Leithead-Todd:

Thank you for your letter dated October 21, 2010. We offer the following responses in the respective order of your February 13, 2008 comments:

1. We acknowledge that Parcel 7-3-009: 017 is designated Conservation by the State Land Use Commission (SLUC), zoned Agricultural (A-5a) by the County, and designated Urban Expansion according to Land Use Pattern Allocation Guide Map (LUPAG).

2. We acknowledge that Parcel 7-3-009: 025 is designated Urban and Agricultural by the State Land Use Commission (SLUC), and designated Urban Expansion according to Land Use Pattern Allocation Guide Map (LUPAG). The parcel is zoned Open by the County.

3. We acknowledge that Parcel 7-3-009: 026 is designated Agricultural by the State Land Use Commission (SLUC), zoned Agricultural (A-5a) by the County, and designated Urban Expansion according to Land Use Pattern Allocation Guide Map (LUPAG).

4. We acknowledge that Parcel 7-3-009: 028 is designated Agricultural by the State Land Use Commission (SLUC), zoned Agricultural (A-5a) by the County, and designated Urban Expansion and Conservation according to Land Use Pattern Allocation Guide Map (LUPAG).

5. We acknowledge that the project site is not located in the County's Special Management Area (SMA). Therefore, SMA rules and regulations are not applicable.

6. We acknowledge that the project site is located within the Kona Community Development Plan's (CDP) Kona Urban Area; is designated a Transit Oriented Development; and located within Concurrency Zone "C."

7. Kaloko Makai is setting aside land for a Hospital/Medical Center. We acknowledge that Kaloko Makai is designated as a Neighborhood TOD, and the County will not "upgrade" to a Regional TOD, until there is a firm commitment with a medical service.

8. We will contact Lanihau Partners and/or the County Police Department to determine if they are still proposing a pistol shooting range on TMK 7-4-008:005.

9. An air quality study is being prepared for the project and will be included in the Draft EIS. The analysis will use the most current State DOH air quality monitoring data.

10. The historic Kohanaiki Trail (Road to the Sea) will be preserved. We continue to consult with Na Ala Hele and the National Park Service, Ala Kahakai National Historic Trail on the alignment of the trail through the project site. Ane Keohokalole Highway will cross the trail.

11. We acknowledge that the General Plan identifies the view plane along Queen Kaahumanu going mauka and makai as an area of natural beauty. The Draft EIS will include a discussion on visual impacts.

12. The Draft EIS will include a Traffic Impact Assessment Report (TIAR) that will address access and traffic issues, as well as provide mitigation measures regarding potential adverse impacts.

13. As stated previously, we continue to consult with Na Ala Hele, the National Park Service, Ala Kahakai National Historic Trail on the alignment of the Kohanaiki Trail (Road to the Sea) through the project site.

We appreciate your participation in the environmental review process.

Sincerely,

Earl Matsukawa, AICP
Project Manager

cc: Mr. Peter Phillips, Stanford Carr Development
Mr. Orlando Dan Davidson, State Land Use Commission

DEPARTMENT OF WATER SUPPLY • COUNTY OF HAWAI'I
345 KEKŪANAŌ'A STREET, SUITE 20 • HILO, HAWAI'I 96720
TELEPHONE (808) 961-8050 • FAX (808) 961-8657

October 25, 2010

RECEIVED
OCT 27 2010
WILSON OKAMOTO CORPORATION

Wilson Okamoto Corporation
1907 South Beretania Street, Suite 400
Honolulu, HI 96826

ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE
APPLICANT: SCD – TSA KALOKO MAKAI, LLC
TAX MAP KEY 7-3-009:017, 025, 026, AND 028

We have reviewed the subject Environmental Impact State Preparation Notice and have the no further comments at this time. Our comments, noted in our February 13, 2008 letter to the County of Hawai'i, Planning Department regarding the applicant's State Land Use Boundary Amendment (A07-778) for the subject project, remains unchanged. A copy of our February 13, 2008 letter is enclosed for your information.

Should there be any questions, you may contact Mr. Finn McCall of our Water Resources and Planning Branch at 961-8070, extension 255.

Sincerely yours,

Milton D. Pavao, P.E.
Manager

FM:dfg

Enc.

copy – SCD – TSA Kaloko Makai, LLC

DEPARTMENT OF WATER SUPPLY • COUNTY OF HAWAI'I
345 KEKŪANAŌ'A STREET, SUITE 20 • HILO, HAWAI'I 96720
TELEPHONE (808) 961-8050 • FAX (808) 961-8657

February 13, 2008

TO: Mr. Christopher J. Yuen, Planning Director
Planning Department

FROM: Milton D. Pavao, Manager

SUBJECT: STATE LAND USE BOUNDARY AMENDMENT A07-778 AND ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE
APPLICANT – SCD KALOKO MAKAI, LLC
REQUEST: CONSERVATION AND AGRICULTURAL TO URBAN
TAX MAP KEY 7-3-009:017, 025 (PORTION), 026, AND 028

We have reviewed the subject Petition for State Land Use Boundary Amendment and Environmental Impact State Preparation Notice and have the following comments.

Please be informed that the Department's existing water system cannot support the proposed development at this time. Extensive additions and improvements would be required, which may include, but not be limited to, source, storage, booster pumps, transmission, and distribution facilities. Currently, funding is not available and no time schedule is set for such improvements by the Department.

The Department has no objection to the proposed request, subject to the applicant providing the offsite and onsite water system improvements necessary to adequately serve the development. All elements of the offsite and onsite water system improvements shall be constructed in accordance with the Department's Water System Standards and Rules and Regulations. Further, the improvements must be properly accepted by and dedicated to the Water Board before water service can be granted.

The developer will be required to enter into a Water Development Agreement with the Water Board in order to establish, among other things, the scope of the water system improvements needed to support the development, water allocation from any newly developed sources, and timeline for completion of said improvements. The Department will provide its comments on the scope of the necessary water system improvements upon review of the Preliminary Engineering Report to be submitted with the Draft Environmental Impact Statement.

Should there be any questions, you may contact Mr. Finn McCall of our Water Resources and Planning Branch at 961-8070, extension 255.

Sincerely yours,

Milton D. Pavao, P.E.
Manager

FM:dfg

copy – SCD Kaloko Makai, LLC
Carlsmith Ball LLP
Wilson Okamoto Corporation
State of Hawaii, State Land Use Commission

WILSON OKAMOTO CORPORATION
ENGINEERS | PLANNERS | CONSULTANTS
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Artesian Plaza, Suite 400
Honolulu, Hawaii, 96826 USA
Phone: 808-946-2277
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7469-01
July 25, 2011

Mr. Milton Pavao, Manager
Department of Water Supply
County of Hawaii
345 Kekuanaoa St., Suite 20
Hilo, HI 96720

Subject: Environmental Assessment (EA)/Environmental Impact Statement Preparation Notice (EISPN)
Kaloko Makai
Kaloko and Kohanaiki, North Kona, Hawaii
Tax Map Key: (3) 7-3-09: 017, 025, 026, and 028

Dear Mr. Pavao:

Thank you for your letter dated October 25, 2010. We acknowledge that you have no comments to offer at this time and your previous comments dated February 13, 2008 remains unchanged. We offer the following responses in the respective order of your February 13, 2008 comments:

1. We acknowledge the Department's existing water system cannot support the proposed project at this time.

2. Kaloko Makai's water demand will require additional water source, storage and transmission facilities. The proposed project will construct the required water system facilities. Kaloko Makai is investigating several alternatives for its potable water needs. The Draft EIS will discuss water resources and the potential impact to ground water resources and the nearshore marine environment.

3. On-site and off-site water improvements shall be constructed in accordance with the Department's Water System Standards and Rules and Regulations.

4. We acknowledge Kaloko Makai will be required to enter into a Water Development Agreement with the Water Board in order to establish, among other things, the scope of water system improvements needed to support the proposed project.

We appreciate your participation in the environmental review process.

Sincerely,

Earl Matsukawa, AICP
Project Manager

cc: Mr. Peter Phillips, Stanford Carr Development
Mr. Orlando Dan Davidson, State Land Use Commission

EM
7 F

William P. Kenoi
Mayor

William T. Takaba
Managing Director

Frank J. DeMarco, P.E.
Director

Ivan M. Torigoe
Deputy Director

County of Hawai'i
DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
25 Aupuni Street • Hilo, Hawai`i 96720
(808) 961-8083 · Fax (808) 961-8086
http://co.hawaii.hi.us/directory/dir_envmng.htm

October 13, 2010

RECEIVED
OCT 19 2010
WILSON OKAMOTO CORPORATION

Wilson Okamoto Corporation
1907 South Beretania
Honolulu, HI 96826

Attention: Mr. Earl Matsukawa, AICP
Project Manager

RE: Environmental Assessment (EA)/Environmental Impact Statement
Preparation Notice (EISPN)
Kaloko Makai
Kaloko and Kohanaiki, North Kona, Hawai`i
TMK:7-3-09:017, 025, 026 and 028

Dear Mr. Matsukawa,

We offer the following comments:

Solid Waste Division
Please submit a Solid Waste Management Plan in accordance with enclosed guidelines.

Thank you for allowing us to review and comment on this project.

Sincerely,

Frank DeMarco

Frank J. DeMarco, P.E.
DIRECTOR

enclosure

cc: SWD

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WILSON OKAMOTO CORPORATION
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7469-01
July 25, 2011

Mr. Frank J. DeMarco, P.E., Director
Department of Enviromental Management
County of Hawaii
25 Aupuni Street
Hilo, HI 96720

Subject: Environmental Assessment (EA)/Environmental Impact Statement
Preparation Notice (EISPN)
Kaloko Makai
Kaloko and Kohanaiki, North Kona, Hawaii
Tax Map Key: (3) 7-3-09: 017, 025, 026, and 028

Dear Mr. DeMarco:

Thank you for your letter dated October 13, 2010. At the appropriate phase project design and development, a Solid Waste Management Plan will be prepared and submitted to the Solid Waste Division.

We appreciate your participation in the environmental review process.

Sincerely,

Earl Matsukawa, AICP
Project Manager

cc: Mr. Peter Phillips, Stanford Carr Development
Mr. Orlando Dan Davidson, State Land Use Commission

William P. Kenoi
Mayor

County of Hawai'i
POLICE DEPARTMENT
349 Kapi'olani Street • Hilo, Hawai'i 96720-3998
(808) 935-3311 • Fax (808) 961-2389

Harry S. Kubojiri
Police Chief

Paul K. Ferreira
Deputy Police Chief

October 11, 2010

Mr. Earl Matsukawa, AICP
Project Manager
Wilson Okamoto Corporation
1907 South Beretania Street
Artesian Plaza, Suite 400
Honolulu, Hawaii 96826

RECEIVED
OCT 15 2010
WILSON OKAMOTO CORPORATION

Dear Mr. Matsukawa:

SUBJECT: Environmental Assessment (EA)/Environmental Impact Statement Preparation Notice (EISPN)
Kaloko Makai
Kaloko and Kohanaiki, North Kona, Hawaii
Tax Map Key: (3) 7-3-09:017, 025, 026, and 028

The above-referenced Environmental Impact Statement Preparation Notice (EISPN) for the proposed Kaloko Makai project has been reviewed, and we have the following concerns.

A development of this size will increase traffic on all roadways associated with the development. Major roadways affected will include Hina Lani Street, Mamalahoa Highway, Queen Kaahumanu Highway, and Palani Road. We request the opportunity to comment on the Traffic Impact Assessment Report (TIAR), upon its completion.

The EISPN also acknowledges that the proposed project will require an increase in police staffing and possible expansion of existing police facilities. Funding for these required increases should be identified and addressed.

Thank you for the opportunity to comment. Should you have any questions, please contact Major Randy Apele, Area II Operations, at (808) 326-4646 ext. 270.

Sincerely,

HARRY S. KUBOJIRI
POLICE CHIEF

HENRY J. TAVARES JR.
ASSISTANT POLICE CHIEF
AREA II OPERATIONS

RA:dmv
RS100754

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www.wilsonokamoto.com

7469-01
July 25, 2011

Mr. Harry S. Kubojiri, Chief of Police
Police Department
County of Hawaii
349 Kapiolani Street
Hilo, HI 96720

Subject: Environmental Assessment (EA)/Environmental Impact Statement Preparation Notice (EISPN)
Kaloko Makai
Kaloko and Kohanaiki, North Kona, Hawaii
Tax Map Key: (3) 7-3-09: 017, 025, 026, and 028

Dear Mr. Kubojiri:

Thank you for your letter dated October 11, 2010. The Draft EIS will include a Traffic Impact Assessment Report (TIAR) addressing access and traffic issues, as well as recommend mitigation measures regarding potential adverse impacts.

Kaloko Makai will coordinate with the Police Department to address service capabilities of police operations, address concerns, and develop appropriate mitigation measures, as appropriate.

We appreciate your participation in the environmental review process.

Sincerely,

Earl Matsukawa, AICP
Project Manager

cc: Mr. Peter Phillips, Stanford Carr Development
Mr. Orlando Dan Davidson, State Land Use Commission

William P. Kenoi
Mayor

Darryl J. Oliveira
Fire Chief

Glen P. I. Honda
Deputy Fire Chief

County of Hawai'i

HAWAI'I FIRE DEPARTMENT
25 Aupuni Street • Suite 2501 • Hilo, Hawai'i 96720
(808) 932-2900 • Fax (808) 932-2928

RECEIVED
OCT 22 2010
WILSON OKAMOTO CORPORATION

October 11, 2010

Mr. Earl Matsukawa
Wilson Okamoto Corporation
1907 South Beretania Street
Artesian Plaza, Suite 400
Honolulu, Hawai'i 96826

SUBJECT: ENVIRONMENTAL ASSESSMENT (EA)/ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE (EISPN)
KALOKO MAKAI
KALOKO AND KOHANAIKI, NORTH KONA, HAWAII
TMK: (3) 7-3-09:017, 025, 026 AND 028

In regards to the above-mentioned environmental assessment and environmental impact statement preparation notice, the following shall be in accordance:

Fire apparatus access roads shall be in accordance with UFC Section 10.207:

"Fire Apparatus Access Roads

"Sec. 10.207. (a) **General.** Fire apparatus access roads shall be provided and maintained in accordance with the provisions of this section.

"(b) **Where Required.** Fire apparatus access roads shall be required for every building hereafter constructed when any portion of an exterior wall of the first story is located more than 150 feet from fire department vehicle access as measured by an unobstructed route around the exterior of the building.

"**EXCEPTIONS:** 1. When buildings are completely protected with an approved automatic fire sprinkler system, the provisions of this section may be modified.

"2. When access roadways cannot be installed due to topography, waterways, nonnegotiable grades or other similar conditions, the chief may require additional fire protection as specified in Section 10.301 (b).

"3. When there are not more than two Group R, Division 3 or Group M Occupancies, the requirements of this section may be modified, provided, in the opinion of the chief, fire-fighting or rescue operations would not be impaired.

"More than one fire apparatus road may be required when it is determined by the chief that access by a single road may be impaired by vehicle congestion, condition of terrain, climatic conditions or other factors that could limit access.

"For high-piled combustible storage, see Section 81.109.

"(c) **Width.** The unobstructed width of a fire apparatus access road shall meet the requirements of the appropriate county jurisdiction.

"(d) **Vertical Clearance.** Fire apparatus access roads shall have an unobstructed vertical clearance of not less than 13 feet 6 inches.

"**EXCEPTION:** Upon approval vertical clearance may be reduced, provided such reduction does not impair access by fire apparatus and approved signs are installed and maintained indicating the established vertical clearance.

"(e) **Permissible Modifications.** Vertical clearances or widths required by this section may be increased when, in the opinion of the chief, vertical clearances or widths are not adequate to provide fire apparatus access.

"(f) **Surface.** Fire apparatus access roads shall be designed and maintained to support the imposed loads of fire apparatus and shall be provided with a surface so as to provide all-weather driving capabilities." (20 tons)

"(g) **Turning Radius.** The turning radius of a fire apparatus access road shall be as approved by the chief." (45 feet)

"(h) **Turnarounds.** All dead-end fire apparatus access roads in excess of 150 feet in length shall be provided with approved provisions for the turning around of fire apparatus.

"(i) **Bridges.** When a bridge is required to be used as access under this section, it shall be constructed and maintained in accordance with the applicable sections of the Building Code and using designed live loading sufficient to carry the imposed loads of fire apparatus.

"(j) **Grade.** The gradient for a fire apparatus access road shall not exceed the maximum approved by the chief." (15%)

"(k) **Obstruction.** The required width of any fire apparatus access road shall not be obstructed in any manner, including parking of vehicles. Minimum required widths and clearances established under this section shall be maintained at all times.

"(l) **Signs.** When required by the fire chief, approved signs or other approved notices shall be provided and maintained for fire apparatus access roads to identify such roads and prohibit the obstruction thereof or both."

Water supply shall be in accordance with UFC Section 10.301(c):

"(c) **Water Supply.** An approved water supply capable of supplying required fire flow for fire protection shall be provided to all premises upon which buildings or portions of buildings are hereafter constructed, in accordance with the respective county water requirements. There shall be provided, when required by the chief, on-site fire hydrants and mains capable of supplying the required fire flow.

"Water supply may consist of reservoirs, pressure tanks, elevated tanks, water mains or other fixed systems capable of providing the required fire flow.

"The location, number and type of fire hydrants connected to a water supply capable of delivering the required fire flow shall be protected as set forth by the respective county water requirements. All hydrants shall be accessible to the fire department apparatus by roadways meeting the requirements of Section 10.207.

DARRYL OLIVEIRA
Fire Chief

RP:lpc

7469-01
July 25, 2011

WILSON OKAMOTO CORPORATION
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FAX: 808-946-2253
www.wilsonokamoto.com

Mr. Darryl J. Oliveira, Fire Chief
Fire Department
County of Hawaii
25 Aupuni Street
Hilo, HI 96720

Subject: Environmental Assessment (EA)/Environmental Impact Statement Preparation Notice (EISPN)
Kaloko Makai
Kaloko and Kohanaiki, North Kona, Hawaii
Tax Map Key: (3) 7-3-09: 017, 025, 026, and 028

Dear Mr. Oliveira:

Thank you for your letter dated October 11, 2010. Within the Kaloko Makai project, fire apparatus access roads shall be developed in accordance with Uniform Fire Code Section 10.207 and the water supply for fire protection shall be developed in accordance with UFC Section 10.301(c).

We appreciate your participation in the environmental review process.

Sincerely,

Earl Matsukawa, AICP
Project Manager

cc: Mr. Peter Phillips, Stanford Carr Development
Mr. Orlando Dan Davidson, State Land Use Commission

Hawaii Electric Light Company, Inc. • PO Box 1027 • Hilo, HI 96721-1027

EM TF

October 1, 2010

RECEIVED
OCT 04 2010
WILSON OKAMOTO CORPORATION

Wilson Okamoto Corporation
Attn: Mr. Earl Matsukawa, AICP
1907 South Beretania Street
Artesian Plaza, Suite 400
Honolulu, HI 96826

Gentlemen:

SUBJECT: Environmental Assessment (EA)/Environmental Impact Statement Preparation Notice (EISPN)
TMK: 7-3-009:017, 025, 026 and 028
Kaloko Makai, North Kona, Island of Hawaii

Thank you for the opportunity to comment on the subject's Environmental Impact Statement Preparation Notice (EISPN). HELCO will be able to provide electrical service to the proposed development in North Kona. A detailed analysis will be performed after the receipt of the consultant's detailed design drawings and estimated load. The following is a summary of our comments:

1. Generation capacity – HELCO's current system peak load is 194,600kW and our total generation system capability is 285,800kW. Our reserve margin is 37% and may have adequate generation to serve the above.

2. Electrical Substation – The area is served by our existing Kaloko electrical substation and a 12,470 volt underground distribution along Hina Lani Street. The capacity of our existing substation is <u>not</u> adequate to serve the anticipated load. A lot with a minimum size of 250' x 250' must be deeded to HELCO for the construction of a new substation.

3. Off-Site Electrical Transmission System – The existing 69,000 volt transmission line along Queen Kaahumanu Highway will need to be extended to the new electrical substation.

4. Off-Site Electrical Distribution System – The existing off-site 12,470 volt distribution system along Hina Lani Street is <u>not</u> adequate to serve the proposed development. Off-site 12,470 volt distribution lines and easements from the new substation to the on-site development are required to serve the anticipated load.

5. On-Site Electrical Distribution System – On-site distribution line extensions and easements are required on the developer's property to serve the anticipated load.

After the development's detailed loading and civil plans are submitted, HELCO will prepare a firm cost to provide electrical power to this development.
HELCO recommends energy efficient and conservation measures to reduce the maximum electrical demand and energy consumption. The developer may call HELCO's Energy Services department at (808) 935-1171 for questions or details on available programs.

It is encouraged that the developer's electrical consultant open a service request with HELCO Engineering department as soon as practicable to ensure timely electrical facility installation. If you have any questions, please contact myself or Shelley Doctor at (808) 327-0504.

Sincerely,

Thomas W. Cummins

Thomas W. Cummins, L.P.L.S.
Manager, Engineering Department
Hawaii Electric Light Co., Inc.

TWC:HKK:sm

Enclosures

cc: S. Tomita
K. Whitener
L. Rogers

2. PROJECT DESCRIPTION

2.1 Project Description

SCD - TSA Kaloko Makai, LLC proposes to develop Kaloko Makai, a residential mixed-use development, on approximately 1,142 acres of undeveloped land in Kaloko and Kohanaiki, North Kona, and Hawaii. Kaloko Makai will be a totally master planned residential community, with supporting commercial, light-industrial, educational, recreational, open space uses and their related infrastructure. This diverse project will entail construction of up to 5,000 new single- and multi-family residential units at low- and medium-densities, centralized commercial and neighborhood retail centers, an array of recreational facilities (e.g. parks, trails, open spaces), urgent care medical facility, a new elementary school, a middle school, and associated infrastructure (e.g., new roadways, utilities, drainage, wastewater and potable and non-potable water distribution systems). The community development will satisfy a wide range of primary market housing needs, including the provision of affordable housing as required by the County of Hawaii. Figure 2-1 illustrates the proposed Conceptual Land Use Plan. See Table 2-1 below for proposed land use categories and acreages.

Table 2-1
Estimated Allocation by Land Use Type

Land Use Type	Estimated Area (Acres)
Urban Center (T5, high density)	229
General Urban (T4, med. density)	193
Sub-Urban (T3, low density)	106
Dryland Forest	150
Schools	34
Hospital/Medical Center	20
Open Space/Civic Space	103
Wastewater Treatment Plan	24
Light Industrial/Commercial/Retail	153
Roadways/Utilities	130
Total	1,142

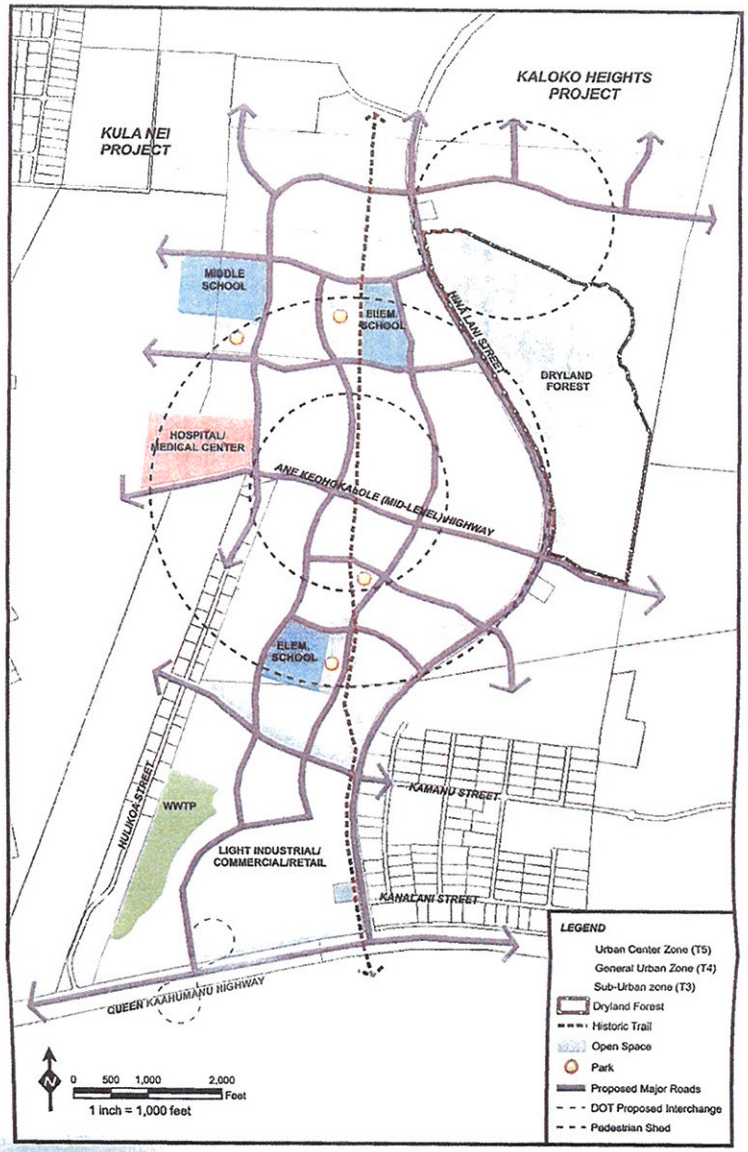

FIGURE 2-1
Conceptual Land Use Map
Kaloko Makai

WILSON OKAMOTO
CORPORATION
ENGINEERS | PLANNERS | CONSULTANTS

1907 South Beretania Street
Artesian Plaza, Suite 400
Honolulu, Hawaii, 96826 USA
Phone: 808-946-2277
FAX: 808-946-2253
www.wilsonokamoto.com

7469-01
July 25, 2011

Mr. Thomas W. Cummins, L.P.L.S., Manager
Engineering Department
Hawaii Electric Light Company
P.O. Box 1027
Hilo, Hawaii 96721-1027

Subject: Environmental Assessment (EA)/Environmental Impact Statement Preparation Notice (EISPN)
Kaloko Makai
Kaloko and Kohanaiki, North Kona, Hawaii
Tax Map Key: (3) 7-3-09: 017, 025, 026, and 028

Dear Mr. Nagata:

Thank you for your letter dated October 1, 2010. We appreciate HELCO's intent to provide electrical service for the proposed development and acknowledge that a detailed analysis will be performed by HELCO as the developer submits design drawings. The information you provided on HELCO's existing capacity and system is valuable and will be used in the planning and design of electrical service for the proposed project.

We appreciate your participation in the environmental review process.

Sincerely,

Earl Matsukawa, AICP
Project Manager

cc: Mr. Peter Phillips, Stanford Carr Development
Mr. Orlando Dan Davidson, State Land Use Commission

EM

September 19,2010

Mr. Earl Matsukawa,AICP
Project Manager

RECEIVED
SEP 21 2010
WILSON OKAMOTO CORPORATION

Dear Mr. Matsukawa,

On behalf of the Kona Hawaiian Civic Club, I have received your EISPN for the proposed Kaloko Makai project. I will review it with the members of our club. Therefore ther will be a comment forthcoming.
Any further business matters should be addressed to

Cynthia Nazara,Pelekikena
Kona Hawaiian Civic Club
P.O. Box 4098
Kailua-Kona, Hi. 96745

Mahalo

Cynthia Nazara,Pelekikena
Kona Hawaiian Civic Club

WILSON OKAMOTO CORPORATION
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7469-01
July 25, 2011

Ms. Cynthia Nazara, Pelekikena
Kona Hawaiian Civic Club
P.O. Box 4098
Kailua-Kona, HI 96745

Subject: Environmental Assessment (EA)/Environmental Impact Statement Preparation Notice (EISPN)
Kaloko Makai
Kaloko and Kohanaiki, North Kona, Hawaii
Tax Map Key: (3) 7-3-09: 017, 025, 026, and 028

Dear Ms. Nazara:

Thank you for your letter dated September 19, 2010. We look forward to receiving additional comments from the Kona Hawaiian Civil Club. The forthcoming Draft EIS will be sent to you for review and comment.

We appreciate your participation in the environmental review process.

Sincerely,

Earl Matsukawa, AICP
Project Manager

cc: Mr. Peter Phillips, Stanford Carr Development
Mr. Orlando Dan Davidson, State Land Use Commission

William P. Kenoi
Mayor

William T. Takaba
Managing Director

County of Hawai'i
DEPARTMENT OF PUBLIC WORKS
Aupuni Center
101 Pauahi Street, Suite 7 · Hilo, Hawai'i 96720-4224
(808) 961-8321 · Fax (808) 961-8630
www.co.hawaii.hi.us

Warren H. W. Lee
Director

Brandon A. K. Gonzalez
Deputy Director

EM

January 5, 2011

RECEIVED
JAN 06 2011
WILSON OKAMOTO CORPORATION

Mr. Earl Matsukawa, AICP
Project Manager
Wilson Okamoto Corporation
1907 South Beretania Street
Honolulu, HI 96826

Subject: Environmental Assessment (EA) Environmental Impact Statement
Preparation Notice (EISPN)
Kaloko Makai
Kaloko and Kohanaiki, N. Kona, HI
TMK: (3) 7-3-009:017, 025, 026 and 028

We reviewed the subject EISPN dated September 2010 and have the following comments. With regard to connectivity and continuity, the General Plan (GP) and Kona Community Development Plan (KCDP) concept maps shall be implemented when practicable. However, there is a concern regarding the extension of Kamanu Street directly through Hina Lani at the existing location because of the grade. We request an engineering study be done to examine alternatives. The study should examine the alternatives on the basis of traffic safety, traffic flow efficiency and accommodation of all modes of transportation.

Full movement intersections on collector streets and arterials should be spaced to provide for proper signal timing. For collectors, minimum spacing should be ¼ mile and for arterials minimum spacing should be ½ mile. Roundabouts can provide more flexibility.

Ane Keohokalole Highway is classified and designed as a major collector road by the Federal Highway Administration and State of Hawaii Department of Transportation. Ane Keohokalole Highway is classified an arterial and Hina Lani Street and Kamanu Streets are classified as collectors on the County's GP and KCDP. The proposed intersection spacing shown on Figure 2.1 does not appear to meet the guidelines stated above.

If you have any questions, Please feel free to contact Kiran Emler of our Kona office at 327-3530.

Warren H.W. Lee, P.E.
Director

cc: Planning Director
Engineering, Hilo/Kona

County of Hawai'i is an Equal Opportunity Provider and Employer.

WILSON OKAMOTO CORPORATION
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7469-01
July 25, 2011

Mr. Warren H.W. Lee, P.E., Director
Department of Public Works
County of Hawaii
101 Pauahi Street, Suite 7
Hilo, HI 96720-4224

Subject: Environmental Assessment (EA)/Environmental Impact Statement Preparation Notice (EISPN)
Kaloko Makai
Kaloko and Kohanaiki, North Kona, Hawaii
Tax Map Key: (3) 7-3-09: 017, 025, 026, and 028

Dear Mr. Lee:

Thank you for you letter dated January 5, 2011 (2010-TA-0513). We offer the following responses in the respective order of your comments:

1. Kaloko Makai met with Mr. Ron Thiel and Mr. Kiran Emler to discuss proposed project, including the Kamanu Street Extension. Based on that consultation, adjustments were made on the Kaloko Makai land plan. Mr. Thiel and Mr. Emler's assistance on this matter is greatly appreciated.

   We acknowledge that the major roadway alignments shown on both the Kona Community Development Plan (CDP) and the Kaloko Makai land plan are presently conceptual and that further engineering and traffic analysis will be required to establish their final alignments.

2. We acknowledge that full movement intersections on collector streets and arterials should be spaced to provide for proper signal timing. Roadways will be designed to meet Hawaii County Code and Kona Community Development (CDP) Connectivity Standards (Policy TRAN-2.1). Alternative intersection configurations, such as roundabouts, will be considered during subsequent engineering and traffic analysis and design in consultation with your agency.

3. We acknowledge that Ane Keohokalole Highway is classified and designed as a major collector road by Federal Highway Administration and State of Hawaii Department of Transportation.

4. We acknowledge Ane Keohokalole Highway is classified as an arterial and Hina Lani Street and Kamanu Streets are classified as collectors according the County General Plan and Kona CDP. As a result of consultation with Mr. Thiel and Mr. Emler, the proposed intersection spacing was revised in the land plan to be included in the forthcoming Draft EIS.

We appreciate your participation in the environmental review process.

Sincerely,

Earl Matsukawa, AICP
Project Manager

cc: Mr. Peter Phillips, Stanford Carr Development
Mr. Orlando Dan Davidson, State Land Use Commission

LINDA LINGLE
GOVERNOR OF HAWAII

CHIYOME LEINAALA FUKINO, M.D.
DIRECTOR OF HEALTH

STATE OF HAWAII
DEPARTMENT OF HEALTH
P.O. BOX 3378
HONOLULU, HAWAII 96801

In reply, please refer to:
EMD / WB
LUD-3 7 3 009 017 etc-ID#509
EA EISPN Kaloko Makai

November 4, 2010

EM
TF

Mr. Earl Matsukawa, AICP
Project Manager
Wilson Okamoto Corporation
1907 South Beretania Street
Artesian Plaza Suite 400
Honolulu, Hawaii 96826

RECEIVED
NOV 0 5 2010
WILSON OKAMOTO CORPORATION

Dear Mr. Matsukawa:

Subject: Environmental Assessment / Environmental Impact Statement Preparation Notice
Kaloko Makai, Kaloko and Kaohanaiki, North Kona, Hawaii
TMK (3) 7-3-009: 017, 025, 026 and 028 1,142 acre master planned community

Thank you for allowing us the opportunity to review the subject project which proposes to develop Kaloko Makai, an approximately 1,142 acre master planned community in Kaloko and Kohaniki, North Kona, Hawaii. The subject project is located in the non-critical wastewater disposal area as determined by the Hawaii County Wastewater Advisory Committee.

The subject document stated that, "A PER will be prepared for the Draft EIS to determine the projected wastewater flow and explore associated facility requirements for the proposed project. It is anticipated that the project will likely construct a wastewater treatment plant." Please be informed that a wastewater treatment plant will be required to be constructed for this project in accordance with Hawaii Administrative Rules (HAR), Chapter 11-62 "Wastewater Systems."

We further encourage the developer to utilize recycled water for irrigation and other non-potable water purposes such as dust control, parks, golf courses, open spaces or landscaping areas. Further, any means to reduce green house gas emissions, practice renewable energy and a reduction in waste is highly recommended.

All wastewater plans must conform to applicable provisions of the Department of Health's HAR, Chapter 11-62 "Wastewater Systems." We do reserve the right to review the detailed wastewater plans for conformance to applicable rules. Should you have any questions, please contact the Planning & Design Section of the Wastewater Branch at 586-4294.

Sincerely,

MARSHALL LUM, P.E., ACTING CHIEF
Wastewater Branch

LM:lmj

c: DOH's Environmental Planning Office (EPO I-3345)
DOH-WWB's Kona Staff – Mr. Dane Hiromasa
SCD-TSA Kaloko Makai LLC

WILSON OKAMOTO CORPORATION
ENGINEERS | PLANNERS | CONSULTANTS

1907 South Beretania Street
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Honolulu, Hawaii, 96826 USA
Phone: 808-946-2277
FAX: 808-946-2253
www.wilsonokamoto.com

7469-01
July 25, 2011

Ms. Sina Pruder, P.E., Acting Chief
Wastewater Branch
Department of Health
State of Hawaii
P.O. Box 3378
Honolulu, HI 96801

Subject: Environmental Assessment (EA)/Environmental Impact Statement Preparation Notice (EISPN)
Kaloko Makai
Kaloko and Kohanaiki, North Kona, Hawaii
Tax Map Key: (3) 7-3-09: 017, 025, 026, and 028

Dear Ms. Pruder:

Thank you for your letter dates November 4, 2010 (EMD/WB LUD-3 7 3 009 017 etc-ID#509 EA EISPN Kaloko Makai). We offer the following responses in the respective order of your comments:

1. We appreciate your confirmation that the proposed project is located in the non-critical wastewater disposal area as determined by the Hawaii County Wastewater Advisory Committee.

2. We acknowledge that the proposed wastewater treatment plant will be required to be constructed in accordance with Hawaii Administrative Rules (HAR), Chapter 11-62 "Wastewater Systems."

3. The proposed wastewater treatment plant will produce reclaimed (R-1) quality water for general irrigation within Kaloko Makai, thus lessening the demand for potable water. Kaloko Makai will also implement feasible measures to promote energy conservation and environmental stewardship, such as the standards and guidelines promulgated by the US Green Building Council, US EPA Energy Star Program, and other similar programs.

4. We acknowledge that wastewater plans must conform to applicable provisions of the Department of Health's HAR, Chapter 11-62 "Wastewater Systems. We further acknowledge that you reserve the right to review detailed wastewater plans for conformance to applicable rules.

WILSON OKAMOTO CORPORATION
ENGINEERS | PLANNERS | CONSULTANTS

We appreciate your participation in the environmental review process.

Sincerely,

Earl Matsukawa, AICP
Project Manager

cc: Mr. Peter Phillips, Stanford Carr Development
Mr. Orlando Dan Davidson, State Land Use Commission

LINDA LINGLE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

MICHAEL D. FORMBY
INTERIM DIRECTOR

Deputy Directors
FRANCIS PAUL KEENO
JIRO A. SUMADA

IN REPLY REFER TO:

STP 8.0269

October 26, 2010

Mr. Earl Matsukawa
Wilson Okamoto Corporation
1907 South Beretania Street, Suite 400
Honolulu, Hawaii 96826

NOV 03 2010

Dear Mr. Matsukawa:

Subject: SCD-TSA Kaloko Makai, LLC
Environmental Assessment (EA)/Environmental Impact Statement Preparation Notice (EISPN)

The State Department of Transportation (DOT) previously commented on the subject case during the EISPN period in its letters STP 8.2966 dated August 12, 2008 and STP 8.2944 dated July 24, 2008 (attached).

The DOT Highways Division Planning Branch is still reviewing the subject project. Until this review is completed, DOT's prior comments remain valid.

DOT appreciates the opportunity to provide comments. If there are any other questions, including the need to meet with DOT Highways Division staff, please contact Mr. David Shimokawa of the DOT Statewide Transportation Planning Office at 831-7976.

Very truly yours,

Francis Paul Keeno
for MICHAEL D. FORMBY
Interim Director of Transportation

Attachments: STP ltr 8.2966 dtd 8/12/08
STP ltr 8.2944 dtd 7/24/08

c: Abbey Seth Mayer, Department of Business, Economic Development and Tourism – Office of Planning

---

LINDA LINGLE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

BRENNON T. MORIOKA
DIRECTOR

Deputy Directors
MICHAEL D. FORMBY
FRANCIS PAUL KEENO
BRIAN H. SEKIGUCHI

IN REPLY REFER TO:
DIR 0954 & 1027
STP 8.2944

July 24, 2008

TO: MR. ABBEY MAYER, DIRECTOR
OFFICE OF PLANNING
DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT AND TOURISM

FROM: for BRENNON T. MORIOKA Francis Paul Keeno
DIRECTOR OF TRANSPORTATION

SUBJECT: SCD KALOKO MAKAI, LLC
KALOKO MAKAI
ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE (EISPN)

Thank you for requesting the Department of Transportation's (DOT) review of the subject development project as presented in the EISPN. The DOT submits the following initial comments:

1. The proposed 1,142-acre master-planned community, consisting of 5,000 residential units, retail and commercial uses, schools, parks, open space network, and supporting infrastructure will significantly impact two DOT highway facilities - Queen Kaahumanu Highway and Mamalahoa Highway.

2. The DOT understands that a Traffic Impact Analysis Report (TIAR) that analyzes traffic impacts on the roadway system within the project vicinity and identifies appropriate mitigation measures will be prepared for DOT review and approval. The DOT Highways Division is particularly interested in the project's cumulative traffic impacts and mitigation measures at and near the highway access points.

3. The DOT Highways Division is currently in discussions with various developments in the area regarding the construction of a full intersection at Queen Kaahumanu Highway and Hulikoa Drive. These discussions include the provisions necessary to preserve Queen Kaahumanu Highway as a high-speed, limited access route, with possible grade-separated connections. The subject project's development plan and TIAR should address these considerations.

4. Drainage flows and systems in or within close proximity of DOT properties require DOT's prior review and approval.

5. Assumptions on timetables for State highway projects should be updated. Section 3.17.4, Roadways System and Traffic states, "...Phase I of the Queen Kaahumanu Highway Expansion is anticipated to be completed by May 2008." The EISPN also states,"...Phase II of the Queen Kaahumanu Highway Expansion is proposed to be completed before the end of 2007." According to the DOT Highways Division, Phase I is scheduled for completion by December 2008 and Phase II is expected to be completed in 2011.

6. The Draft EIS should discuss the project relative to past, current and future land development projects and growth in the area.

7. The petitioner/applicant should consult with the DOT Highways Division Planning Branch regarding the above concerns.

8. The DOT is an interested party and requests at least four (4) copies of the forthcoming Draft EIS. The DOT defers further comment on the subject project, until its review of the Draft EIS.

The DOT appreciates the opportunity to provide its comments.

ET:km

c: Christopher Yuen, Hawaii Department of Planning
Mr. Alan Suwa, Wilson Okamoto Corporation

bc: HWY, -H, -P, -T
STP(ET)

LINDA LINGLE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

BRENNON T. MORIOKA
DIRECTOR

Deputy Directors
MICHAEL D. FORMBY
FRANCIS PAUL KEENO
BRIAN H. SEKIGUCHI

IN REPLY REFER TO:
DIR 0954 & 1027
STP 8.2966

August 12, 2008

TO: MR. ABBEY MAYER, DIRECTOR
OFFICE OF PLANNING
DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT AND TOURISM

FROM: BRENNON T. MORIOKA
DIRECTOR OF TRANSPORTATION

SUBJECT: SCD KALOKO MAKAI, LLC
KALOKO MAKAI
ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE (EISPN)

The following comments are provided by the Department of Transportation (DOT) Highways Division to supplement DOT's letter, STP 8.2944, dated July 24, 2008, on the proposed subject development project:

1. DOT opposes the change in land use designation from Conservation to Urban on the portion of the site adjoining Queen Kaahumanu Highway that is proposed for commercial development. Based on DOT's long-range regional transportation requirements and preliminary engineering plans, a grade-separated interchange is proposed for the area between Hina Lani Street and Huliko'a Drive. DOT thus seeks the dedication of Right-of-Way (RoW) in this area for the grade-separated interchange as a condition of land use approval for the remainder of the proposed project area.

   It is DOT's policy to preserve the Queen Kaahumanu Highway corridor as a future, high-speed, access-controlled facility. This will allow the DOT to meet its long-term requirements for regional movement of people and goods. Access onto Queen Kaahumanu Highway would only be allowed through grade-separated interchanges. Direct access onto Queen Kaahumanu Highway from adjoining properties would be restricted.

   The petitioner for the proposed subject development should contact the DOT Highways Division, Planning Branch, regarding the specific location and dimensions of the RoW for the proposed grade-separated interchange.

2. The layout of the proposed subject development should be modified and based on the long-range plans for an access-controlled highway that includes a grade-separated interchange between Hina Lani Street and Huliko'a Drive. The TIAR for the proposed development, however, must also address the interim highway conditions that include an at-grade intersection at Hina Lani Street. It must also be noted that the Queen Kaahumanu Highway-Phase II project is currently proceeding through its procurement phase. This Design-Build project will widen Queen Kaahumanu Highway to a four-lane divided roadway between Kealakehe Parkway and the Keahole Airport Access Road, and includes improvements at the Hina Lani Street/Queen Kaahumanu Highway intersection.

3. Traffic generated by the proposed subject development is anticipated to significantly impact the Queen Kaahumanu Highway/Hina Lani Street intersection as well as the Hina Lani Street/Mamalahoa Highway/Palani Road intersection. The petitioner must properly mitigate all anticipated project-generated impacts and properly coordinate the timely implementation of these mitigation measures with the DOT Highways Division. The petitioner should also be required to pay for a fair share of the regional transportation improvements.

4. The proposed subject development should be consistent with the County of Hawaii's Kona Community Development Plan (CDP) that includes: a comprehensive regional transportation system of both parallel north-south roads and mauka-makai roads; a major mid-level road that would serve as a trunk transit route; connectivity between adjoining developments; and concurrency on the timing of developments to avoid overloading the regional arterial transportation system.

The DOT appreciates the opportunity to provide these supplemental comments.

ET/GS:km

c: Christopher Yuen, Hawaii Planning Department
Alan Suwa, Wilson Okamoto, Inc.

bc: HWY, -H, -P (PS 08-238), -T, STP(ET)

NEIL ABERCROMBIE
GOVERNOR

JEFFREY CHANG
ACTING DIRECTOR

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

IN REPLY REFER TO
STP 8.0302

December 8, 2010

RECEIVED
DEC 14 2010
WILSON OKAMOTO CORPORATION

Mr. Earl Matsukawa
Wilson Okamoto Corporation
1907 South Beretania Street, Suite 400
Honolulu, Hawaii 96826

Dear Mr. Matsukawa:

Subject: SCD-TSA Kaloko Makai, LLC
Environmental Assessment (EA)/Environmental Impact Statement
Preparation Notice (EISPN)

The State Department of Transportation (DOT) previously commented on the EA/EISPN for the subject project in its letter STP 8.0269 dated October 26, 2010, (attached) and offers the following supplemental Highways comments regarding the Traffic Impact Analysis Report (TIAR):

1. The TIAR needs to include supporting documentation regarding the assumptions used in its preparation, estimates of contributory traffic impacts from developments likely to contribute materially to background traffic increases and the basis for any "without project" roadway system improvements that are to be done by others.

2. The TIAR should address the future right-of-way requirements for a grade-separated interchange, and the provisions for a compatible roadway and connecting roadways (i.e. a frontage road) to avoid delaying this roadway upgrade.

3. The TIAR should also provide a description of the basis used in arriving at the costs applied in determining the developer's fair share contribution towards regional roadway improvements.

DOT appreciates the opportunity to provide supplemental comments on the subject project. When the DEIS for the project is completed, DOT requests that at least four (4) hard, paper copies of the document in addition to electronic media (i.e. CD-ROM) be provided. If there are any questions, including the need to meet with Highways Division staff, please contact

STP 8.0302

Mr. David Shimokawa of the DOT Statewide Transportation Planning Office at telephone number (808) 831-7976.

Very truly yours,

JEFFREY CHANG
Acting Director of Transportation

Attachment: Ltr STP 8.0269 dtd 10/26/10

LINDA LINGLE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

MICHAEL D. FORMBY
INTERIM DIRECTOR

Deputy Directors
FRANCIS PAUL KEENO
JIRO A. SUMADA

IN REPLY REFER TO

STP 8.0269

October 26, 2010

Mr. Earl Matsukawa
Wilson Okamoto Corporation
1907 South Beretania Street, Suite 400
Honolulu, Hawaii 96826

Dear Mr. Matsukawa:

Subject: SCD-TSA Kaloko Makai, LLC
Environmental Assessment (EA)/Environmental Impact Statement
Preparation Notice (EISPN)

The State Department of Transportation (DOT) previously commented on the subject case during the EISPN period in its letters STP 8.2966 dated August 12, 2008 and STP 8.2944 dated July 24, 2008 (attached).

The DOT Highways Division Planning Branch is still reviewing the subject project. Until this review is completed, DOT's prior comments remain valid.

DOT appreciates the opportunity to provide comments. If there are any other questions, including the need to meet with DOT Highways Division staff, please contact Mr. David Shimokawa of the DOT Statewide Transportation Planning Office at 831-7976.

Very truly yours,

for MICHAEL D. FORMBY
Interim Director of Transportation

Attachments: STP ltr 8.2966 dtd 8/12/08
STP ltr 8.2944 dtd 7/24/08

c: Abbey Seth Mayer, Department of Business, Economic Development and Tourism – Office of Planning

7469-01
July 25, 2011

WILSON OKAMOTO CORPORATION
ENGINEERS | PLANNERS | CONSULTANTS
1907 South Beretania Street
Artesian Plaza, Suite 400
Honolulu, Hawaii, 96826 USA
Phone: 808-946-2277
FAX: 808-946-2253
www.wilsonokamoto.com

Mr. Glenn Okimoto, Director
Department of Transportation
State of Hawaii
869 Punchbowl Street
Honolulu, HI 96813-5097

Subject: Environmental Assessment (EA)/Environmental Impact Statement Preparation Notice (EISPN)
Kaloko Makai
Kaloko and Kohanaiki, North Kona, Hawaii
Tax Map Key: (3) 7-3-09: 017, 025, 026, and 028

Dear Mr. Okimoto:

Thank you for your letters dated October 26, 2010 (STP 8.0269) and December 8, 2010 (STP 8.0302). Your October 26, 2010 letter also states that comments offered in your letter dated July 24, 2008 on the previous EISPN published for the project remain valid. We offer the following responses in the respective order of your comment letters.

July 24, 2008 (DIR 0954 & 1027, STP 8.2944)

1. We acknowledge that the proposed project may significantly impact DOT Highway Facilities – Queen Kaahumanu Highway and Mamalahoa Highway. The Draft EIS will include a Traffic Impact Assessment Report (TIAR) that will address access and traffic issues, as well as recommend mitigation measures to address potential adverse impacts.

2. As mentioned above, the Draft EIS will include a TIAR, which will also address cumulative impacts.

3. Intersection improvements at Hulikoa and Queen Kaahumanu Highway have been implemented. We acknowledge DOT's policy to preserve Queen Kaahumanu corridor as a future, high-speed, access-controlled facility. The proposed project is not proposing direct access to Queen Kaahumanu.

4. We acknowledge that any modification of drainage systems in or within close proximity to DOT properties require your review and approval.

5. Notably, we understand that Phase 1 of the Queen Kaahumanu Highway has been completed and Phase 2 from Kealakehe Parkway to Keahole Airport Access Road is underway. The updated information on DOT project schedule is appreciated. We will incorporate this information, as well as any subsequent updates in our TIAR and Draft EIS.

6. The Draft EIS will discuss current and future land development projects in the vicinity of the project site.

7. Kaloko Makai will consult with DOT Highways Division, Planning Branch regarding the preceding information.

8. We will provide four copies of the forthcoming Draft EIS to DOT.

August 12, 2008 Letter (DIR 0954 & 1027, STP 8.2966)

1. We understand that the State of Hawaii Department of Transportation's (DOT) opposition to the change in land use designation from Conservation to Urban on the portion of the site adjoining Queen Kaahumanu Highway. Use of this area for an interchange, however, is more consistent with Urban designation than Conservation. We acknowledge DOT's long-range transportation plan for a proposed grade-separated interchange at this location. Any proposed interior use of this area by Kaloko Makai, such as for light-industrial and mixed-use would be subject to removal when DOT is ready to construct the interchange.

2. The land plan in the forthcoming Draft EIS will indicate the location of DOT's planned interchange. The TIAR will consider the current at-grade conditions, as well as plans for intersection improvements at the Hina Lani Street intersection associated with the on-going Queen Kaahumanu Highway Widening Project.

3. The TIAR will recommend mitigation measures to address traffic impacts associated with Kaloko Makai. These mitigation measures and Kaloko Makai's fair share cost responsibilities will be the subject of future consultation with DOT, Highways Division, Planning Branch.

4. The project will be consistent with the County's Kona Community Development Plan, including provision for transportation improvements and concurrency, as will be discussed in the forthcoming Draft EIS.

December 8, 2010 (STP 8.0302)

1. The TIAR will include supporting documentation regarding the assumptions used in preparing estimates of contributory traffic impacts from developments likely to contribute materially to background traffic increases and the basis for any "without project" roadway system improvements that are to be done by others.

2. As discussed above, in recognition of DOT's planned grade-separated interchange planned for the area, the proposed light-industrial and mixed-use is subject to removal when DOT is ready to construct the interchange.

3. Kaloko Makai acknowledges that the project would be required to contribute a fair share portion of the cost for constructing transportation improvements, however, it is premature to speculate on what the contribution should be at this conceptual planning stage.

9. We will provide four copies and a CD with pdf file of the forthcoming Draft EIS to DOT.

We appreciate your participation in the environmental review process.

Sincerely,

Earl Matsukawa, AICP
Project Manager

cc: Mr. Peter Phillips, Stanford Carr Development
Mr. Orlando Dan Davidson, State Land Use Commission

LINDA LINGLE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF HEALTH
P. O. BOX 3378
HONOLULU, HAWAII 96801-3378

CHIYOME L. FUKINO, M.D.
DIRECTOR OF HEALTH

In reply, please refer to:
File:

October 25, 2010

TO: Mr. Earl Matsukawa, AICP
Wilson Okamoto Corporation

FROM: Russell S. Takata, Program Manager
Indoor and Radiological Health Branch

SUBJECT: Environmental Assessment (EA)/Environmental Impact Statement Preparation Notice (EISPN)
Kaloko Makai
Kaloko and Kohanaiki, North Kona, Hawaii
Tax Map Key: (3) 7-3-09: 017, 025, 026 & 028

Our comments should be printed as follows:

"Project activities shall comply with the Administrative Rules of the Department of Health:

- Chapter 11-46 Community Noise Control.

Should there be any questions, please contact me at 586-4701.

WILSON OKAMOTO CORPORATION
ENGINEERS | PLANNERS | CONSULTANTS
1907 South Beretania Street
Artesian Plaza, Suite 400
Honolulu, Hawaii, 96826 USA
Phone: 808-946-2277
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7469-01
July 25, 2011

Mr. Russell Takata, Program Manager
Indoor and Radiological Health Branch
Department of Health
State of Hawaii
P.O. Box 3378
Honolulu, HI 96801-3378

Subject: Environmental Assessment (EA)/Environmental Impact Statement Preparation Notice (EISPN)
Kaloko Makai
Kaloko and Kohanaiki, North Kona, Hawaii
Tax Map Key: (3) 7-3-09: 017, 025, 026, and 028

Dear Mr. Takata:

Thank you for you letter dated October 25, 2010. The proposed project will comply with Hawaii Administrative Rules (HAR), Chapter 11-46 "Community Noise Control." The Draft EIS will also include a Noise Study that will address potential short-term and long-term noise impacts generated by the project.

We appreciate your participation in the environmental review process.

Sincerely,

Earl Matsukawa, AICP
Project Manager

cc: Mr. Peter Phillips, Stanford Carr Development
Mr. Orlando Dan Davidson, State Land Use Commission

Appendix S

Second Draft EIS Comment and Response Letters

EWM

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122, Box 50088
Honolulu, Hawaii 96850

OCT 0 4 2011

In Reply Refer To:
2011-TA-0128
2011-TA-0362

Mr. Earl Matsukawa
Wilson Okamoto Corporation
1907 South Beretania Street
Artesian Plaza, Suite 400
Honolulu, Hawaii 96826

Subject: Comments on the Draft Environmental Impact Statement for the Kaloko Makai Development, Hawaii

Dear Mr. Matsukawa:

The U.S. Fish and Wildlife Service (Service) has reviewed the July 2011, Draft Environmental Impact Statement (DEIS) for the Kaloko Makai Development, proposed by the developer, SCD-TSA Kaloko Makai, LLC. At build-out, this master-planned community will have 5,000 single-family and multi-family residences, commercial centers, schools, community services and supporting infrastructure. This housing project will be located on 1,142 acres of land that is currently undeveloped. We requested and received a time extension until October 6, 2011, to submit our comments and we thank you for the additional time.

The DEIS includes and evaluates the actions described in the Draft Kaloko Makai State Habitat Conservation Plan (HCP) to augment the discussion regarding natural resources. The Draft HCP is being developed to satisfy endangered species regulations as described in Hawaii Revised Statute 195D. However, the Draft HCP has only recently been initiated with the State of Hawaii Division of Forestry and Wildlife (DOFAW) and there are several steps yet to complete, including HCP review by the Endangered Species Recovery Committee, a 45-day public review period and approval by the Board of Land and Natural Resources. Hookuleana, LLC, a consulting firm, is currently working with DOFAW to develop a final HCP. We submitted our comments on the Draft HCP in a letter dated July 18, 2011 (Service File 2011-TA-0362).

Between March 22, 2010, and September 23, 2010, the U. S. Fish and Wildlife Service (Service), Federal Highway Administration (FHWA), County of Hawaii, SCD-TSA Kaloko Makai, LLC, Stanford Carr, LLC, and Hookuleana, LLC negotiated several measures to achieve conservation

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for the following listed plant species: (1) aiea (*Nothocestrum brevaflorum*); (2) uhiuhi (*Caesalpinia kavaiense*); (3) maoloa (*Neraudia ovate*); (4) hala pepe (*Pleomele hawaiiensis*) and; (5) the candidate kookoolau (*Bidens micrantha* ssp. *ctenophylla*). These discussions focused on the impacts associated with the proposed construction of the Ane Keohokalole Highway. The FHWA conducted a section 7 consultation pursuant to the Endangered Species Act of 1973, as amended, that addressed the construction of the Ane Keohokalole Highway and included conservation measures for the collection, propagation and outplanting of the aforementioned species to offset impacts associated with the new highway. Additional conservation measures were agreed to by the Service and the Kaloko Makai Development. Most important, Kaloko Makai Development agreed to set aside 150 acres (ac) (60.7 hectares (ha)) to create the Kaloko Makai Dryland Forest Preserve (Preserve) to offset direct impacts to listed species due to the proposed housing project.

The measures agreed to in our August 16, 2010, meeting between the Service, FHWA, County of Hawaii, SCD-TSA Kaloko Makai, LLC, Stanford Carr, LLC, and Hookuleana, LLC are as follows:

FHWA Responsibilities

1. Collect genetic material, propagate and ouplant uhiuhi and maoloa so that 30 individuals of each survive in the Preserve.

2. Collect genetic material, propagate and ouplant hala pepe so that 40 individuals survive in the Preserve.

3. Collect genetic material, propagate and outplant aiea, uhiuhi, maoloa, and hala pepe so that 30 individuals of each species, in each of two locations to be determined in coordination with the Service, survive outplanting.

4. Outplant enough individuals of kookoolau so that 120 individuals survive in the preserve and two populations of 90 individuals survive, at locations to be determined in coordination with the Service.

5. Control weeds in a 15-foot (ft) (5-meter (m)) buffer around existing endangered plants (aeia, uhiuhi, maoloa, hala pepe and kookoolau) in the Preserve for five years.

6. Control weeds in the staging area for Hina Lani Street.

7. Install 13,100 ft (3,993 m) of 4-ft (1.2-m) hogwire fence along the east side of the Ane Keohokalole Highway.

Kaloko Makai Development Responsibilities

1. Set aside 150 acres (60.7 ha) in perpetuity for the creation of the Preserve.

2. Install 4-ft (1.2-m) hogwire fence around remaining unfenced portion of the Preserve.

3. Monitor fence and remove ungulates.

4. After FHWA completes their five year weed control program, control weeds throughout the entire Preserve.

5. Control weeds along a 15-ft (5-m) buffer along all roads.

Additional comments regarding the DEIS are as follows:

1. The endangered Blackburn's sphinx moth (*Manduca blackburni*; BSM) may occur in the project area. The adult moth feeds on nectar from native plants including beach morning glory (*Ipomea pes-caprea*), iliee (*Plumbago zeylanica*), and maiapilo (*Capparis sandwichiana*). The larvae feed upon the native *Nothocestrum breviflorum* and nonnative tree tobacco (*Nicotiana glauca*) which can be found in disturbed areas such as open fields, roadway margins, and dry to moist forests at elevations ranging from 1,500 to 5,000 feet. During his 2006 survey, Art Whistler identified beach morning glory and maiapilo within the project area. Any of the other species may also occur on the project site. We recommend the project area be surveyed by a qualified biologist for the presence of BSM host plants during the wet season and if host plants are found, contact our office for further assistance.

2. The endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*) may occur within the proposed project area. Hawaiian hoary bats roost in exotic and native woody vegetation at heights greater than 15 feet. If trees or shrubs suitable for bat roosting are cleared during the bat breeding season, there is a risk that breeding bats could inadvertently be harmed or killed. Young bats, which are incapable of flight, are particularly vulnerable during the bat-birthing and pup-rearing season (June 1 through September 15). To minimize potential impacts to the Hawaiian hoary bat, woody plants greater than 15 feet tall should not be removed or trimmed between June 1 and September 15 throughout the development and ongoing operation of the proposed project.

3. The DEIS states "Kaloko Makai will use best efforts to collect genetic material, propagate and plant hala pepe so that 6 individuals survive in the Kaloko Makai Dryland Forest Preserve. The 6 new individuals represent a 3 for 1 replacement of the 2 hala pepe outside of the Dryland Forest Preserve which will be removed and transplanted..." The intent of the 3:1 ratio is 3 populations created for any 1 destroyed, not 3 individuals for every 1 individual. We recommend collecting and growing propagules of the existing plants and outplanting enough individuals so that 3 populations survive within the Preserve. Survival of these plants, if transplanted, is highly unlikely. We recommend you and Hookuleana, LLC coordinate with DOFAW to ensure the State's net benefit requirement is achieved.

4. The HCP (not mentioned in the DEIS) proposes to transplant approximately 12 to 17 kookoolau from within the area to be developed to the Preserve. As stated above, survival of these individuals is unlikely and we recommend collecting propagules of the existing plants and outplanting these individuals in the Preserve. We recommend you

and Hookuleana, LLC coordinate with DOFAW to ensure the State's net benefit requirement is achieved.

5. The HCP and DEIS state "After construction, Kaloko Makai will develop a 25-ft (7.6-m) buffer between the existing aiea tree and any structure." We recommend this buffer be increased to 50 ft (15.2 m). It was also our understanding that no development would occur until successful outplanting of aiea has occurred.

6. In the HCP and DEIS, the developer commits to controlling weeds in a 15-ft (5-m) buffer around extant and outplanted listed and candidate plants. As negotiated previously, weeds are to be controlled in the entire dryland forest preserve and along all roadsides within the development. In addition, as we negotiated, FHWA funds would cover the cost of interim weed control (within the 15-ft (5-m) buffer) in the preserve for five years until the developers of Kaloko Makai took over responsibility for weed control throughout the entire preserve, including areas outside of the 15-ft (5-m) buffer.

7. The HCP and DEIS state "These 150 acres will be set aside and preserved as a dryland forest preserve thus ensuring the continuation of this dryland forest ecosystem." On August 26, 2010, the Hawaii County Planning Department signed a document agreeing to set-aside this 150-ac (60.7-ha) parcel for the purpose of conservation. Stipulations within the document require that applicant comply with conservation measures agreed upon by the applicant and the Service as a condition of approval for county land entitlements. This information should be included in your FEIS.

8. The HCP and DEIS state that a 4-ft high (1.2-m) woven mesh fence will be installed along the common boundary of the Ana Keohokalole Highway and the Kaloko Makai Dryland Forest Preserve. This is a conservation measure from the section 7 consultation with FHWA. As previously negotiated, the remaining borders of the preserve would be fenced by Kaloko Makai Development and monitoring/repair of the entire fence and ungulate removal should be included in your management plan for the Preserve.

9. The Service was unaware that a wildland fire dip tank would be installed inside the Preserve. This will take away from the overall acreage available for outplanting sites and will reduce the size of the overall conservation area. We recommend you either relocate the dip tank outside of the Preserve or increase the size of the Preserve to offset the footprint of the tank and access road leading to it.

10. Several water supply alternatives being investigated by the applicant include utilizing high-elevation off-site pumping wells. The DEIS estimates that the cumulative effects of pumping high-elevation wells in the area of the proposed project could increase salinity in the Kaloko-Honokohau National Historical Park's (Park) waters to up to 16.69 parts per thousand (ppt) at the shoreline. The anticipated increases in salinity may adversely affect aquatic ecosystems in the Park. For example, controlled laboratory experiments reveal that the eggs and naiads of the candidate-endangered orange-black Hawaiian damselfly (*Megalagrion xanthomelas*) are sensitive to increased salinity and temperature, and that naiads exhibit a threshold response to salinity above 15 ppt, with no naiads surviving at 20 ppt (Tango, 2010). Utilizing high-elevation off-site pumping wells

upslope from the Park should be excluded as an alternative for supplying water to this project to protect aquatic ecosystems.

11. We recommend the FEIS include the development of a public education program, including signage that will encourage confinement of pets, discourage feeding of feral animals and promote the installation of animal proof garbage containers.

We look forward to continuing a close collaborative relationship with you to develop a final EIS that results in the restoration and protection of the ecological integrity of the Kaloko Makai Dryland Forest Preserve for future generations. If you have questions regarding these comments, please contact Jodi Charrier, Fish and Wildlife Biologist, (phone: 808-792-9400, email: jodi_charrier@fws.gov).

Sincerely,

Loyal Mehrhoff
Field Supervisor

Literature cited

Tango, L. 2010 The effect of salinity and temperature on survival of the orange-black Hawaiian Damselfly, *Megalagrion xanthomelas*. Masters Abstracts International. 48(05) 46 pp.

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7469-01
July 25, 2013

Dr. Loyal Mehrhoff, Field Supervisor
Pacific Islands Fish and Wildlife Office
Fish and Wildlife Service
U.S. Department of the Interior
300 Ala Moana Boulevard, Room 3-122, Box 50088
Honolulu, Hawai'i 96850

Subject: Draft Environmental Impact Statement (DEIS)
Kaloko Makai
Kaloko and Kohanaiki, North Kona, Hawaii
Tax Map Key: (3) 7-3-09: 017, 025, 026, and 028

Dear Dr. Mehrhoff:

Thank you for your letter dated October 4, 2011. The Applicant is preparing a Second DEIS to address changes in the proposed project that will be reassessed, as needed, in the forthcoming document. You will be notified of its availability for review and comment pursuant to Chapter 343, Hawaii Revised Statutes (HRS) and Title 11, Chapter 200 Hawaii Administrative Rules (Department of Health).

With regard to your comments on the subject DEIS, we offer the following responses in the respective order of your comments:

The U.S. Fish and Wildlife Service (Service) has reviewed the July 2011, Draft Environmental Impact Statement (DEIS) for the Kaloko Makai Development, proposed by the developer, SCD-TSA Kaloko Makai, LLC. At build-out, this master-planned community will have 5,000 single-family and multi-family residences, commercial centers, schools, community services and supporting infrastructure. This housing project will be located on 1,142 acres of land that is currently undeveloped. We requested and received a time extension until October 6, 2011, to submit our comments and we thank you for the additional time.

The DEIS includes and evaluates the actions described in the Draft Kaloko Makai State Habitat Conservation Plan (HCP) to augment the discussion regarding natural resources. The Draft HCP is being developed to satisfy endangered species regulations as described in Hawaii Revised Statute 195D. However, the Draft HCP has only recently been initiated with the State of Hawaii Division of Forestry and Wildlife (DOFAW) and there are several steps yet to complete, including HCP review by the Endangered Species Recovery Committee, a 45-day public review period and approval by the Board of Land and Natural Resources. Hookuleana, LLC, a consulting firm, is currently working with DOFAW to develop a final HCP. We submitted our comments on the Draft HCP in a letter dated July 18, 2011 (Service File 2011-TA-0362).

Between March 22,2010, and September 23, 2010, the U. S. Fish and Wildlife Service (Service), Federal Highway Administration (FHWA), County of Hawaii, SCD-TSA Kaloko Makai, LLC, Stanford Carr, LLC, and Hookuleana, LLC negotiated several measures to achieve conservation for the following listed plant species: (1) aiea (Nothocestrum brevaflorum); (2) uhiuhi (Caesalpinia kavaiense); (3) maoloa (Neraudia ovate); (4) hala pepe (Pleomele hawaiiensis) and; (5) the candidate kookoolau (Eidens micrantha ssp. ctenophylla). These discussions focused on the impacts associated with the proposed construction of the Ane Keohokalole Highway. The FHWA conducted a section 7 consultation pursuant to the Endangered Species Act of 1973, as amended, that addressed the construction of the Ane Keohokalole Highway and included conservation measures for the collection, propagation and outplanting of the aforementioned species to offset impacts associated with the new highway. Additional conservation measures were agreed to by the Service and the Kaloko Makai Development. Most important, Kaloko Makai Development agreed to set aside 150 acres (ac) (60.7 hectares (ha)) to create the Kaloko Makai Dryland Forest Preserve (Preserve) to offset direct impacts to listed species due to the proposed housing project.

The measures agreed to in our August 16, 20 I 0, meeting between the Service, FHWA, County of Hawaii, SCD-TSA Kaloko Makai, LLC, Stanford Carr, LLC, and Ho'okuleana, LLC are as follows:

<u>FHWA Responsibilities</u>

1. *Collect genetic material, propagate and outplant uhiuhi and maoloa so that 30 individuals of each survive in the Preserve.*
2. *Collect genetic material, propagate and outplant hala pepe so that 40 individuals survive in the Preserve.*
3. *Collect genetic material, propagate and outplant aiea, uhiuhi, maoloa, and hala pepe so that 30 individuals of each species, in each of two locations to be determined in coordination with the Service, survive outplanting.*
4. *Outplant enough individuals of kookoolau so that 120 individuals survive in the preserve and two populations of 90 individuals survive, at locations to be determined in coordination with the Service.*
5. *Control weeds in a 15-foot (ft) (5-meter (m)) buffer around existing endangered plants (aiea, uhiuhi, maoloa, hala pepe and kookoolau) in the Preserve for five years.*
6. *Control weeds in the staging area for Hina Lani Street.*
7. *Install 13,100 ft (3,993 m) of 4-ft (1.2-m) hogwire fence along the east side of the Ane Keohokalole Highway.*

<u>Kaloko Makai Development Responsibilities</u>

1. *Set aside 150 acres (60.7 ha) in perpetuity for the creation of the Preserve.*
2. *Install 4-ft (1.2-m) hogwire fence around remaining unfenced portion of the Preserve.*
3. *Monitor fence and remove ungulates.*

4. *After FHWA completes their five year weed control program, control weeds throughout the entire preserve.*
5. *Control weeds along a 15-ft (5-m) buffer along all roads.*

Response: You are correct that representatives of the Applicant participated in some informal discussions with USFWS, FHWA, and the County concerning the proposed dryland forest preserve and other matters. However, Applicant was never a party to any formal agreements with USFWS. Applicant understands that the informal consultation between USFWS, FHWA, and the County resulted in FHWA and the County agreeing to implement certain conservation measures, including a commitment to work with the adjacent landowners [such as Applicant and Lanihau] to preserve a total of 154.6 acres of land. FHWA and the County also agreed to a variety of genetic collection, outplanting, weed control, fencing and other measures. However, Applicant is not a party any agreement with USFWS. For that reason, we respectfully disagree with your characterization of items 1 – 5 in your comment letter as "Kaloko Makai Development Responsibilities." Nevertheless, the Applicant reaffirms its prior statements that, in connection with the development of Kaloko Makai project, it would set aside 150-acres of Dryland forest for preservation purposes. As acknowledged in your comment letter, this set aside will offset direct impacts to listed species as a result of the development of the Kaloko Makai project. Within this preserve, a variety of species will have continued protection and their habitats set aside in perpetuity, enhancing their prospects for survival.

The Kaloko Makai property has been the subject of numerous botanical surveys over the years. Based on these surveys, four listed endangered plant species are found within the project site.

- 'aiea (Nothocestrum breviflorum)
- hala pepe (Pleomele hawaiiensis)
- uhiuhi (Caesalpinia kavaiensis)
- ma'aloa (Neraudia ovata)

In the anticipated development discussed in the Draft EIS, only one 'aiea and two hala pepe plants are found outside the dryland forest preserve; the action, then, proposed removal of these plants due to the proposed development. Based on comments during the DEIS process and further evaluation of the project layout, under the development proposal described in the Second Draft EIS, none of the listed endangered plants situated outside the dryland forest preserve will be "taken" in the development and construction of the Kaloko Makai project.

Instead, Kaloko Makai will leave those plants in place and incorporate a 50-foot buffer around the one 'aiea and two hala pepe and any structure within the

project. The plants will be incorporated into landscaping within the 50-foot buffers.

(1) The endangered Blackburn's sphinx moth (BSM) may occur in the project area. The adult moth feeds on nectar from native plants including beach morning glory, iliee and Maiapilo. The larvae feed upon the native nothocestrum breviflorum and non-native tree tobacco which can be found in disturbed areas such as open fields, roadway margins, and dry to moist forests at elevations ranging from 1,500 to 5,000 feet. During 2006 survey, A. Whistler identified beach morning glory and maiapilo within the project area. Any of the other species may also occur on the project site. We recommend the project area be surveyed by qualified biologist for the presence of BSM host plants during the wet season and if host plants are found, contact our office for further assistance.

Response: Since the occurrence of potential host plants in any particular location will likely change overtime, a survey of planned construction sites during the wet season preceding construction will be conducted. If any potential host plants are found, your office will be contacted to determine an appropriate course of action.

(2) The endangered Hawaiian hoary bat may occur within the proposed project area. Hawaiian hoary bats roost in exotic and native woody vegetation at heights greater than 15 feet. If trees or shrubs suitable for bat roosting are cleared during the bat breeding season, there is a risk that breeding bats could inadvertently be harmed or killed. Young bats, which are incapable of flight, are particularly vulnerable during the bat birthing and pup rearing season (June 1 - Sept. 15). To minimize potential impacts to the Hawaiian hoary bat, woody plants greater than 15 ft. tall should not be removed or trimmed between June 1 - Sept. 15 throughout the development and ongoing operation of project.

Response: The Petitioner will incorporate the recommended protocols to address the Hawaiian hoary bat.

(3) The DEIS states "Kaloko Makai will use best efforts to collect genetic material, propagate and plant hala pepe so that 6 individuals survive in the Kaloko Makai Dryland Forest Preserve. The 6 new individuals represent a 3 for 1 replacement of the 2 hala pepe outside of the dryland forest preserve which will be removed and transplanted..." The intent of the 3:1 ratio is 3 populations created for any 1 destroyed, not 3 individuals for every 1 individual. We recommend collecting and growing propagules of the existing plants and outplanting enough individuals so that 3 populations survive within the Preserve. Survival of these plants, if transplanted, is highly unlikely. We recommend you and Hookuleana LLC coordinate with DOFAW to ensure the State's net benefit requirements are achieved.

(4) The HCP (not mentioned in the DEIS) proposes to transplant approximately 12 to 17 kookoolau from within the area to be developed to the Preserve. As stated above (comment #3), survival of these individuals is unlikely and we recommend collecting propagules of the existing plants and outplanting these individuals in the Preserve. We recommend you and Hookuleana LLC coordinate with DOFAW to ensure the State's net benefit requirement is achieved.

Response: Based on comments during the DEIS process and further evaluation of the project layout, under the development proposal described in the Second DEIS, none of the listed endangered plants situated outside of the dryland forest will be "taken" in the development and construction of the Kaloko Makai project. Furthermore, it is anticipated that the project will be developed in such a manner as to avoid any "take" of Bidens micrantha ssp. Ctenophylla, which is currently proposed for listing as an endangered species. Applicant wil incorporate avoidance measures to the extent possible. Because no incidental take license will be needed, Applicant no longer anticipates entering into a Habitat Conservatoin Plan (HCP) as previously suggested in the DEIS.

(5) The HCP and DEIS state "After construction, Kaloko Makai will develop a 25-ft (7.6-m) buffer between the existing aiea tree and any structure." We recommend this buffer be increased to 50 ft (15.2 m). It was also our understanding that no development would occur until successful outplanting of aiea has occurred.

Response: As stated above, Applicant will incorporate avoidance measures to the extent possible, thereby eliminating the need to obtain an incidental take license and entering into a HCP. Nevertheless, your comments regarding the proposed size of the buffer around of 'aiea tree have been taken under consideration, and Applicant intends to incorporate a 50-foot buffer around one 'aiea tree and any structure within the project. In addition, Applicant intends to incorporate a similar buffer around the two hala peppe and any structure within the project. The plants will be incorporated into landscaping within the 50-foot buffers.

(6) In the HCP and DEIS, the developer commits to controlling weeds in a 15 ft. buffer around extant and outplanted listed and candidate plants. As negotiated previously, weeds are to be controlled in the entire dryland forest preserve and along all roadsides within the development. In addition, as we negotiated, FHWA funds would cover the cost of intermediate weed control (within 15 ft buffer) in the preserve for 5 years until the developers of Kaloko Makai took over responsibility for weed control throughout the entire preserve, including areas outside of 15 ft. buffer.

Response: As stated above, Applicant will incorporate avoidance measures to the extent possible, thereby eliminating the need to obtain an incidental take license and enter into a HCP. Also as stated above, at this time Applicant is not a party to any agreement with USFWS.

(7) The HCP and DEIS state "These 150 acres will be set aside and preserved as a dryland forest preserve, thus ensuring the continuation of this dryland forest ecosystem." On August 26, 2010, the COH Planning Dept. signed a document agreeing to set aside this 150 acre parcel for the purpose of conservation. Stipulations within the document require that the applicant comply with conservation measures agreed upon by the applicant and the Service as a condition of approval for county land entitlements. This information should be included in FEIS.

Response: It is incorrect to state that the County agreed to set aside any property owned by the Applicant. Kaloko Makai understands that the County of Hawaii made a written representation to USFWS and FHWA that the County will require the formal set-aside of 150 acres within the Kaloko Makai property as a condition of approval for County land use entitlements for the Kaloko Makai project. Furthermore, the County represented that the implementation of whatever conservation measures that may at some point be agreed to by USFWS and Applicant will be required as a condition of obtaining County land use entitlements for the Kaloko Makai project.

(8) The HCP and DEIS state that a 4 ft. woven mesh fence will be installed along the common boundary of the Ane Keohokalole Hwy. and Kaloko Makai Dryland Forest Preserve. This is a conservation measure from Section 7 consultation with FHWA. As previously negotiated, the remaining borders of the preserve would be fenced by Kaloko Makai development and monitoring/repair of the entire fence and ungulate removal should be included in your management plan for the Preserve.

Response: As stated above, Applicant will incorporate avoidance measures to the extent possible, thereby eliminating the need to obtain an incidental take license and enter into a HCP. Also as stated above, at this time the Applicant is not a party to any agreement with USFWS.

(9) The Service was unaware that a wildland fire dip tank would be installed inside the Preserve. This will take away from the overall acreage available for outplanting sites and will reduce the size of the overall conservation area. We recommend you either relocate the dip tank outside of the Preserve or increase the size of the Preserve to offset the footprint of the tank and access road leading to it.

Response: A previously-graded portion of land within the proposed Preserve is being used by Hawaii Forestry Industry Association (HFIA) as a staging and propagation area for management actions agreed to by USFWS and FHWA. This approximately 5.6-acre staging area serves as a central site for a variety of activities including parking, plant propagation, plant nursery, laboratories and may include a dip tank.

Dip tanks decrease the travel time required between bucket drops of water during a fire, and, most importantly, can allow first responders to more quickly respond to a fire in the first hour.

The dip take has also been considered for use to irrigate seedlings which the HFIA is propagating within the staging area.

(10) Several water supply alternatives being investigated by the applicant include utilizing high-elevation off-site pumping wells. The DEIS estimates that the cumulative effects of pumping high elevation wells in the area of the proposed project could increase salinity in the Kaloko Honokohau NHP waters to up to 16.69 ppt at the shoreline. The anticipated increases in salinity may adversely affect aquatic ecosystems in the park. For example, controlled laboratory experiments reveal that the eggs and naiads of the candidate-endangered orange-black Hawaiian damselfly are sensitive to increased salinity and temperatures, and that naiads exhibit a threshold response to salinity above 15 ppt, with no naiads surviving at 20 ppt (Tango 2010). Utilizing high-elevation off-site pumping wells upslope from the Park should be excluded as an alternative for supplying water to this project to protect aquatic ecosystems

Response: The Second DEIS assesses three alternative water sources now being considered for the project's drinking water supply.

1. On-site wells at 710-foot elevation
2. On-site wells at 710-foot elevation with reverse osmosis (RO) Treatment
3. Desalinization of saline groundwater from 363-foot elevation on-site wells

These alternatives can be affirmatively demonstrated as having no impact on the basal lens. They are limited to use of the high level groundwater drawn from strata far below the basal groundwater so as not to impact it, and desalinizing saline groundwater, also drawn from below the basal lens. Brine from the desalinization alternative would also be discharged far below the basal groundwater.

An Assessment of the Potential Impact on Water Resources and An Assessment of Marine and Pond Environments has been prepared by Tom Nance Water Resource Engineering (TNWRE) and Marine Research Consultants (MRC) respectively. Both reports will be included in the forthcoming Second DEIS.

According to the reports, salinity and temperatures fluctuate daily within the water surrounding Kaloko-Honokohau NHP. The TNWRE report indicates salinity will decrease, not increase due to recharge from excess applied

irrigation. The MRC report shows results of strong diurnal temperature variation within the fishponds which should also decrease in amplitude with increase flux of groundwater.

(11) We recommend the FEIS include development of a public education program, including signage that will encourage confinement of pets, discourage feeding of feral animals and promote the installation of animal proof garbage containers.

Response: Your comments have been noted. Appropriate signage will be developed to encourage public cooperation and discourage trespassing, vandalism or arson within the Kaloko Makai Dryland Forest Preserve.

Your letter, along with this response, will be reproduced and included in the forthcoming Second DEIS. We appreciate your participation in the EIS review process.

Sincerely,

Earl Matsukawa, AICP
Project Manager

cc: Mr. Jay Nakamura, Stanford Carr Development
Mr. Daniel Orodenker, State Land Use Commission

United States Department of Agriculture

NRCS

Natural Resources Conservation Service
P.O. Box 50004 Rm. 4-118
Honolulu, HI 96850
808-541-2600

EM

August 9, 2011

Mr. Orlando Dan Davidson, Executive Officer
State Land Use Commission
Department of Business, Economic Development and Tourism
P.O. Box 2359
Honolulu, HI 96804

RE: FPPA Determination for lands to be converted by Kaloko Makai, LLC, Project, North Kona, Hawai`i

Dear Mr. Davidson,

Thank you for providing USDA-Natural Resources Conservation Service (NRCS) the opportunity to review the status of lands that will be affected by the proposed Kaloko Makai project in North Kona, Hawai`i. We confine our comments to issues within the purview of NRCS, specifically those related to soil properties that are typically used to assess the quality of land for agricultural uses.

Upon review of the provided Draft Environmental Impact Statement, we find that approximately 6% of the land within the project area – roughly 70 acres – is classified as "Other Important Aglands" under the Agricultural Land of Importance to the State of Hawaii (ALISH) statute and will require that a USDA Form AD-1006 – Farmland Conversion Impact Rating – be completed as part of the Environmental Assessment process. A copy of this form and instructions are attached.

If you have any questions concerning the soils and related quality and suitability ratings for this project area, please contact Dr. Cynthia Stiles, Assistant State Soil Scientist, by phone (808) 541-2600 x129 or email cynthia.stiles@hi.usda.gov.

Sincerely,

ANGEL FIGUEROA
Director
Pacific Islands Area

Enclosure:

cc: Peter Phillips, SCD – TSA Kaloko Makai, LLC
Earl Matsukawa, AICP – Wilson Okamoto Corp.
Jennifer Sternfels, District Conservationist, Kealakekua, Hawaii
Cynthia Stiles, Asst. State Soil Scientist, Honolulu, Hawaii

Helping People Help the Land

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U.S. Department of Agriculture

FARMLAND CONVERSION IMPACT RATING

PART I *(To be completed by Federal Agency)*		Date Of Land Evaluation Request		
Name Of Project		Federal Agency Involved		
Proposed Land Use		County And State		
PART II *(To be completed by NRCS)*		Date Request Received By NRCS		
Does the site contain prime, unique, statewide or local important farmland? *(If no, the FPPA does not apply – do not complete additional parts of this form).*	Yes ☐ No ☐	Acres Irrigated	Average Farm Size	
Major Crop(s)	Farmable Land In Govt. Jurisdiction Acres: %	Amount Of Farmland As Defined In FPPA Acres: %		
Name Of Land Evaluation System Used	Name Of Local Site Assessment System	Date Land Evaluation Returned By NRCS		

PART III *(To be completed by Federal Agency)*	Alternative Site Rating Site A	Site B	Site C	Site D
A. Total Acres To Be Converted Directly				
B. Total Acres To Be Converted Indirectly				
C. Total Acres In Site	0.0	0.0	0.0	0.0
PART IV *(To be completed by NRCS)* Land Evaluation Information				
A. Total Acres Prime And Unique Farmland				
B. Total Acres Statewide And Local Important Farmland				
C. Percentage Of Farmland In County Or Local Govt. Unit To Be Converted				
D. Percentage Of Farmland In Govt. Jurisdiction With Same Or Higher Relative Value				
PART V *(To be completed by NRCS)* Land Evaluation Criterion Relative Value Of Farmland To Be Converted *(Scale of 0 to 100 Points)*	0	0	0	0

PART VI *(To be completed by Federal Agency)* Site Assessment Criteria *(These criteria are explained in 7 CFR 658.5(b)*	Maximum Points				
1. Area In Nonurban Use					
2. Perimeter In Nonurban Use					
3. Percent Of Site Being Farmed					
4. Protection Provided By State And Local Government					
5. Distance From Urban Builtup Area					
6. Distance To Urban Support Services					
7. Size Of Present Farm Unit Compared To Average					
8. Creation Of Nonfarmable Farmland					
9. Availability Of Farm Support Services					
10. On-Farm Investments					
11. Effects Of Conversion On Farm Support Services					
12. Compatibility With Existing Agricultural Use					
TOTAL SITE ASSESSMENT POINTS	160	0	0	0	0
PART VII *(To be completed by Federal Agency)*					
Relative Value Of Farmland *(From Part V)*	100	0	0	0	0
Total Site Assessment *(From Part VI above or a local site assessment)*	160	0	0	0	0
TOTAL POINTS *(Total of above 2 lines)*	260	0	0	0	0

Site Selected:	Date Of Selection	Was A Local Site Assessment Used? Yes ☐ No ☐

Reason For Selection:

(See Instructions on reverse side)

This form was electronically produced by National Production Services Staff

Form AD-1006 (10-83)

STEPS IN THE PROCESSING THE FARMLAND AND CONVERSION IMPACT RATING FORM

Step 1 – Federal agencies involved in proposed projects that may convert farmland, as defined in the Farmland Protection Policy Act (FPPA) to nonagricultural uses, will initially complete Parts I and III of the form.

Step 2 – Originator will send copies A, B and C together with maps indicating locations of site(s), to the Natural Resources Conservation Service (NRCS) local field office and retain copy D for their files. (Note: NRCS has a field office in most counties in the U.S. The field office is usually located in the county seat. A list of field office locations are available from the NRCS State Conservationist in each state).

Step 3 – NRCS will, within 45 calendar days after receipt of form, make a determination as to whether the site(s) of the proposed project contains prime, unique, statewide or local important farmland.

Step '4 – In cases where farmland covered by the FPPA will be converted by the proposed project, NRCS field offices will complete Parts II, IV and V of the form.

Step 5 – NRCS will return copy A and B of the form to the Federal agency involved in the project. (Copy C will be retained for NRCS records).

Step 6 – The Federal agency involved in the proposed project will complete Parts VI and VII of the form.

Step 7 – The Federal agency involved in the proposed project will make a determination as to whether the proposed conversion is consistent with the FPPA and the agency's internal policies.

INSTRUCTIONS FOR COMPLETING THE FARMLAND CONVERSION IMPACT RATING FORM

Part I: In completing the "County And State" questions list all the local governments that are responsible for local land controls where site(s) are to be evaluated.

Part III: In completing item B (Total Acres To Be Converted Indirectly), include the following:

1. Acres not being directly converted but that would no longer be capable of being farmed after the conversion, because the conversion would restrict access to them.

2. Acres planned to receive services from an infrastructure project as indicated in the project justification (e.g. highways, utilities) that will cause a direct conversion.

Part VI: Do not complete Part VI if a local site assessment is used.

Assign the maximum points for each site assessment criterion as shown in § 658.5 (b) of CFR. In cases of corridor-type projects such as transportation, powerline and flood control, criteria #5 and #6 will not apply and will, be weighed zero, however, criterion #8 will be weighed a maximum of 25 points, and criterion #11 a maximum of 25 points.

Individual Federal agencies at the national level, may assign relative weights among the 12 site assessment criteria other than those shown in the FPPA rule. In all cases where other weights are assigned relative adjustments must be made to maintain the maximum total weight points at 160.

In rating alternative sites, Federal agencies shall consider each of the criteria and assign points within the limits established in the FPPA rule. Sites most suitable for protection under these criteria will receive the highest total scores, and sites least suitable, the lowest scores.

Part VII: In computing the "Total Site Assessment Points" where a State or local site assessment is used and the total maximum number of points is other than 160, adjust the site assessment points to a base of 160. Example: if the Site Assessment maximum is 200 points, and alternative Site "A" is rated 180 points:

Total points assigned Site A = 180 x 160 = 144 points for Site "A."
Maximum points possible 200

Site Assessment Scoring for the Twelve Factors Used in FPPA

The Site Assessment criteria used in the Farmland Protection Policy Act (FPPA) rule are designed to assess important factors other than the agricultural value of the land when determining which alternative sites should receive the highest level of protection from conversion to non agricultural uses.

Twelve factors are used for Site Assessment and ten factors for corridor-type sites. Each factor is listed in an outline form, without detailed definitions or guidelines to follow in the rating process. The purpose of this document is to expand the definitions of use of each of the twelve Site Assessment factors so that all persons can have a clear understanding as to what each factor is intended to evaluate and how points are assigned for given conditions.

In each of the 12 factors a number rating system is used to determine which sites deserve the most protection from conversion to non-farm uses. The higher the number value given to a proposed site, the more protection it will receive. The maximum scores are 10, 15 and 20 points, depending upon the relative importance of each particular question. If a question significantly relates to why a parcel of land should not be converted, the question has a maximum possible protection value of 20, whereas a question which does not have such a significant impact upon whether a site would be converted, would have fewer maximum points possible, for example 10.

The following guidelines should be used in rating the twelve Site Assessment criteria:

1. **How much land is in non-urban use within a radius of 1.0 mile from where the project is intended?**

More than 90 percent:	15 points
90-20 percent:	14 to 1 points
Less than 20 percent:	0 points

This factor is designed to evaluate the extent to which the area within one mile of the proposed site is non-urban area. For purposes of this rule, "non-urban" should include:

- Agricultural land (crop-fruit trees, nuts, oilseed)
- Range land
- Forest land
- Golf Courses
- Non paved parks and recreational areas
- Mining sites
- Farm Storage
- Lakes, ponds and other water bodies
- Rural roads, and through roads without houses or buildings
- Open space
- Wetlands
- Fish production
- Pasture or hayland

Urban uses include:

- Houses (other than farm houses)
- Apartment buildings
- Commercial buildings
- Industrial buildings
- Paved recreational areas (i.e. tennis courts)
- Streets in areas with 30 structures per 40 acres
- Gas stations

- Equipment, supply stores
- Off-farm storage
- Processing plants
- Shopping malls
- Utilities/Services
- Medical buildings

In rating this factor, an area one-mile from the outer edge of the proposed site should be outlined on a current photo; the areas that are urban should be outlined. For rural houses and other buildings with unknown sizes, use 1 and 1/3 acres per structure. For roads with houses on only one side, use one half of road for urban and one half for non-urban.

The purpose of this rating process is to insure that the most valuable and viable farmlands are protected from development projects sponsored by the Federal Government. With this goal in mind, factor S1 suggests that the more agricultural lands surrounding the parcel boundary in question, the more protection from development this site should receive. Accordingly, a site with a large quantity of non-urban land surrounding it will receive a greater
number of points for protection from development. Thus, where more than 90 percent of the area around the proposed site (do not include the proposed site in this assessment) is non-urban, assign 15 points. Where 20 percent or less is
non-urban, assign 0 points. Where the area lies between 20 and 90 percent non-urban, assign appropriate points from 14 to 1, as noted below.

Percent Non-Urban Land within 1 mile	Points
90 percent or greater	15
85 to 89 percent	14
80 to 84 percent	13
75 to 79 percent	12
70 to 74 percent	11
65 to 69 percent	10
60 to 64 percent	9
55 to 59 percent	8
50 to 54 percent	7
45 to 49 percent	6
40 to 44 percent	5
35 to 39 percent	4
30 to 24 percent	3
25 to 29 percent	2
21 to 24 percent	1
20 percent or less	0

2. How much of the perimeter of the site borders on land in non-urban use?

More than 90 percent:	10 points
90 to 20 percent:	9 to 1 point(s)
Less than 20 percent:	0 points

This factor is designed to evaluate the extent to which the land adjacent to the proposed site is non-urban use. Where factor #1 evaluates the general location of the proposed site, this factor evaluates the immediate perimeter of the site. The definition of urban and non-urban uses in factor #1 should be used for this factor.

In rating the second factor, measure the perimeter of the site that is in non-urban and urban use. Where more than 90 percent of the perimeter is in non-urban use, score this factor 10 points. Where less than 20 percent, assign 0 points. If a road is next to the perimeter, class the area according to the use on the other side of the road for that area. Use 1 and 1/3 acre per structure if not otherwise known. Where 20 to 90 percent of the perimeter is non-urban, assign points as noted below:

Percentage of Perimeter Bordering Land	Points
90 percent or greater	10
82 to 89 percent	9
74 to 81 percent	8
65 to 73 percent	7
58 to 65 percent	6
50 to 57 percent	5
42 to 49 percent	4
34 to 41 percent	3
27 to 33 percent	2
21 to 26 percent	1
20 percent or Less	0

3. How much of the site has been farmed (managed for a scheduled harvest or timber activity) more than five of the last ten years?

More than 90 percent:	20 points
90 to 20 percent:	19 to 1 point(s)
Less than 20 percent:	0 points

This factor is designed to evaluate the extent to which the proposed conversion site has been used or managed for agricultural purposes in the past 10 years.

Land is being farmed when it is used or managed for food or fiber, to include timber products, fruit, nuts, grapes, grain, forage, oil seed, fish and meat, poultry and dairy products.

Land that has been left to grow up to native vegetation without management or harvest will be considered as abandoned and therefore not farmed. The proposed conversion site should be evaluated and rated according to the percent, of the site farmed.

If more than 90 percent of the site has been farmed 5 of the last 10 years score the site as follows:

Percentage of Site Farmed	Points
90 percent or greater	20
86 to 89 percent	19
82 to 85 percent	18
78 to 81 percent	17
74 to 77 percent	16
70 to 73 percent	15
66 to 69 percent	14
62 to 65 percent	13
58 to 61 percent	12
54 to 57 percent	11
50 to 53 percent	10
46 to 49 percent	9
42 to 45 percent	8
38 to 41 percent	7
35 to 37 percent	6
32 to 34 percent	5
29 to 31 percent	4
26 to 28 percent	3

23 to 25 percent	2
20 to 22 percent percent or Less	1
Less than 20 percent	0

4. Is the site subject to state or unit of local government policies or programs to protect farmland or covered by private programs to protect farmland?

Site is protected:	20 points
Site is not protected:	0 points

This factor is designed to evaluate the extent to which state and local government and private programs have made efforts to protect this site from conversion.

State and local policies and programs to protect farmland include:

State Policies and Programs to Protect Farmland

1. Tax Relief:

A. Differential Assessment: Agricultural lands are taxed on their agricultural use value, rather than at market value. As a result, farmers pay fewer taxes on their land, which helps keep them in business, and therefore helps to insure that the farmland will not be converted to nonagricultural uses.

1. Preferential Assessment for Property Tax: Landowners with parcels of land used for agriculture are given the privilege of differential assessment.

2. Deferred Taxation for Property Tax: Landowners are deterred from converting their land to nonfarm uses, because if they do so, they must pay back taxes at market value.

3. Restrictive Agreement for Property Tax: Landowners who want to receive Differential Assessment must agree to keep their land in - eligible use.

B. Income Tax Credits

Circuit Breaker Tax Credits: Authorize an eligible owner of farmland to apply some or all of the property taxes on his or her farmland and farm structures as a tax credit against the owner's state income tax.

C. Estate and Inheritance Tax Benefits

Farm Use Valuation for Death Tax: Exemption of state tax liability to eligible farm estates.

2. "Right to farm" laws:

Prohibits local governments from enacting laws which will place restrictions upon normally accepted farming practices, for example, the generation of noise, odor or dust.

3. Agricultural Districting:

Wherein farmers voluntarily organize districts of agricultural land to be legally recognized geographic areas. These farmers receive benefits, such as protection from annexation, in exchange for keeping land within the district for a given number of years.

4. Land Use Controls: Agricultural Zoning.

Types of Agricultural Zoning Ordinances include:

A. Exclusive: In which the agricultural zone is restricted to only farm-related dwellings, with, for example, a minimum of 40 acres per dwelling unit.

B. Non-Exclusive: In which non-farm dwellings are allowed, but the density remains low, such as 20 acres per dwelling unit.

Additional Zoning techniques include:

A. Sliding Scale: This method looks at zoning according to the total size of the parcel owned. For example, the number of dwelling units per a given number of acres may change from county to county according to the existing land acreage to dwelling unit ratio of surrounding parcels of land within the specific area.

B. Point System or Numerical Approach: Approaches land use permits on a case by case basis.

LESA: The LESA system (Land Evaluation-Site Assessment) is used as a tool to help assess options for land use on an evaluation of productivity weighed against commitment to urban development.

C. Conditional Use: Based upon the evaluation on a case by case basis by the Board of Zoning Adjustment. Also may include the method of using special land use permits.

5. Development Rights:

A. Purchase of Development Rights (PDR): Where development rights are purchased by Government action.

Buffer Zoning Districts: Buffer Zoning Districts are an example of land purchased by Government action. This land is included in zoning ordinances in order to preserve and protect agricultural lands from non-farm land uses encroaching upon them.

B. Transfer of Development Rights (TDR): Development rights are transferable for use in other locations designated as receiving areas. TDR is considered a locally based action (not state), because it requires a voluntary decision on the part of the individual landowners.

6. Governor's Executive Order: Policy made by the Governor, stating the importance of agriculture, and the preservation of agricultural lands. The Governor orders the state agencies to avoid the unnecessary conversion of important farmland to nonagricultural uses.

7. Voluntary State Programs:

A. California's Program of Restrictive Agreements and Differential Assessments: The California Land Conservation Act of 1965, commonly known as the Williamson Act, allows cities, counties and individual landowners to form agricultural preserves and enter into contracts for 10 or more years to insure that these parcels of land remain strictly for agricultural use. Since 1972 the Act has extended eligibility to recreational and open space lands such as scenic highway corridors, salt ponds and wildlife preserves. These contractually restricted lands may be taxed differentially for their real value. One hundred-acre districts constitute the minimum land size eligible.

Suggestion: An improved version of the Act would state that if the land is converted after the contract expires, the landowner must pay the difference in the taxes between market value for the land and the agricultural tax value which he or she had been

paying under the Act. This measure would help to insure that farmland would not be converted after the 10 year period ends.

B. Maryland Agricultural Land Preservation Program: Agricultural landowners within agricultural districts have the opportunity to sell their development rights to the Maryland Land Preservation Foundation under the agreement that these landowners will not subdivide or develop their land for an initial period of five years. After five years the landowner may terminate the agreement with one year notice.

As is stated above under the California Williamson Act, the landowner should pay the back taxes on the property if he or she decides to convert the land after the contract expires, in order to discourage such conversions.

C. Wisconsin Income Tax Incentive Program: The Wisconsin Farmland Preservation Program of December 1977 encourages local jurisdictions in Wisconsin to adopt agricultural preservation plans or exclusive agricultural district zoning ordinances in exchange for credit against state income tax and exemption from special utility assessment. Eligible candidates include local governments and landowners with at least 35 acres of land per dwelling unit in agricultural use and gross farm profits of at least $6.000 per year, or $18,000 over three years.

8. Mandatory State Programs:

A. The Environmental Control Act in the state of Vermont was adopted in 1970 by the Vermont State Legislature. The Act established an environmental board with 9 members (appointed by the Governor) to implement a planning process and a permit system to screen most subdivisions and development proposals according to specific criteria stated in the law. The planning process consists of an interim and a final Land Capability and Development Plan, the latter of which acts as a policy plan to control development. The policies are written in order to:

- prevent air and water pollution;
- protect scenic or natural beauty, historic sites and rare and irreplaceable natural areas; and
- consider the impacts of growth and reduction of development on areas of primary agricultural soils.

B. The California State Coastal Commission: In 1976 the Coastal Act was passed to establish a permanent Coastal Commission with permit and planning authority The purpose of the Coastal Commission was and is to protect the sensitive coastal zone environment and its resources, while accommodating the social and economic needs of the state. The Commission has the power to regulate development in the coastal zones by issuing permits on a case by case basis until local agencies can develop their own coastal plans, which must be certified by the Coastal Commission.

C. Hawaii's Program of State Zoning: In 1961, the Hawaii State Legislature established Act 187, the Land Use Law, to protect the farmland and the welfare of the local people of Hawaii by planning to avoid "unnecessary urbanization". The Law made all state lands into four districts: agricultural, conservation, rural and urban. The Governor appointed members to a State Land Use Commission, whose duties were to uphold the Law and form the boundaries of the four districts. In addition to state zoning, the Land Use Law introduced a program of Differential Assessment, wherein agricultural landowners paid taxes on their land for its agricultural use value, rather than its market value.

D. The Oregon Land Use Act of 1973: This act established the Land Conservation and Development Commission (LCDC) to provide statewide planning goals and guidelines. Under this Act, Oregon cities and counties are each required to draw up a comprehensive plan, consistent with statewide planning goals. Agricultural land preservation is high on the list of state goals to be followed locally.

If the proposed site is subject to or has used one or more of the above farmland protection programs or policies, score the site 20 points. If none of the above policies or programs apply to this site, score 0 points.

5. How close is the site to an urban built-up area?

The site is 2 miles or more from an urban built-up area	15 points
The site is more than 1 mile but less than 2 miles from an urban built-up area	10 points
The site is less than 1 mile from, but is not adjacent to an urban built-up area	5 points
The site is adjacent to an urban built-up area	0 points

This factor is designed to evaluate the extent to which the proposed site is located next to an existing urban area. The urban built-up area must be 2500 population. The measurement from the built-up area should be made from the point at which the density is 30 structures per 40 acres and with no open or non-urban land existing between the major built-up areas and this point. Suburbs adjacent to cities or urban built-up areas should be considered as part of that urban area.

For greater accuracy, use the following chart to determine how much protection the site should receive according to its distance from an urban area. See chart below:

Distance From Perimeter of Site to Urban Area	Points
More than 10,560 feet	15
9,860 to 10,559 feet	14
9,160 to 9,859 feet	13
8,460 to 9,159 feet	12
7,760 to 8,459 feet	11
7,060 to 7,759 feet	10
6,360 to 7,059 feet	9
5,660 to 6,359 feet	8
4,960 to 5,659 feet	7
4,260 to 4,959 feet	6
3,560 to 4,259 feet	5
2,860 to 3,559 feet	4
2,160 to 2,859 feet	3
1,460 to 2,159 feet	2
760 to 1,459 feet	1
Less than 760 feet (adjacent)	0

6. How close is the site to water lines, sewer lines and/or other local facilities and services whose capacities and design would promote nonagricultural use?

None of the services exist nearer than 3 miles from the site	15 points
Some of the services exist more than one but less than 3 miles from the site	10 points
All of the services exist within 1/2 mile of the site	0 points

This question determines how much infrastructure (water, sewer, etc.) is in place which could facilitate nonagricultural development. The fewer facilities in place, the more difficult it is to develop an area. Thus, if a proposed site is further away from these services (more than 3 miles distance away), the site should be awarded the highest number of points (15). As the distance of the parcel of land to services decreases, the number of points awarded declines as well. So, when the site is equal to or further than 1 mile but less than 3 miles away from services, it should be given 10 points. Accordingly, if this distance is 1/2 mile to less than 1 mile, award 5 points; and if the distance from land to services is less than 1/2 mile, award 0 points.

Distance to public facilities should be measured from the perimeter of the parcel in question to the nearest site(s) where necessary facilities are located. If there is more than one distance (i.e. from site to water and from site to sewer), use the average distance (add all distances and then divide by the number of different distances to get the average).

Facilities which could promote nonagricultural use include:

- Water lines
- Sewer lines
- Power lines
- Gas lines
- Circulation (roads)
- Fire and police protection
- Schools

7. Is the farm unit(s) containing the site (before the project) as large as the average-size farming unit in the county? (Average farm sizes in each county are available from the NRCS field offices in each state. Data are from the latest available Census of Agriculture, Acreage of Farm Units in Operation with $1,000 or more in sales.)

As large or larger:	10 points
Below average: Deduct 1 point for each 5 percent below the average, down to 0 points if 50 percent or more is below average	9 to 0 points

This factor is designed to determine how much protection the site should receive, according to its size in relation to the average size of farming units within the county. The larger the parcel of land, the more agricultural use value the land possesses, and vice versa. Thus, if the farm unit is as large or larger than the county average, it receives the maximum number of points (10). The smaller the parcel of land compared to the county average, the fewer number of points given. Please see below:

Parcel Size in Relation to Average County Size	Points
Same size or larger than average (100 percent)	10
95 percent of average	9
90 percent of average	8
85 percent of average	7
80 percent of average	6
75 percent of average	5
70 percent of average	4
65 percent of average	3
60 percent of average	2
55 percent of average	1
50 percent or below county average	0

State and local Natural Resources Conservation Service offices will have the average farm size information, provided by the latest available Census of Agriculture data

8. If this site is chosen for the project, how much of the remaining land on the farm will become non-farmable because of interference with land patterns?

Acreage equal to more than 25 percent of acres directly converted by the project	10 points
Acreage equal to between 25 and 5 percent of the acres directly converted by the project	9 to 1 point(s)
Acreage equal to less than 5 percent of the acres directly converted by the project	0 points

This factor tackles the question of how the proposed development will affect the rest of the land on the farm The site which deserves the most protection from conversion will receive the greatest number of points, and vice versa. For example, if the project is small, such as an extension on a house, the rest of the agricultural land would remain farmable, and thus a lower number of points is given to the site. Whereas if a large-scale highway is planned, a greater portion of the land (not including the site) will become non-farmable, since access to the farmland will be blocked; and thus, the site should receive the highest number of points (10) as protection from conversion

Conversion uses of the Site Which Would Make the Rest of the Land Non-Farmable by Interfering with Land Patterns

Conversions which make the rest of the property nonfarmable include any development which blocks accessibility to the rest of the site Examples are highways, railroads, dams or development along the front of a site restricting access to the rest of the property.

The point scoring is as follows:

Amount of Land Not Including the Site Which Will Become Non-Farmable	Points
25 percent or greater	10
23 - 24 percent	9
21 - 22 percent	8
19 - 20 percent	7
17 - 18 percent	6
15 - 16 percent	5
13 - 14 percent	4
11 - 12 percent	3
9 - 11 percent	2
6 - 8 percent	1
5 percent or less	0

9. Does the site have available adequate supply of farm support services and markets, i.e., farm suppliers, equipment dealers, processing and storage facilities and farmer's markets?

All required services are available	5 points
Some required services are available	4 to 1 point(s)
No required services are available	0 points

This factor is used to assess whether there are adequate support facilities, activities and industry to keep the farming business in business. The more support facilities available to the agricultural

landowner, the more feasible it is for him or her to stay in production. In addition, agricultural support facilities are compatible with farmland. This fact is important, because some land uses are not compatible; for example, development next to farmland cam be dangerous to the welfare of the agricultural land, as a result of pressure from the neighbors who often do not appreciate the noise, smells and dust intrinsic to farmland. Thus, when all required agricultural support services are available, the maximum number of points (5) are awarded. When some services are available, 4 to 1 point(s) are awarded; and consequently, when no services are available, no points are given. See below:

Percent of Services Available	Points
100 percent	5
75 to 99 percent	4
50 to 74 percent	3
25 to 49 percent	2
1 to 24 percent	1
No services	0

10. Does the site have substantial and well-maintained on farm investments such as barns, other storage buildings, fruit trees and vines, field terraces, drainage, irrigation, waterways, or other soil and water conservation measures?

High amount of on-farm investment	20 points
Moderate amount of non-farm investment	19 to 1 point(s)
No on-farm investments	0 points

This factor assesses the quantity of agricultural facilities in place on the proposed site. If a significant agricultural infrastructure exists, the site should continue to be used for farming, and thus the parcel will receive the highest amount of points towards protection from conversion or development. If there is little on farm investment, the site will receive comparatively less protection. See-below:

Amount of On-farm Investment	Points
As much or more than necessary to maintain production (100 percent)	20
95 to 99 percent	19
90 to 94 percent	18
85 to 89 percent	17
80 to 84 percent	16
75 to 79 percent	15
70 to 74 percent	14
65 to 69 percent	13
60 to 64 percent	12
55 to 59 percent	11
50 to 54 percent	10
45 to 49 percent	9
40 to 44 percent	8
35 to 39 percent	7
30 to 34 percent	6
25 to 29 percent	5
20 to 24 percent	4
15 to 19 percent	3
10 to 14 percent	2
5 to 9 percent	1
0 to 4 percent	0

11. Would the project at this site, by converting farmland to nonagricultural use, reduce the support for farm support services so as to jeopardize the continued existence of these support services and thus, the viability of the farms remaining in the area?

Substantial reduction in demand for support services if the site is converted	10 points
Some reduction in demand for support services if the site is converted	9 to 1 point(s)
No significant reduction in demand for support services if the site is converted	0 points

This factor determines whether there are other agriculturally related activities, businesses or jobs dependent upon the working of the pre-converted site in order for the others to remain in production. The more people and farming activities relying upon this land, the more protection it should receive from conversion. Thus, if a substantial reduction in demand for support services were to occur as a result of conversions, the proposed site would receive a high score of 10; some reduction in demand would receive 9 to 1 point(s), and no significant reduction in demand would receive no points.

Specific points are outlined as follows:

Amount of Reduction in Support Services if Site is Converted to Nonagricultural Use	Points
Substantial reduction (100 percent)	10
90 to 99 percent	9
80 to 89 percent	8
70 to 79 percent	7
60 to 69 percent	6
50 to 59 percent	5
40 to 49 percent	4
30 to 39 percent	3
20 to 29 percent	2
10 to 19 percent	1
No significant reduction (0 to 9 percent)	0

12. Is the kind and intensity of the proposed use of the site sufficiently incompatible with agriculture that it is likely to contribute to the eventual conversion of the surrounding farmland to nonagricultural use?

Proposed project is incompatible with existing agricultural use of surrounding farmland	10 points
Proposed project is tolerable of existing agricultural use of surrounding farmland	9 to 1 point(s)
Proposed project is fully compatible with existing agricultural use of surrounding farmland	0 points

Factor 12 determines whether conversion of the proposed agricultural site will eventually cause the conversion of neighboring farmland as a result of incompatibility of use of the first with the latter. The more incompatible the proposed conversion is with agriculture, the more protection this site receives from conversion. Therefor-, if the proposed conversion is incompatible with agriculture, the site receives 10 points. If the project is tolerable with agriculture, it receives 9 to 1 points; and if the proposed conversion is compatible with agriculture, it receives 0 points.

CORRIDOR - TYPE SITE ASSESSMENT CRITERIA

The following criteria are to be used for projects that have a linear or corridor - type site configuration connecting two distant points, and crossing several different tracts of land. These include utility lines, highways, railroads, stream improvements, and flood control systems. Federal agencies are to assess the suitability of each corridor-type site or design alternative for protection as farmland along with the land evaluation information.

For Water and Waste Programs, corridor analyses are not applicable for distribution or collection networks. Analyses are applicable for transmission or trunk lines where placement of the lines are flexible.

(1) How much land is in nonurban use within a radius of 1.0 mile form where the project is intended?

(2) More than 90 percent	(3) 15 points
(4) 90 to 20 percent	(5) 14 to 1 point(s).
(6) Less than 20 percent	(7) 0 points

(2) How much of the perimeter of the site borders on land in nonurban use?

(3) More than 90 percent	(4) 10 point(s)
(5) 90 to 20 percent	(6) 9 to 1 points
(7) less than 20 percent	(8) 0 points

(3) How much of the site has been farmed (managed for a scheduled harvest or timber activity) more than five of the last 10 years?

(4) More than 90 percent	(5) 20 points
(6) 90 to 20 percent	(7) 19 to 1 point(s)
(8) Less than 20 percent	(9) 0 points

(4) Is the site subject to state or unit of local government policies or programs to protect farmland or covered by private programs to protect farmland?

Site is protected	20 points
Site is not protected	0 points

(5) Is the farm unit(s) containing the site (before the project) as large as the average - size farming unit in the County? (Average farm sizes in each county are available from the NRCS field offices in each state. Data are from the latest available Census of Agriculture, Acreage of Farm Units in Operation with $1,000 or more in sales.)

As large or larger	10 points
Below average deduct 1 point for each 5 percent below the average, down to 0 points if 50 percent or more below average	9 to 0 points

(6) If the site is chosen for the project, how much of the remaining land on the farm will become non-farmable because of interference with land patterns?

Acreage equal to more than 25 percent of acres directly converted by the project	25 points
Acreage equal to between 25 and 5 percent of the acres directly convened by the project	1 to 24 point(s)
Acreage equal to less than 5 percent of the acres directly converted by the project	0 points

(7) Does the site have available adequate supply of farm support services and markets, i.e., farm suppliers, equipment dealers, processing and storage facilities and farmer's markets?

All required services are available	5 points
Some required services are available	4 to 1 point(s)
No required services are available	0 points

(8) Does the site have substantial and well-maintained on-farm investments such as barns, other storage building, fruit trees and vines, field terraces, drainage, irrigation, waterways, or other soil and water conservation measures?

High amount of on-farm investment	20 points
Moderate amount of on-farm investment	19 to 1 point(s)
No on-farm investment	0 points

(9) Would the project at this site, by converting farmland to nonagricultural use, reduce the demand for farm support services so as to jeopardize the continued existence of these support services and thus, the viability of the farms remaining in the area?

Substantial reduction in demand for support services if the site is convened	25 points
Some reduction in demand for support services if the site is convened	1 to 24 point(s)
No significant reduction in demand for support services if the site is converted	0 points

(10) Is the kind and intensity of the proposed use of the site sufficiently incompatible with agriculture that it is likely to contribute to the eventual conversion of surrounding farmland to nonagricultural use?

Proposed project is incompatible to existing agricultural use of surrounding farmland	10 points
Proposed project is tolerable to existing agricultural use of surrounding farmland	9 to 1 point(s)
Proposed project is fully compatible with existing agricultural use of surrounding farmland	0 points

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7469-01
July 25, 2013

Ms. Angel Figueroa, Director
Pacific Islands Area
Natural Resources Conservation Service
U.S. Department of Agriculture
P.O. Box 50004, Room 4-118
Honolulu, HI 96850

Subject: Draft Environmental Impact Statement (DEIS)
Kaloko Makai
Kaloko and Kohanaiki, North Kona, Hawaii
Tax Map Key: (3) 7-3-09: 017, 025, 026, and 028

Dear Ms. Figueroa:

Thank you for your letter dated August 9, 2011. The Petitioner is preparing a Second DEIS to address changes in the proposed project that will be reassessed, as needed, in the forthcoming document. You will be notified of its availability for review and comment pursuant to Chapter 343, Hawaii Revised Statutes (HRS) and Title 11, Chapter 200 Hawaii Administrative Rules (Department of Health).

With regard to your comments on the subject DEIS, the proposed project is not receiving federal funds. Therefore the USDA Form AD-1006 Farmland Conversion Impact Rating is not required.

Your letter, along with this response, will be reproduced and included in the forthcoming Second DEIS. We appreciate your participation in the EIS review process.

Sincerely,

Earl Matsukawa, AICP
Project Manager

cc: Mr. Jay Nakamura, Stanford Carr Development
Mr. Daniel Orodenker, State Land Use Commission

United States Department of the Interior
NATIONAL PARK SERVICE
Kaloko Honokōhau National Historical Park
73-1486 Kanalani Street, #14
Kailua Kona, Hawaii 96740

IN REPLY REFER TO:
L7621

October 5, 2011

Mr. Earl Matsukawa, AICP
Wilson Okamoto Corporation
1907 South Beretania Street, Suite 400
Honolulu, Hawaii 96826

RE: National Park Service Review of the Draft Environmental Impact Statement for the Kaloko Makai Project, North Kona, Island of Hawai'i

Dear Mr. Matsukawa:

Thank you for providing the National Park Service (NPS) with the opportunity to review and comment on the Draft Environmental Impact Statement (DEIS) for the Kaloko Makai Project, North Kona, Hawaii. The applicant (SCD-TSA Kaloko Makai, LLC) plans to petition the Land Use Commission for a Land Use District Boundary Amendment to reclassify land in Conservation and Agricultural Districts to Urban Districts, and to develop this land into a mixed-use community. As described in the DEIS, the proposed development will be a 1,142-acre, master-planned, mixed-use residential community with up to 5,000 new single- and multi-family residential units, approximately 153 acres of light-industrial/commercial/retail, an urgent care medical facility with potential for a regional hospital, two elementary schools, a middle school, a wastewater treatment plant, associated roadways, utilities, drainage, and water source and distribution system.

NPS submits these comments in furtherance of its Congressionally mandated mission to protect the natural and cultural resources within Kaloko Honokōhau National Historical Park (National Park) and the Honokōhau Settlement National Historic Landmark (NHL), and Ala Kahakai National Historic Trail (Historic Trail). Specific comments are attached to this letter. The project is located upslope and adjacent to the National Park and the NHL and the Historic Trail, and is approximately 1 mile from the coast. The project will have significant, irreversible adverse impacts to the cultural and natural resources that make these NPS lands and resources nationally significant.

Congress established the National Park in 1978 "to provide a center for the preservation, interpretation, and perpetuation of traditional native Hawaiian activities and culture, and to demonstrate historic land use patterns as well as to provide a needed resource for the education, enjoyment, appreciation of such traditional native Hawaiian activities and culture by local residents and visitors" (Public Law 95-625). Water quality and quantity are critical to this mission and to the integrity of the Park. National Park lands and waters are also significant

cultural resources, and provide habitat for 16 threatened, endangered, and candidate species. Additionally, visual and auditory resources, and air quality are of critical importance within the National Park. Light and soundscapes, viewsheds, and cultural landscapes are preserved to protect flora, fauna, cultural integrity and visitor enjoyment. Traffic congestion and noise, airborne particulates from exhaust of potentially 10,000 additional cars in the area, combined with existing sources of particulates, may affect human health as well as natural and cultural resources. Impacts resulting from changes in volume of visitor use and impacts to visitor protection services within the National Park are all of concern to the NPS and have not been addressed, or adequately addressed by the DEIS.

A fundamental purpose of an environmental impact statement as required by HRS 343 is to provide decision makers and the public with information and analysis of the nature and scope of the proposed project, the known and potential impacts that the projects presents, measures that can avoid or mitigate those impacts, and the impacts that cannot be mitigated if the project goes forward as planned. Unfortunately, the DEIS for the proposed Kaloko Makai project fails to accomplish any of these requirements.

The DEIS does not satisfy the requirements of HRS 343 because the information about the proposed project is presented at a conceptual level that lacks detail, makes speculative analyses and unsupportable conclusions using partial or no analysis of existing data or scientific literature. This has resulted in misleading discussions, inadequate response to comments submitted during the review process, a lack of substantive analyses of the cumulative impacts from other existing and planned developments, and an inadequate exploration of mitigation measures. Because completion of the project is planned to take 30 years, many of the stated purposes and assumptions of the project will change—what may actually be built can be fundamentally and radically different from what is presented in the DEIS. The document appears to merely be "a self-serving recitation of benefits and rationalization of the proposed action" (HAR §11-200-14) in which impacts are downplayed throughout.

Measures to mitigate known or potential impacts are vague and not directly connected to the impacts from the proposed project (whether actually identified or not). The DEIS lacks analysis of the effectiveness of the measures described and fails to provide sufficient detail on those measures that are listed in the DEIS. In places, no mitigation measures are even identified. The NPS does note that the DEIS calls out several items to allegedly address impacts from the proposed project on groundwater resources. It appears that the project proponent and its consultants simply pulled measures imposed on or adopted by developments which are adjacent to or near the project site. Although it is somewhat encouraging that the DEIS lists these, it appears that their inclusion is to placate anticipated concerns of the NPS and others without any thought (or analysis) of their appropriateness, effectiveness, ability to be implemented, or enforceability, as they relate to the Kaloko Makai proposed project.

The fundamental problems with the DEIS are also of concern because the same developer (TSA), in the same general location, submitted a similar inadequate analysis of impacts from a development adjacent to the Kaloko Makai project site, Kaloko Light Industrial Park-Phases III and IV, over 10 years ago. In that Docket (A00-732), the Land Use Commission (LUC) found that the conclusions and analysis were inadequate or unsupported (A00-732 FFCLDO 2002). A

similar lack of analysis and unsupported conclusions from the Kaloko Industrial Park-Phases III and IV EIS and LUC proceeding are presented in the Kaloko Makai DEIS.

In the TSA matter, the LUC stated it was ". . . is acutely aware that continuous development is planned for this coastline. Although each developer might claim that only a "small amount" of pollution will result from their development and that the area's ecosystem will show "little" effects, these developments and their impacts are cumulative and, absent strong mitigation measures, have the potential to devastate the fragile resources of the coastal and marine aquatic environments of the entire Kona coastal region." (LUC Docket A00-732, FFCLDO, p. 103). The LUC recognized the extent and significance of the resources within the National Park and the NHL as well as the threat to those resources. In particular, the LUC, based on the "Precautionary Pricinple" in Hawai'i law, determined that "for all proposed development adjacent to or near a National Park that raises threats of harm to the environment, cultural resources, or human health, precautionary measures should be taken to protect the National Park cultural and natural resources, even if some cause and effect relationships are not fully established scientifically." (Ibid, FF number 165). The LUC also acknowledged its obligations to protect the trust resources of the state, including the customary and traditional practices of Native Hawaiians, finding that ". . . native Hawaiian rights and natural and cultural resources would be damaged or destroyed by the pollution of groundwater that reaches the National Park from surrounding areas, including Petitioner's proposed development at the Kaloko Industrial Park. Appropriate mitigation measures are, therefore, required under the Hawai'i Constitution and the Commission's decision-making criteria in order to approve reclassification of the project area." (Ibid, CL number 7).

The DEIS should be re-drafted to describe a phased project with appropriate detail and rigorous analyses, and supported by adequate scientific studies to enable the required public review and comment. The DEIS should be revised to incorporate relevant, well described protective mitigation measures with effective, realistic mechanisms for enforcement. The NPS is opposed to the notion of this proposed 30-year project receiving boundary amendment approval all at once. If approved, it should be only on a phased-basis, with an additional EIS and public review as required by HRS 343 at each stage. Furthermore, the LUC should not base their decision on the final EIS for this project, unless the final EIS provides sufficient detail and analysis on what will be built. Therefore another draft of this EIS should be released for public review and comment. To release a final based on this DEIS would demonstrate recklessness with county, state, and national resources on the part of the project proponent. The Land Use Commission should require this project (including environmental impact analyses) to be phased in its boundary amendment changes and should not grant the boundary amendment for the entire project all at once. Particular attention should be paid to the proposed hospital. Because the potential environmental impacts from a hospital are many, the LUC should require full analysis of the potential environmental impacts of a hospital in a hospital-specific EIS.

Our specific comments and concerns regarding the DEIS are attached. Thank you for the opportunity to provide comments on this DEIS. If you have questions regarding these comments,

please contact me at 800-329-6881 x1201, Kathy_Billings@nps.gov, or Dr. Jeff Zimpfer of my staff, at x1500, Jeff_Zimpfer@nps.gov.

Sincerely,

Kathy Billings

Kathy Billings
Superintendent

cc: Hawaii Office of Environmental Quality Control
State of Hawaii Land Use Commission
State Office of Planning
County of Hawaii Planning Department
County of Hawaii Department of Water Supply
County of Hawaii Department of Public Works
Department of Hawaiian Home Lands
Department of Land and Natural Resources
Commission on Water Resources Management
Office of Hawaiian Affairs
DLNR, State Historic Preservation Division
Advisory Council for Historic Preservation
U.S. Fish and Wildlife Service
NOAA Fisheries Protected Resources Division
State of Hawaii Coastal Zone Management Program
Department of Health Clean Water Branch
Department of Health Safe Drinking Water Branch, UIC Program
National Parks Conservation Association
NPS Pacific West Regional Office
NPS Water Rights Branch
DOI Solicitor's Office
U.S. EPA Pacific Islands Contact Office

October 6, 2001 Comments by National Park Service Comments on the Kaloko Makai Draft EIS (date July 2011)

The National Park Service only had 60 days to review and evaluate this Draft Environmental Impact Statement. Sixty days is inadequate to review a project of this magnitude and complexity. Therefore, these comments may not represent all of the National Park Service's concerns.

1. Page 1-1. The size of the off-site potable wellfield is stated as 3.5 acres. This is inconsistent with other statements on this page, and elsewhere in the document, which refer to the size of the off-site well field as 18 acres.

2. Pages 1-12 and 4-8. The DEIS does not state how many 1, 2, 3 etc. story buildings will be constructed and where will they be located. Page 1-12 and 4-81 mention "*single story structures*" and "*multistory structures*" but not how many or where they will be located. There is no clear way to evaluate the environmental impact (e.g., aesthetics) without knowing the basic size and shape of the buildings and where they will be located relative to existing features in the area.

3. Page 1-17. Section 1.7.8, lists unresolved issues related to the DEIS but does not list the uncertainty related to the hydrologic connection between the high-level and coastal groundwater systems. The hydrologic connection between the high-level and coastal groundwater systems is one of the main factors that will control how the withdrawal of fresh groundwater for the proposed development will affect the quantity and quality of groundwater resources in downgradient areas. The DEIS (p. 3-15) states the following, which highlights the uncertainty related to the connection between the high-level and coastal groundwater systems "*In addition to it creating a substantial reservoir of potable quality water, this subsurface feature also controls the location and manner of groundwater movement into the downgradient basal lens. While the hydraulic relationship between the two groundwater bodies is not yet understood, it is undoubtedly the reason for the anomalous characteristics of basal groundwater in the Keahole to Kailua area (Nance 2008).*" Also on p. 3-15, the DEIS states "*Groundwater responses when these wells are ultimately used to their full capacity may shed light on the unknown aspects of this groundwater occurrence, including the geologic feature which creates the high-level water, the hydraulic relationships among the differing high-level groundwater compartments, and where, how and if the high-level groundwater drains into the basal lens (Nance 2008).*" Both of these statements indicate that it would be appropriate to list the uncertain hydrologic connection between the high-level and coastal groundwater systems as one of the important unresolved issues in Section 1.7.8.

4. Page 2-10. "*Kaloko Makai would consist of homes, ranging from traditional single-family homes to mixed-use, mid- and higher-density multifamily units.*" Figure 2-7, County General Plan Land Use Pattern Allocation Guide, does not indicate any medium or high-density zones at or near the proposed project.

5. Page 2-16. Section 2.1.5, ¶2 The references for the radiocarbon dates are not given.

6. Page 2-31 to 2-38 (Figures 2-11 to 2-14). The use of the term "natural zone" is unclear.

October 6, 2001 Comments by National Park Service Comments on the Kaloko Makai Draft EIS (date July 2011)

7. Page 2-14. No explanation is provided for the proposed change in land use designation from agriculture land to urban for the dryland forest preserve. If a land use designation change is necessary, conservation would be more appropriate for a forest preserve.

8. Page 2-44. "*Archaeological data created by others makai of the Queen Kaahumanu Highway*" should be clarified and the references listed.

9. Page 2-44. The discussion of where and how the trail will be realigned is unclear.

10. Page 2-45. "*Kaloko Makai will also incorporate two trails that run through the dryland forest*" is unclear. The reader cannot tell if the trails will be protected. These also should incorporate a preservation corridor to protect the integrity of the trails as historic properties under Section 6E.

11. Page 2-48; Page 4-106; Page 5-40. The DEIS states that average potable water demand will be approximately 3.2 Mgd and maximum water demand will be 4.8 Mgd. These values are incorrect and underestimate water demand due to several miscalculations in Table 4-24. Pages 2-48, 4-106 and 5-40 should be revised to accurately reflect the estimated water demand for the project.

12. Page 2-48. The preferred alternative to supply potable water for the project involves drilling up to four mid-level wells to tap a fresh water layer underlying the basal aquifer, about 2.5 miles upgradient of the National Park. No reference to credible scientific information is provided to support the sustainability of this new source of potable water. The DEIS acknowledges on p. 3-16 that the depth, inclination and geologic nature of the formation confining this layer of fresh water in this area are not known. The possibility that all, or even some, of the potable water needs of the project can be supplied by an "*underlying fresh water layer*" at the project site is therefore speculative as this resource has never been developed for potable or irrigation water on the Kona Coast. The DEIS should have included information demonstrating that this resource can be developed and used in a manner that can be continued indefinitely, without causing unacceptable environmental, economic, or social consequences.

13. Page 2-48. Several alternatives being investigated to supply potable water for the proposed project, including the preferred alternative, may require an on-site desalination facility, about one mile from the National Park. However, no information is presented on the proposed quantity of brackish water needed to produce potable water, nor is any information presented on the quantity or quality of effluent that will be generated as part of the desalination process. Statements indicating that the desalination water system will have "no impact" are unsubstantiated. More specifically:
    a. Page 2-49; Page 4-114. The statement "*The desalination water system will have no impact on potable or brackish groundwater. Likewise, it will not affect nearshore waters and will not affect groundwater used by neighboring projects or anchialine pools and fishponds in the area, including nearby Kaloko-Honokōhau National Park*"

is unsupported by a quantitative analysis and no desalination plants have been used to supply potable water on a large-scale on the Kona Coast. The DEIS should have included credible scientific information to support this conclusion.

b. The DEIS does not state the anticipated number of injection wells, their injection rate, or quality of the injected fluids that will be needed to desalinate brackish groundwater, yet finds there will be no impact on basal groundwater. The DEIS should have included this information to support the conclusion of no significant impact.

c. The DEIS does not evaluate the cumulative impact of the proposed desalination plant in addition to The Shores at Kohanaiki desalination plant which began operating in November 2008 immediately downgradient of the proposed project site and adjacent to the National Park. This desalination plant includes eight pumping wells and one injection well and will further complicate the response of the basal aquifer to pumping and injection. The Shores at Kohanaiki are required to report chloride concentrations at all pumping wells and eight monitoring wells on a monthly basis, to monitor water quality at the injection well on a quarterly basis, and to collect a conductivity-temperature-depth profile at the deepest monitor well on a quarterly basis. The DEIS should have included a quantitative analysis of the cumulative effects of the proposed and existing desalination facility. This analysis should include a review of the monitoring data collected at the Kohanaiki desalination plant since it began operating in 2008.

d. If desalination is required to produce potable water from on- or off-site wells, then the volume of brackish groundwater that must be pumped to produce potable water will be much greater than the water demand estimated in the DEIS. For example, The Shores at Kohanaiki estimated that the ratio of brackish (46% seawater) groundwater pumped to potable product water was about 1.5 (Kohanaiki Non-potable Water Plan). Ooma Beachside Village estimated that the ratio of brackish (78% seawater) groundwater pumped to potable product water would be about 2.25 (Exhibit 42, LUC Docket A07-774). The DEIS should have quantified the pumping rate of the on- or off-site brackish wells and evaluate the effect of pumping up to 2.25 times the estimated water demand to provide potable water for the project.

e. The DEIS does not estimate or consider the additional source of nitrate-nitrogen to groundwater from RO injection. The actual nitrate-nitrogen added to groundwater from the Kohanaiki injection well is greater than estimated for that project by nearly a factor of three (source: Kohanaiki injection well water quality reports and 2007 Kohanaiki Non-Potable Water Plan).

14. Page 2-48. "*Kaloko Makai is committed to water conservation strategies... the goal is to reduce the total water use through a combination of water saving equipment and strategies*" The "*equipment and strategies*" are not discussed or described in any detail, and, therefore, there is now way to tell if this "commitment" is appropriate, effective, or implementable.

15. Page 2-48. The DEIS does not identify how sustainable building design and LEED concepts and certifications will be implemented. There are no specific commitments from the project

proponent to actually follow through with implementing sustainable building design and LEED concepts.

16. Page 2-50. "*The projected wastewater generation demand for Kaloko Makai is 2.37 million gallons per day (mgd) average dry weather flow. The WWTP will be designed to reduce the concentrations of Total Nitrogen (TN) to <5 mg/l, and Total Phosphorous (TP) to <2 mg/. Installation of the Private WWTP shall be subject to conditions of approval by the DOH, including any lower concentrations of TN and/or TP in the effluent, and HAR Chapter 11-62. The amount of recycled water produced will be essentially the same as the amount received for processing, or 2.37 mgd.*" A general rule of thumb for projecting wastewater generation (refer to Wastewater Engineering Treatment, Disposal, and Reuse by Metcalf and Eddy, EPA website, and other sources) is that it will equal the projected water use at full build-out, minus outdoor use (such as car washing and irrigation), minus loss and leakage (should be minimal). Since most of the proposed project's irrigation water is coming from R1 treated water, the projected wastewater generation demand should be approximately equal to projected water use at full build-out (3.0-3.2 mgd (average) and 4.7-4.8 mgd (max)). Therefore, the DEIS has underestimated wastewater generation by as much as half of what can be expected based on the estimated water use in the DIES – which is itself substantially underestimated. The amount of wastewater, therefore, will be significantly larger than stated in the DEIS.

    The DEIS does not provide any scientific justification for why these concentrations of TN and TP are protective and appropriate, or why lower concentrations would not be more appropriate and protective. The DEIS should provide scientific studies, not solely citations from engineering wastewater manuals, that support the selection of these concentrations. Before an appropriate analysis of the impacts from the disposal of wastewater (whether through irrigation, infiltration basins, or injection wells) on coastal and marine resources, including the resources within the National Park, can be completed, the DEIS must provide a more detailed description of the quality of the water to be discharged including what methods will be used to reduce nutrients and what methods will be used to prevent pharmaceuticals and other contaminants from reaching the National Park. If a hospital is built as part of the project as described, it is especially important to analyze the full range of potential impacts from a hospital including the fate of pharmaceuticals in treated wastewater from the facility. For a wastewater facility this close to a national park, which will include injection wells as part of waste management, wastewater treatment should include maximum nutrient removal, be treated to tertiary standards including removal of pathogens, and de-chlorination should follow chlorination steps. The DEIS should describe why dry-lining for potential hookup to the Kealakehe WWTP is not an option as was required for Lanihau and TSA developments adjacent or near the project site.

17. Page 2-59. Adequate justification is not made in the DEIS to support the density and number of housing units proposed. The NPS questions the need for an additional 4,180 multi-family units in North Kona. Especially since many thousand more single- and multi-family units are planned for construction in the immediate area. Given the impact to the community and the

environment, the project proponents have not justified the need for the number and density of housing units in their preferred alternative.

18. Page 3-4. The statements that the soils within Kaloko Makai are not suitable for cultivation are not accurate. The project location is known for high productivity of food crops, as evidenced by the numerous examples given within this document. This DEIS notes on page 4-10 that agriculture (including farming, horticulture and subsistence planting) and animal husbandry are "*function types commonly encountered in this general area*" and that there are "*several pervasive agricultural sites in the project area with widespread clearing and planting mounds*" (Table 4-2). On page 4-43 of the DEIS, "*During the mid 1800s, Captain Charles Wilkes of the American Exploring Team comments on the agricultural use of pāhoehoe excavations (similar to the modification of pāhoehoe outcrop in the project) which he observed specifically in the Kona region.*" Page 4-50 of this document notes "*During the 1930s to 1940s, the alahe'e along with mango, banana, uhi or yam (Dioscorea alat), and pia, a Polynesian arrowroot (Tacca leontopetaloides) used as medicine and food by Hawaiians, were also widely distributed in the project area.*"

    Oral histories of the area, ethnographic evidence and archeological evidence document that the upland Kaloko and neighboring areas are prime for agricultural purposes. Ethnographic and archeological evidence for the Kaloko ahupua'a is a well developed part of the Kona Field System (Tuggle and Tuggle 2006, Cordy 2000, Newman 1970, Schilt 1984). Crops from this area included sweet potato, taro, banana, mountain apple, wauke and breadfruit historically (Tuggle and Tuggle 2006, Land Commission and Boundary Commission documents) and more recently was known to be plentiful in mango, pineapple and sweet potato. Areas slightly further south at the same elevation as the project area within the Kona field system are known to be fertile for production of sweet potato, wauke, and breadfruit (Kelly 1983).

19. Page 3-14. The DEIS states that "*The groundwater lens in the Keahole vicinity is brackish and discharges freely along the coast in a narrow band of a few feet wide in the intertidal zone.*" However, later the DEIS states on Page 3-35 that "*A somewhat unusual finding is that the lowest salinities in the ocean samples were not found nearest to the shoreline off of either fishpond. Rather, the lowest salinities were measured in surface ocean samples approximately 25-50-m offshore.*" These statements appear to contradict each other. The DEIS should have clarified the area where groundwater discharges to the ocean.

20. Page 3-14. The DEIS states that "*Salinity, lens thickness and the diffuse transition zone are all indicative of a modest groundwater flow.*" The DEIS should define "modest" quantitatively. Also, the listed factors do not preclude the possibility of high groundwater flow (say greater than 5 Mgd per mile of width) with a large amount of mixing caused by hydrodynamic dispersion.

21. Page 3-15. The DEIS states that "*While the hydraulic relationship between the two groundwater bodies is not yet understood, it is undoubtedly the reason for the anomalous characteristics of basal groundwater in the Keahole to Kailua area. (Nance 2008).*" The

DEIS should explain what is meant by "*anomalous characteristics.*"

22. Page 3-15. The DEIS states that "*Use of Well 3857-01 at Wai'aha started in 2005.*" The State Commission on Water Resource Management lists this well as abandoned and sealed. Perhaps the correct well number should be 3857-04.

23. Page 3-15. The DEIS states that fresh water was encountered at 1,060 ft below sea level at the Kamakana Villages Well (3959-01), but no information is provided to support this statement. Documenting the source of this information is important because this resource has never been developed for municipal use, yet it is the preferred alternative to supply over 3 Mgd of potable water for the project. The DEIS should have included credible scientific documentation of the circumstances under which fresh water was encountered at the Kamakana Well.

24. Page 3-25. Section 3.5.1 "*Due to high permeability of the natural ground surface across the project site, ...surface runoff does not occur on the project site even during the most intense rainfalls. Natural drainage of the project site consists of rainfall percolation through the layers of very porous lava to the ground water table.*" The more development at the project site (and on the upslope lands), the more difficult it will be for "green space" to take-in or absorb the surface water runoff water, as the "green space" will not have the same surface area it once did to percolate. Furthermore, the claim that rainfall percolates through the layers of very porous lava to the ground water table (with respect to surface water), is contradictory to the claim that wastewater effluent disposed onsite percolating through the same layers of very porous lava to the ground water table will not have significant impact.

25. Page 3-26. The DEIS states that reverse osmosis concentrate will be injected into the basal aquifer in strata where groundwater salinity is 30 ppt or greater, and asserts on p. 4-110 that "*Since the concentrate has a greater density than the surrounding saline groundwater, it will flow seaward without rising above the surrounding saline groundwater and will not rise to the basal freshwater layer. It is then discharged into the ocean offshore at a substantial depth and distance from the shoreline.*" At the same time, the DEIS also notes on p. 3-16 the presence of a saltwater circulation system where "*Saltwater flows landward in the deeper parts of the aquifer, rises and then mixes with seaward-flowing groundwater.*" The predicted fate and transport of the injected reverse osmosis concentrate is speculative and unsubstantiated by references to any credible scientific evidence. The DEIS should have included (1) the estimated salinity of the reverse osmosis concentrate from the proposed project, and (2) a quantitative analysis of the potential for the injected reverse osmosis concentrate to enter the saltwater circulation system and increase the salinity of inland and nearshore marine waters downgradient of the project site.

26. Page 3-26 The DEIS should have discussed in detail how it will protect NPS resources downslope from the proposed project. The DEIS should have included a thorough and rigorous analysis of potential impacts, direct and cumulative, to groundwater and groundwater-fed ecosystems from termiticides and pesticides used on houses, buildings, grounds, and common areas; added nutrients from irrigation and fertilized green spaces;

potential releases of contaminants from commercial businesses in the light-industrial/commercial parks who generate hazardous wastes (e.g., metal finishing, photoprocessing, automotive maintenance, dentistry, pesticide companies, printing, etc); potential releases of medical wastes, pathogens, and pharmaceuticals from the medical facilities; nutrients, pathogens, and pharmaceuticals carried in wastewater; contaminants associated with roadways and other impermeable surfaces including petroleum products, metals, pesticides, nutrients, and other pollutants.

27. Page 3-26. "*As the excess irrigation water percolates downward through the unsaturated zone to the groundwater, natural removal of nitrogen and phosphorus from the water will be significant.*" The DEIS should have quantified "*significant.*" It is not possible to analyze impacts to NPS resources without an accurate understanding of the increased flow of nitrogen and phosphorous into NPS waters.

28. Pages 3-26 and 3-74. Details regarding stormwater management and impacts to NPS aquatic resources are not provided in the DEIS. Surface runoff from impermeable surfaces associated with this development will occur. DOH and County drainage regulations do not address polluted runoff, only volume of runoff. Drywells are nothing more than holes in the ground; conduits for polluted runoff to groundwater. No specific pollution reduction devices or methods with numerical removal efficiencies are proposed beyond stating BMPs will be used. Moreover, there is no discussion of how the BMPs will implemented, who will monitor the BMPs, or how they will be enforced. It is not adequate for purposes of an EIS to merely state "*Innovative and more natural ways to handle drainage improvements will be sought to comply with the County drainage standards.*" The details of these "innovative" means should be explained. Potential environmental impacts to coastal and marine resources, including the resources in the National Park, have not been evaluated and the statement that "*Kaloko Makai is not expected to have an adverse effect on groundwater or coastal marine waters*" is completely unsupported. No data have been presented to support this conclusion.

29. Page 3-27. "*Control of contaminated surface water can be achieved through the development of a PPP designed to address all pollutants associated with the development and to identify measures that will contain and treat such pollutants in order to prevent any release into the environment, including the groundwater. There will be no anticipated adverse impact on groundwater quality from the development of this project.*" These statements are highly speculative with no analysis to support the conclusion that there will be no adverse impacts to groundwater quality, and are not substantiated by any data presented. PPPs, although a statement of good intentions, are difficult to implement, monitor, or enforce. PPPs, even good ones, cannot guarantee that no contaminated surface water will reach the groundwater. There is no discussion of how the project proponent will implement the PPP, which is especially problematic given the multitude of land uses (industrial, recreational, and single and multi- family housing units) and length of time to complete this development. CCRs are an inadequate mechanism to prevent pollution offsite of the development as there is no reason for landowners to self-police for offsite damages and no governmental agency – local, state or federal – can enforce them.

30. Page 3-28. The DEIS states: "*Nutrient loading and its subsequent impact is one of the more important issues concerning conservation and protection of coral reefs*" and then goes on to say "*However, according to Atkinson (2003)[sic], the conclusion that nutrients are deleterious to a reef ecosystem is incorrect.*" Although some of the statements made in this section of the DEIS are indeed in Atkinson and Falter (2003) book chapter (cited in the DEIS as Atkinson 2003), this statement must be taken in context with other statements in Atkinson and Falter that are not mentioned in the DEIS. Overall the comments in the DEIS that were derived from Atkinson and Falter (2003) are one sided, incomplete, and are not fully supported for Kaloko-Honokohau marine waters. Atkinson and Falter (2003) focuses on the flux of nutrients in and out of coral systems, not on indirect effects of nutrients on the coral. In fact, the Atkinson and Falter (2003) states that significant anthropogenic impacts of nutrients on coral tend to occur "*in areas of groundwater or surface water where relatively large areas are discharge into shallow reef flats.*" This is the situation at the National Park, where approximately three million gallons per day of groundwater discharge to marine waters in Honokohau and Kaloko Bays. Atkinson and Falter also state there is a need for more studies in which the organism or community responses are a function of actual nutrient loading, per area of benthos, not a function of concentration. The DEIS should have stated that nutrient impacts to coral reefs are probably indirect and long term and that it is possible that nutrients can stimulate bacteria and other disease vectors that might harm coral. Overall, the statements that are quoted from Atkinson and Falter in the DEIS seem to have been selectively picked to include only the ones that support the hypothesis that excess nutrients have little or no impacts on coral health in order to mislead the reader. The statements that tell the other side of the story, such as those quoted just above, are not included in the DEIS. There are many cases in the published scientific literature where excess nutrients, as well as the pathogens that will be associated with this development, can result in coral reef degradation due to various indirect processes. There is no conclusive evidence presented in the DEIS that corals cannot be harmed by excess nutrients and/or an unnatural ratio of organic to inorganic nutrients or human pathogens. Excessive nutrients cause excess algae growth that can lead to depletion in oxygen available for other organisms associated with a coral reef and can lead to algae blooms that take over sections of coral, blocking the sunlight and hurting its ability to thrive. The state of Hawaii is experiencing a significant decline in some of Maui's coral reefs experiencing a significant decline where excess nutrients are implicated in invasive algae blooms. Although the factors influencing Maui's reef decline are complex, the DAR reported (Williams et al 2007) "*strong indications that human impacts have been very important.*" Supporting data include proximity of private and county sewage injection wells, which place nutrient loads close to the coral substrate, high levels of nitrogen and phosphorus, and stable isotope ratios indicative of animal waste (presumably sewage) in algae. The potential for a hospital associated with this development is another concern. Pathogens, pharmaceuticals, and endocrine disrupting compounds are associated with hospital waste, many of these are unlikely to be fully eliminated by the proposed sewage treatment plan. The effects of these pathogens and compounds on coral reefs were not mentioned or analyzed in the DEIS, therefore the DEIS is seriously inadequate to evaluate impacts to coral reefs.

31. Page 3-29 to 3-34. "*3.5.2.1.1. Assessment of Coral Ecosystem Health of Kealakekua Bay and Honokōhau Bay.*" The discussion in this section supports the conclusion that inputs of nutrients from the Kaloko Makai development will likely result in adverse impacts to the natural and cultural resources within the National Park. None of the arguments or information presented supports the assertion that more nutrients and other pollutants will not result in impacts to the NPS natural and cultural resources. Furthermore, none of the other sites discussed in the DEIS for comparison are in pristine conditions. The NPS mission is to maintain its marine waters in as pristine conditions as possible.

32. Pages 3-33 and 3-34. "*Coral ecosystems will not normally recover from chronic stresses until the stressors are removed (Grigg, 1995; Edinger et al., 1998). If elevated nutrients and/or algal cover are chronic stressors to the coral ecosystems of this study as the results indicate, and future human population growth and development continue to increase nutrient inputs to these bays, then it is likely that future degradation is imminent ...*" The DIES did not discuss how the coral reef ecosystems within NPS boundaries, or North Kona, will be affected by cumulative nutrient stresses associated with the proposed development and other nearby developments. Compare these pages with lack of any discussion on pages 8-2 to 8-4.

33. Page 3-34. "*3.5.2.2. Endangered Marine Species*" The presence of endangered species, and the difficulty of assigning specific impacts to specific causes in these complex environments, argues for using the precautionary principle to significantly limit additional inputs of human sewage including organic nutrients, pharmaceuticals, and other contaminants into the groundwater that flows through, under, and in the National Park.

34. Section 3.5.2.3. This section of the DEIS is a long review of very old, non-peer reviewed reports, containing in large part data collected nearly a decade or more ago. These reports and the data therein were presented in the TSA and Lanihau Dockets and were refuted by the LUC at those hearings. (TSA FFCLDO 2002, Lanihau FFCLDO 2002). The discussion and conclusions regarding nutrients, pond characteristics and groundwater level and flow in this section are wholly unsupported even by the reports cited. In addition, as in these previous proceedings, the developer and its consultants failed to conduct an environmental risk analysis. Even the most basic facts in this section are wrong; for example, Kaloko Fishpond waters are becoming less saline and are experiencing higher residence times, not the other way around. Groundwater flows into both ponds, not around them. Both ponds do <u>not</u> function as anchialine ponds, Kaloko is connected to the ocean. No effort was made to accurately portray the current status of the coastal water resources and ecosystems, or the endangered species that inhabit those ecosystems, nor was any effort put forward to assess direct, indirect, and cumulative impacts to the endangered species dependent upon the park's water resources.

    The DEIS states "*the potential exists that the development could pose secondary threats to the National Park and to its endangered birds if noxious substances such as petroleum, oils lubricants, and sewage were to migrate downslope (makai) from the project into the Park*" (p.3-57) but then makes no attempt to analyze these threats. The DEIS also does not assess the cultural impact to Native Hawaiian traditional and customary activities resulting from

degraded water quality and a restricted quantity of water. The project proponent appears to take the approach throughout the discussion of marine and brackish water resources that if the resources are currently experiencing degradation from anthropogenic activities then that is reason to continue to add to the degradation. The DEIS does not consider the proposed project in the context of other projects occurring in the National Park and elsewhere with regard to these resources. Moreover, the DEIS does not even attempt to analyze the amount of nutrients and other contaminants that will come from the proposed project, the fate and transport of those contaminants, or the risk posed to receptors (i.e. flora and fauna). The conclusions of no impact from the proposed development to water quality in the DEIS are unanalyzed and unsupported, and the document is utterly inadequate for decision makes and the public to understand the real consequences that will occur if the project is completed. It is pure speculation, contradictory to both common sense and logic, and unsupported by any credible scientific study to state that "*It is unlikely that there would be any effects to the nearshore marine environment as a result of increases in nutrient concentrations in groundwater.*"

    The NPS is concerned that the cumulative effects of the combination of restricted groundwater flow from over-withdrawal and additional nutrient/pollutant inputs when the proposed developments in close proximity to the Park are built out, poses a significant threat to endangered species at 'Aimakapā Fishpond. The U.S. Fish and Wildlife Service has identified 'Aimakapā Fishpond as core recovery habitat for endangered Hawaiian waterbirds. The endangered Hawaiian stilt (*Himantopus mexieanus knudseni*) and endangered Hawaiian coot (*Fuliea alai*) are found at two fishponds at Kaloko-Honokohau National Historical Park. An avian botulism outbreak was documented there in 1994. The coot population was decimated, but the stilt population appeared to have been less impacted. Morin (1996) suggests that anthropogenic changes to water quality and quantity are likely to increase the potential for further botulism outbreaks. Because of the historical nature of the fishpond, the restoration actions are complex and traditional methods of draining and dredging are not readily available to the NPS, therefore additional nutrients and contaminants should be prevented from entering the fishponds.

35. Page 3-43. "*Future developments will be required to utilize the County wastewater treatment plants, hence eliminating the major source of nutrient subsidies.*" However, in Section 4.10.2, pg 4-124, the DEIS states, "*The Kealakehe Wastewater Treatment Plant shall be expanded to accommodate the projected sewage volume from the Urban Area extending south of Hina Lani Street to the Keauhou WWTP..... Representatives from the County DEM noted that there are no plans for construction of (a) decentralized WWTP in the immediately future.*" To our knowledge, there is no planned expansion of the Kealakehe WWTP. It is likely that most or all of the private developments surrounding the Park will be disposing their wastewater onsite before the County can improve their wastewater treatment capabilities; therefore, Kaloko Makai has significantly underestimated the "*cumulative changes to groundwater from the total assemblage of existing and proposed projects with the potential to alter pond and marine environments.*"

36. Page 3-45 (and pages 3-66-67 and 3-75) the DEIS also mentions a groundwater monitoring plan to detect contaminants in the groundwater below the proposed project. The proposed groundwater-monitoring plan will include monitoring wells, and a sampling and analysis plan. Parameters to be analyzed include: pH, temperature, salinity, nitrate, ammonia, dissolved organic nitrogen, TDS, TN, phosphate, dissolved organic phosphorus and TP and any other parameters required by the DOH. The project proponents are proposing to start water sampling prior to the start of grading activity, and to sample quarterly for two years, or as required by the DOH. Two years of sampling starting at the initial grading of this project means that water quality sampling will last through the initial phases of construction and no monitoring would happen for any part of the actual use of the project site, including the use of the WWTP. Two years of sampling, regardless of when it started, is insufficient to monitor the impacts to groundwater from this project and inform decision makers and the public on how the project is adversely affecting the environment. Furthermore, DOH water monitoring protocols are designed to protect human health, not the ecological integrity of aquatic ecosystems. It is unlikely that all of the effluent generated by the WWTP will be used for irrigation. It is quite costly to install water lines to distribute the effluent and there may not be a sufficient need for all of the effluent for irrigation. Furthermore, systems breakdown and backup systems need to be in place. The DEIS does not mention what type of back-up system will be used to dispose of wastewater. The DEIS should disclose to the Kona community that injection wells will be used and to what extent. The DEIS must analyze the potential impacts to coastal resources from injection wells (utilizing the information from Maui). The DEIS does mention infiltration basins as a means of disposing of treated wastewater not needed for irrigation during wet periods. Infiltration basins should be well defined and described. The impacts of infiltration basins and injection wells on the coastal and marine resources along the Kona coast, including the resources within the National Park, were not mentioned, discussed or analyzed in the DEIS

37. Page 3-62. The information cited on this page regarding groundwater resources within the National Park suffers the same problems as identified for section 3.5.2.3.

38. Page 3-62. The statement in the DEIS that "*No adverse groundwater effects have been observed from any of the existing wells in the regions, individually or cumulatively. Therefore, no adverse effect is anticipated under the Kaloko Makai on or off-site groundwater wells*" is unsupported by references to existing scientific evidence relevant to the conclusion. The conclusion ignores the rise in chlorides due to pumping and saltwater intrusion at the Kahaluu shaft wellfield (3557-01 to -05), which skims water from the basal lens and provides much of the drinking water for the North Kona System. The conclusion also ignores reasonably foreseeable significant adverse impacts from groundwater withdrawals based upon theoretical approaches or research methods generally accepted in the scientific community, including but not limited to USGS Water Resources Investigations Report 99-4070 and State of Hawai'i Department of Land and Natural Resources 2008 Hawai'i Water Plan. The DEIS should have included references to credible scientific information to support the statement that existing groundwater development has had no adverse effects.

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39. Page 3-63. Alternatives to supply potable water to the proposed project include utilizing new and existing off-site high-level wells upgradient from the National Park. According to USGS Water Resources Investigations Report 99-4070, groundwater withdrawals from wells directly upgradient of the National Park will have a greater effect on freshwater discharge within the National Park. According to the DEIS, an analytical model developed by Tom Nance, Water Resources Engineering, indicates that pumping from high-level wells in the vicinity of the proposed project has the potential to raise the salinity of groundwater within the National Park by up to 53% (Table 3-6) . This predicted effect may cause unacceptable impacts to groundwater-dependent cultural and natural resources in the National Park and along the Kona coast. The NPS seeks to maintain the flow of fresh groundwater to all inland and nearshore marine waters in the National Park to fulfill the specific purposes for which the Park was established, including traditional and customary Native Hawaiian practices and the protection of endangered species. Groundwater pumping has the potential to limit both the productivity and distribution of culturally important flora and fauna. For these reasons, pumping of high-elevation wells upgradient from the National Park is not an acceptable alternative to supply water to Kaloko Makai.

40. Page 3-63. The DEIS states that "*With the addition of Palani Well No. 1, combined with the anticipated projects proposed in the region, salinity levels are estimated to increase*" in the National Park. The analysis upon which this predicted cumulative impact is based, however, did not include groundwater development associated with the proposed Kaloko Makai project (see Table 1, Appendix 7, Palani Well No. 1 (State Well No. 4158-03) North Kona, Island of Hawai'i, State of Hawai'i, Final Environmental Assessment). The DEIS should include the additional pumping of at least 4.8 Mgd (but this is probably an underestimate) from high-level wells upgradient from the National Park, because this alternative is being investigated to supply water to Kaloko Makai.

41. Page 3-63. The DEIS references "*Montgomery 2009*" in several locations but this reference is not included in Chapter 11 References.

42. Page 3-64. The DEIS implies that the native orange-black damselfly can tolerate increasing salinity and temperature in anchialine pools due to the effects of pumping high-level wells. This assertion conflicts with the results of controlled laboratory experiments, which reveal that the eggs and naiads of the candidate-endangered orange-black Hawaiian damselfly (*Megalagrion xanthomelas*) are sensitive to increased salinity and temperature, and that naiads exhibit a threshold response to salinity above 15 ppt, with no naiads surviving at 20 ppt (Tango, L.K.K., 2010, The effect of salinity and temperature on survival of the orange-black Hawaiian damselfly, *Megalagrion xanthomelas*. Master's Thesis, University of Hawai'i at Hilo, 46 p).

43. Page 3-65. While it may be true that marine water within the National Park are already in violation of the State's water quality standards for nutrients, including nitrates, ammonia, and phosphate, and chlorophyll-a and turbidity, this does not mean more nutrients (especially organic nutrients) would not further degrade the ecological integrity of the aquatic ecosystems within the National Park. It is pure speculation, contradictory to both common

sense and logic, and unsupported by any credible scientific analysis to state that "*It is unlikely that there would be any effects to the nearshore marine environment as a result of increases in nutrient concentrations in groundwater.*" Some of the conclusions from these older studies have been contradicted in testimony and comments on previously proposed nearby developments.

44. Page 3-65 and 3-66 "*Atkinson (1992) modeled the input of nutrients to the ocean down slope from two golf courses in West Hawai'i over a four-year period. Results of the studies showed that at a location where fertilizer nutrients entered an embayment (Keauhou Bay) with restricted circulation relative to open coastal shorelines, nitrates increased by about 100% and phosphate increased by about 20% over natural input (Marine Research Consultants 2002).*" To our knowledge, this model has never been validated. Model results should not be accepted as facts without sufficient validation.

45. Page 3-66. "*These results indicated that even with long-term input of extremely high nutrient subsidies, there are situations where there are no negative effects to the receiving environment.*" This is a false conclusion. Only a subset of the environment was reported to be sampled; no evidence offered that the proposed development is comparable to this case. The DEIS should have provided details on which nutrients, into what volume of water and coastline.

46. Page 3-67. "*The physical and hydraulic characteristics of the vadose zone dampen the flux of water and contaminants to the water table. While transiting the vadose zone, contaminants such as fertilizers, pesticides, herbicides and industrial chemicals can be degraded by a process known as natural attenuation.*" While natural attenuation does occur in areas that are more mesic and have deeper and more developed soil profiles, with the shallow soils, young geology and arid conditions at the proposed project site, natural attenuation is unlikely to remove all of the pollutants before they reach NPS resources. The DEIS should have contained peer-reviewed sources describing the "*natural attenuation*" capability of this area's geological and climatic conditions.

47. Pages 3-68 to 3-74. The DEIS presents a summary of neighboring developments and concludes that upgradient wells and resorts have not had a negative impacts to the surrounding ecosystems. These conclusions are not supported by references to credible scientific analysis nor are the conclusions supported by any reference to scientific data. As stated, the conclusions are the unsubstantiated opinions of consultants for the Koloko Makia project proponent. The DEIS should include credible scientific evidence to support conclusions that upgradient wells and development have not had a negative impacts. It is unclear how the discussion of three resorts is relevant to the discussion of how the proposed project will adversely impact the coastal and marine resources within the National Park and along the Kona coast. Information dealing with impacts to the National Park or from situations posing similar threats (i.e. Maui) is more relevant.

48. 3-74 and 3-75. As mentioned before, a PPP is a statement of good intentions and is not very self-executing or enforceable. PPP's are difficult to enforce and monitor the effectiveness, and in fact, we know that they are sometimes simply ignored.

49. Page 3-75. Since this project is so large and includes a hospital, there should also be reporting for pharmaceuticals and endocrine disrupting compounds, in addition to reporting requirements to the DOH's, Wastewater Branch.

50. Page 4-2. "*Based on available information about the proposed development and the visual gravity of industrial/commercial development flanking the project area to the north and south, and Queen Kaahumanu to the west (makai), the proposed project is considered to add to an established urban trend in coastal North Kona.*" This sentence is inaccurate regarding the visual gravity of industrial/commercial development flanking the project area. The majority of the areas surrounding the proposed project area is now open space.

51. Page 4-4. "*Summary of Previous Archaeological Studies*" this section (including Figure 4-1) needs to be updated to include more information, including but not limited to the data recorded in the following survey reports:

Emory, K.P., and L.J. Soehren
1971 Archaeological and Historical Survey, Honokōhau Area, North Kona, Hawai'i. Prepared for State Department of Land and Natural Resources. Departmental Report Series 61-1. Department of Anthropology, B.P. Bishop Museum, Honolulu.

O'Hare, Constance, and Susan T. Goodfellow
1992 Kohana-Iki Resort, Phased Archaeological Mitigation Program, Phase II—Data Recovery. Land of Kohana-Iki, North Kona District, Island of Hawai'i. Paul H. Rosendahl, Ph.D., Inc., Hilo.

Tomonari-Tuggle, M.J., and H. David Tuggle
2006 Archeological Survey of Lands Surrounding Kaloko Fishpond, Kaloko-Honokōhau National Historical Park (KAHO). International Archaeological Research Institute, Inc.

Monahan, Christopher M., Trevor Yucha, and Connie O'hare
2010 Draft Supplemental Archaeological Inventory Survey for the Proposed QueenKa'ahumanu Highway Widening Phase 2 Project, Kalaoa, Kalaoa-O'oma, O'oma 2, Kohanaiki, Kaloko, Honokōhau 1-2 and Kealakehe, North Kona and South Kohala Districts, Hawai'i Island. Cultural Surveys Hawai`i, Inc. Prepared for SSFM International, Inc.

Reinecke, John E.
1930 Survey of Sites on West Hawai'i[also, Archaeology of Kona, Hawai'i]. MS, in the files of the State Historic Preservation Division, Department of Land and Natural Resources, State of Hawai'i .

Renger, Robert C.
1974 Human adaptation to marginal coastal environments: the archaeology of Kaloko, North Kona, Hawai'i. Ph.D. dissertation, University of California, Santa Barbara.

52. Page 4-4. Summary of Previous Archeological Studies, Information needs to be provided clarifying whether these sites have assigned SIHP numbers.

53. Page 4.8. A total number of lava tubes encountered, including synopses of caves containing cultural materials found within the project area should be presented so that the public and decision makers can make an informed decision.

54. Page 4-12. Table 4-4, this table, along with site types, functions, and mitigations should not be considered finalized until the AIS is approved by SHPD. Regarding all the trail remnants listed with mitigations of "no further work," NPS supports the SHPD stance that trail segments should be preserved and incorporated into development plans whenever possible. These trails are prehistoric and fall under the Highways Act of 1892 (HRS 264b).

55. Page 4-18. The DEIS states that "*the archaeological surveys have been submitted to SHPD for their review. At the time of the preparation of this DEIS, SHPD was still reviewing the archaeological inventory surveys.*" Until SHPD approval has been received, the information provided in the DEIS cannot be considered final as it is currently based on the unapproved AIS. If the AIS changes as a result of the SHPD's review and approval, then a new analysis will be required to analyze impacts to NPS lands, resources and associated landscapes.

56. Page 4-30 "*Historic properties north and south of the project area are of less concern due to the extensive industrial/commercial developments separating the project area from the potential sites there.*" This statement is inaccurate. The majority of the areas to the north and south are now open space, with a high concentration of historic properties. The background research for these sections should be included in this study and the analysis of impacts to the cultural resources and cultural landscape of the area.

57. Page 4-33, ¶6 All appropriate parties, including the NPS, should be allowed to comment on the burial treatment plan(s) for the proposed project area.

58. Page 4-34. ¶1The first sentence is contradictory to the information provided on page 4-29, the "*Off-Site Potable Well Field*" section, paragraph two "*The AIS recommended that seven burial sites (10701, 10717, 10722, 10728, 10740, and 10754) and one heiau with a burial (10736) be preserved. Four of these sites are located within parcel 062 and the remaining are located on parcels 057, 058, and 059. SHPD concurred with the recommendations on October 24, 2005. As a result, a preservation plan was submitted and approved by SHPD in 2006 and Kaloko Heights Associates, LLC, property owner, submitted a Declaration of Archaeological Easements for the preservation of all seven sites.*" This is unclear. There should be an explanation of which surveys correlate to the offsite well field.

59. Page 4-84. The vehicle emissions study only reports using traffic at intersections, while the proposed project is on a significant hill between two highways. Vehicles utilize greater amounts of fuel climbing up hill; the plans include 3 plus 2 lanes entering the project from the bottom of the hill vs. 1 lane entering the project from the top of the hill. The fuel usage and emissions from the bulk of a 5,000-home community driving vehicles uphill must be analyzed.

60. Page 4-52. Near Queen Ka'ahumanu Highway, near the present water tank, there are major sections of trail which are still intact and should be preserved. Kaloko Makai should consult with NPS, lineal and cultural descendants, Na Ala Hele and SHPD on this. These trail sections are not shown in any of the figures within this document and are within the Conservation area.

61. Page 4-53. The "*Mitigation Measures*" section is inadequate and does not provided specific mitigations. This section directly quotes what is outlined in the "recommendations" section of the CIA. However, no specifics are mentioned about how the Kaloko Makai project plans to use the recommendations as mitigation measures. For instance, the third bullet in this section notes that "*Efforts should be made to protect...water collection lava tubes*" yet many of these features are listed to receive no additional work in the AIS. It is unclear how these features be protected. The DEIS should have stated if these features will be avoided as a mitigation measure.

    This section should have specifically addressed how the proponent of the project will specifically address the concerns outlined in the community consultations, i.e. how Kaloko Makai will implement the recommendations into planning development.

62. Page 4-54. "*The trail entirely traverses pāhoehoe and is generally well defined throughout the eastern portion of the parcel, except near the makai parcel boundary where bulldozing and grading has nearly destroyed the ahupua'a wall and eliminated any definitive sign of the trail.*" This statement is inaccurate. There are definitive signs of trail in the makai parcel. The trail within the project area is clearly visible up until it crosses Hina Lani (near the intersection of Hina Lani and Kamanu). Furthermore, although in some areas, the wall has been historically robbed for rock, some sections may have fallen over, or been bulldozed, the remnants of the wall are in clear view and the footprint (i.e. form and outline) of the original wall remain.

63. Page 4-54. "*Archaeological data created by others makai of the Queen Ka'ahumanu Highway*" should be clarified. What are the citations.

64. Page 4-55. ¶4 First Sentence "*Since the integrity of the historic trail is lost at that point, due to Hina Lani road construction..*" is misleading. The lower portion of the trail has been identified and the NPS has recommended the appropriate preservation measures.

65. Page 4-55. "*Community members and groups responsible for the long-term care of the Kohanaiki and Kaloko Ahupua'a, as well as cultural practitioners who utilize the area for*

gathering and for cultural and educational activities, should be further consulted regarding the above issues and other concerns throughout the planning, development and operation of the proposed housing development. This consultation should include all interested community groups and individuals who have a stake in the project area." Using Kaloko Heights' treatment measures that were reached between the "community" and Kaloko Heights is grossly inadequate as a treatment plan for Kaloko Makai's preservation of the Kohanaiki/Road to the Sea Trail. NPS believes that the agreement that was accepted for Kaloko Heights is not acceptable for the remainder of the trail. Kaloko Makai has a responsibility to meet with community members, groups and cultural practitioners, as well as formally consult with the NPS to determine the best treatment for this and other trails within the project area. This trail is eligible for the National Register of Historic Places as a contributing element to the National Park and the National Historic Landmark.

66. Page 4-56 – 4-57. Potential Impacts and Mitigation Measures, NPS recommends rewriting this section to preserve the existing trail and buffer zone rather than altering it.
#1 The DEIS should explain how the trail will be "*retained in perpetuity.*"

#2. There should be a preservation corridor to be used such that schoolchildren, community members, etc. experience a more meaningful sense of place when using this ancient trail. The thirty foot trail right of way will not provide the user an authentic experience within the unique cultural landscape of this area, part of the historically significant lifeline between the historic mauka village and the makai coastal villages of Kaloko and Honokōhau, which now comprise the National Historical Landmark. Instead of a rigid thirty foot buffer, the corridor should be fluid to include significant cultural and natural features along the route. NPS archeological staff from Ala Kahakai National Historic Trail, working with descendent communities and the State Historic Preservation Division and local communities should be consulted to establish an appropriate corridor. Trail buffer areas should not be physically altered whatsoever. Altering the landscape within buffers negates the purpose of the trail buffer and adversely impacts the setting and character of the trail, as well as the integrity of the trail as a historic property.

#3. No physical scarring or alteration of existing trail features or buffer zones should take place. The priority should be that the trail is preserved. One option may be overpasses and bridges.

Cutting and filling within the trail corridor is not acceptable and should not be allowed. Altering the entire landscape and then marking where the trail used to be is not an adequate preservation measure for this trail. Removing the trail materials and replacing them in the same horizontal alignment is not acceptable treatment of a historic property under 6E or Section 106 preservation standards. State Historic Preservation Division and the NPS should be consulted as to the treatment plan for the trail. Cut and fill stepping of the landscape is not the only alternative for land modification in a subdivision. As an example, the developer could design grading pad areas only for planned structures; post and pier construction is also a method used to minimize destruction of the natural landscape and cultural features.

#4. The trail should not be physically altered. No vertical or any other changes to this historic trail are acceptable. The text should be revised to read "*The original trail surface, and other cultural resources located within the trail corridor, including, but not limited to, existing native trees will be retained.*"

#5. The NPS agrees that cultural features along the existing Trail shall be preserved and incorporated into the preservation corridor. When significant cultural resources are located further away from the Trail, the Trail preservation corridor should be adjusted to incorporate and preserve them. Cultural and natural resources should be preserved in place, as moving them destroys the spatial context and integrity of the resource.

#6. First sentence should read "*In further consideration of existing governmental rules and regulations pertaining to preservation of historic and cultural resources any trail crossing will not physically scar or alter the original trail fabric, features or corridor in any way.*" For example: Metal (e.g., marine aluminum) grate crossings-bridges can be built for any trail crossings. Metal grates can allow the entire original trail and buffer land surface to be preserved intact, allow people to view the original trail surface and walk the original trail route within inches of the tread elevation. In many cases only two tire width grates would be needed to allow automobiles to cross trails; large trucks and heavy construction equipment can be directed to alternative entrances for their occasional access needs on the two sides of the trail. Heavy construction equipment should not cross the trail, heavy equipment entry to areas near the trail should be made from adjacent land, not across the trail. Recommend defining heavy as the weight of a horse or cow (which are likely to have used or crossed the trail before).

Recommend if the developers are not willing to propose crossings that no trail crossings, except pedestrian traffic be allowed, without another environmental assessment; roadways already exist on both sides of the trail.

The NPS requests to be consulted with in regards to any and all Trail crossings.

#7. The NPS recommends that such details should be determined in the Final Preservation Plan for the Trail after the necessary and appropriate consultation with descendants, Na Ala Hele, the SHPD and the NPS.

#8. Existing rock walls should be preserved in situ. Replace existing text with "No rock walls will be moved or altered." These are historic cultural structures to be preserved. Routes around existing rock walls will be developed or small bridges constructed for pedestrian crossing.

#6, 7 and 8 The sentence "*At this early stage of the planning process for Kaloko Makai it is premature for SCD to propose the number and location of specific Trail crossings.*" is inconsistent with the detailed figures provided in this EIS and the concept of an EIS. The numbers and locations of trail and wall crossings as well as changes in walls, trails, and

buffer zones need to be disclosed so that their individual and cumulative effects can be evaluated in the EIS. A map-plan is provided in the DEIS. Does the above comment imply that Kaloko Makai does not intend to follow these plans? If the figures and the calculations in the DEIS are wrong, then the analysis presented of impacts to resources is premature and inadequate.

#9. This section's connection to the trail is unclear. Above it is noted that any native trees within the trail corridor will be preserved in place. NPS recommends removal of this point from this section of the EIS. In this harsh dry landscape the location where a tree can survive is uncommon and very unique. The spacing and location of the native trees can be vital to the survival of organisms that depend on them for shelter and food. Without specific details, removal of trees from this landscape is not advisable.

#11 "*Where the Trail intersects with Hina Lani Street, SCD will realign the remaining lower portion of the Trail from that point to run parallel with and adjoining the Hina Lani right-of-way down to Queen Ka'ahumanu Highway.*" No existing historical structures or artifact (i.e. fragments of existing trail) should be altered; nothing existing should go away. New trails leading from the historic trail to the intersection, crosswalks, and walkways along the roads can be constructed where they do not physically alter existing historic trails and buffers. NPS should be consulted on the alignment of the trail between Ka'ahumanu Highway and the trail/Hina Lani intersection.

#12. Kaloko Makai should incorporate Hawaiian cultural perspectives into the overall planning and execution of the development including the treatment of the 'aina within the project area by preserving the natural contours, geologic features and existing cultural features, not terraforming the project area into a state unrecognizable from the original landscape.

67. Page 4-57. "*Roadways and Traffic*". As noted in the DEIS the existing traffic conditions are currently highly impacted and this proposed project will further add congestion. Park visitors use these roads to access the Park and traffic contributes to their overall park experience. No impact analysis of traffic, or its mitigation, to the National Park is made in the DEIS.

68. Page 4-73. Noise impacts to Kaloko-Honokōhau National Historical Park are not discussed. Significant noise increases are mentioned but only mentions that these impacts are to undeveloped property. The analysis needs to describe the impacts to the NPS resources. What are the Leq levels at 50 and 100 ft on Park property (Table 4, page 13)? Based on the information in the tables in Appendix N, there appear to be significant additional noise impacts from project related traffic increases. Since Kaloko-Honokōhau National Historical Park is a noise-sensitive area, there should be discussion of how traffic noise and construction noise will impact activities at the Park and what measures will be implemented to mitigate the noise impacts.
    a. Appendix N Table 6 Discussion needs to identify where the 65 DNL and 75 DNL setback contours fall on Park property for Year 2011 and 2035.

    b. Appendix N Page 32 Chapter VII should discuss project-related noise impacts (traffic noise and construction noise) to Kaloko-Honokōhau National Historical Park and possible mitigation measures.

69. Page 4-81. Six-foot high sound attenuation "walls" along roadways are likely to look out of place in with the existing landscape, while six-foot piles of lava rock can likely be made to look like native 'a'a lava and edges of pahoehoe flows. Native plants on the sides and top of such a constructed lava barrier would contribute to sound attenuation and appearance of such a structure. Utility conduits and access points could be incorporated into lava rock if extensive sound barriers are necessary.

70. Page 4-84. The NPS disagrees with the conclusion that there "*may potentially result in a long-term increase in emissions.*" There will be a long-term increase in emissions. Assuming that each household on average owns 1-2 vehicles, it is safe to say that this development will mean 5-10,000 additional vehicles in the vicinity which will mean a significant amount of pollutants being introduced into the air and water in the area. The DEIS contains no analysis of impacts to NPS resources and Native Hawaiian cultural practices from increased emissions.

71. Page 4-86. Section 4.7, this section needs to address the major visual impacts that this project will have on Kaloko-Honokōhau National Historical Park and the Honokōhau Settlement National Historic Landmark. The Park and Landmark house over 400 archaeological sites, numerous ethnographic resources as protected resources. These resources are also protected under Section 106 of the National Historic Preservation Act. Under this act visual impacts must be taken into consideration as they can affect the setting of historic properties eligible for the National Register of Historic Places. These sites, ethnographic resources, the Park and the NHL as a whole will be significantly impacted by the alteration of the viewshed by this project. Mitigation measures will need to address these impacts.

72. Page 4-86. Project lighting will also have a negative effect on visual resources and nightscape in the National Park. Light pollution of the night sky will interfere with visitor experience and evening traditional cultural practices. No impact analysis of light pollution, or its mitigation, to the National Park is made in the DEIS.

73. Page 4-87. "*The proposed project will not impact significant mountain or mauka views…*" This statement is inaccurate. Currently, this proposed project area consists of large expanses of open space, this project will drastically change the viewshed and visual resources of open space, highly valued in the Kona community, to an urban landscape and thus will have major impacts on both mauka and makai views of the area. In addition, the mauka changes to viewshed from the Park and National Landmark from over 400 National Register-eligible historic properties affects the integrity of these sites by affecting the setting, feeling and association of these resources.

74. Page 4-91. Section 4.8.5., this section does not analyze the impacts to the Park or Landmark or Ala Kahakai National Historic Trail. The plan does not address impacts that the influx of 5000 new residences in the immediate vicinity will have on resources in the park. Major impacts to Park facilities and resources will occur as a result of the Park becoming a "*recreational facility*" to many thousands of people. The NPS will be impacted at many levels responding to the inevitable damage to resources and increased facility demands. Protected green sea turtle habitat is dependent on low levels of human disturbance, as is other endangered waterbird habitat. The National Park is already experiencing high levels of visitation and dealing with overcrowding of facilities and overuse of resources along the coast. The introduction of thousands of new regular users would mean overextension of staff, rapid depletion of ocean resources, impacts to cultural practices and high potential of damage to cultural resources such as archaeological sites. The analysis in this section is inadequate.

75. Page 4-99. The National Park Service questions the need for 5,000 more homes in North Kona. During the 2010 census, one fifth of the homes on Hawai'i Island were vacant (West Hawai'i Today, June 15, 2011).

76. Page 4-107. Water demand calculated in Table 4-24 is incorrect due to several errors and results in a significant underestimation of water demand for the proposed project. Errors in Table 4-24 should be corrected to provide an accurate estimate of the water demand for this proposed project. More specifically:
    a. The 20-acre wastewater treatment plant and 1.7-acre desalination plant are not explicitly listed in Table 4-24. Revise Table 4-24 to include water demand of 4000 gpd/acre, per Hawai'i County Department of Water Supply guidelines, or explain why a different rate was used.
    b. Water demand for Phase 1 Parks is 54,000 gpd/acre but is 6,000 gpd/acre for Phase 3 Parks in Table 4-24. These values are not consistent with the rate of 4,000 gpd/acre listed under "Assumptions" for Table 4-24. Correct the water demand for Parks or explain why different rates were used in Table 4-24.
    c. Water demand for Phase 2 Parks is not included in Table 4-24. Table 2-6 indicates that Phase 2 will include a 13-acre park. Revise Table 4-24 to include the water demand for a 13-acre Phase 2 Park.
    d. The acreage for the Phase 2 School in Table 4-24 is not consistent with Table 2-6. Revise Table 4-24 to include water demand for an 18-acre Phase 2 middle school.
    e. Water demand for the Phase 2 School in Table 4-24 is 6,000 gpd/acre, which is not consistent with water demand of 4,000 gpd/acre used for Schools in Phases 1 and 3. Revise Table 4-24 to use a consistent water use rate for Schools or explain why different values were used.
    f. A rate of 400 gpd per unit is used to estimate residential water demand in Table 4-24. This rate is not consistent with the rate used by the Hawai'i County Department of Water Supply to estimate water demand for North Kona. The 2011 Water Use and Development Plan Update (p. 2-12) uses a value of 1000 gpd per unit for single family residential units in North Kona based upon actual historic consumption data. Revise the residential water demand in Table 4-24 to be consistent with the

Department of Water Supply guidelines for North Kona.

77. Page 4-107. Table 4-24, total water demand was recalculated based upon information presented in Table 2-6 of the DEIS and the Hawai'i County Water Use and Development Plan Update water consumption guidelines (p. 2-12). The revised table below indicates that the average daily water demand for the proposed project could be as high as 6.9 Mgd, over two times that estimated in the DEIS. The DEIS should have (1) evaluated whether the proposed alternatives to supply potable water are sufficient to meet this water demand, and (2) evaluated the potential effects of each alternative on the water resources and groundwater-dependent ecosystems in the area of the proposed project.

NPS Recalculated Water Demand for Kaloko Makai Draft Environmental Impact Statement:

Zoning Designation	Units	Acres	Water Use Unit Rate (gpd/unit or acre)	Average Daily Demand (gpd)
Residential housing	5000		1000	5000000
Commercial		282	3000	846000
Light Industrial		75	4000	300000
Judiciary		10	3000	30000
Schools		42	4000	168000
Parks		57	4000	228000
Hospital		40	4000	160000
Police Substation		3	3000	9000
Wastewater treatment		24	4000	96000
Desalination Plant		1.7	4000	6800
Project Total (Average Demand)				6928800
Average Demand (Mgd)				6.9
Maximum Daily Demand (Mgd)				10.4
Peak Hour Demand (Mgd)				34.6

78. Page 4-110. The DEIS states that reverse osmosis concentrate will be discharged in on-site disposal wells at depths sufficient to reach groundwater with "*30 parts per trillion (ppt) salinity.*" The notation is also defined on Page G-5 as "parts per trillion." This is inconsistent with the more feasible definition given on Page 3-26, which states that the concentrate will be disposed in strata where groundwater salinity is "30 parts per thousand (ppt) or greater." The DEIS should be revised to confirm the targeted salinity of the strata into which reverse osmosis concentrate will be disposed.

79. Page 4-126. "*Wastewater Treatment Alternatives*" While the use of recycled water to the R-1 level is the appropriate treatment to reduce viral and bacterial pathogens for irrigation uses

around residential areas, the stated level of nutrients contained in the wastewater effluent is a significant concern.

80. Page 4-129. "*During periods of wet weather, excess R-1 water will be disposed of via infiltration basins.*" The DEIS has no analysis of impacts to aquatic ecosystems resulting from the disposal of sewage effluent via infiltration basins.

81. Page 4-129. Table 4-25 lists potential uses for treated wastewater, however, there are no calculations for the actual amount of wastewater that will be disposed of via irrigation or other methods. The project will occur in phases and it is unlikely that the supply of treated wastewater and the demand for treated wastewater will be in synch. Considering the cost of installing separate waterlines for the treated wastewater, without specific volumes of wastewater and timelines, there is no guarantee that all of the treated wastewater will not be disposed of via the infiltration basins.

82. Page 4-132 "*It is assumed that approximately 15% of applied irrigation water will percolate down to the basal ground water. As the excess irrigation water percolates downward through the unsaturated zone to the groundwater, removal rates of nitrogen and phosphorus from the water will be significant.*" No scientific data or scientific studies are provided to support the assumptions that 1) fifteen percent of the irrigation water will reach groundwater and 2) nitrogen and phosphorous removal rates will be "significant." Public review and decision-making actions cannot rely upon unsupported claims and assumptions regarding potential impacts to nationally significant resources.

83. At the proposed O`oma Beachside Village development, less than 1 mile from the proponent's project, Waimea Water Services estimated that approximately 54% of the total irrigation water used would infiltrate into the aquifer. (The Water Development Impacts Study for the Shores of Kohanaiki, Figure 6, Waimea Water Services, Inc., 2007). There is a large discrepancy in the estimates for the two developments that are located in the same general area with the same soil composition. The DEIS should have explained this discrepancy and provide data to support the stated assumption of 15%.

84. Page 8-1. "*Relationship Between the Short-Term Uses of the Environment and the Maintenance and Enhancement of Long-Term Productivity*" The DEIS fails to capture the cumulative impacts, secondary impacts, irreversible commitments of resources, and probable adverse environmental effects to the area, especially at Kaloko-Honokohau NHP, as suggested by the comments listed above.

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7469-01
July 25, 2013

Ms.Tammy Dushesne, Superintendent
National Park Service
U.S. Department of the Interior
73-4786 Kanalani St. #14
Kailua-Kona, Hawai'i 96740

Subject: Draft Environmental Impact Statement (DEIS)
Kaloko Makai
Kaloko and Kohanaiki, North Kona, Hawaii
Tax Map Key: (3) 7-3-09: 017, 025, 026, and 028

Dear Ms. Dushesne:

Thank you for your letter dated October 6, 2011. The Petitioner is preparing a Second DEIS to address changes in the proposed project that will be reassessed, as needed, in the forthcoming document. You will be notified of its availability for review and comment pursuant to Chapter 343, Hawaii Revised Statutes (HRS) and Title 11, Chapter 200 Hawaii Administrative Rules (Department of Health).

With regard to your comments on the subject DEIS, we offer the following in response to your comments, as referenced:

1. *Page 1.1 The size of the off-site potable well field is stated as 3.5 acres. This is inconsistent with other statements on this page, and elsewhere in the document, which refer to the size of the off-site well field as 18 acres.*

   Response: The off-site potable well field has been omitted from consideration in the forthcoming Second DEIS.

2. *Pages 1-12 and 4-8. The DEIS does not state how many 1,2,3 etc. story buildings will be constructed and where will they be located. Page 1-12 and 4-81 mention "single story structures" and "multistory structures" but not how many or where they will be located. There is no clear way to evaluate the environmental impact (e.g., aesthetics) without knowing the basic size and shape of the buildings and where they will be located relative to existing features in the area.*

   Response: The Project will be designed to be consistent with the Kona Community Development Plan (Kona CDP), which seeks to direct future growth patterns toward compact villages, preserving Kona's rural, diverse and historical character. The majority of future growth should be directed north of Kailua, with some future growth in the Kailua to Keauhou area, in the form of compact villages that offer increased density and mixture of homes, shops and places to work.

The Kona CDP goes on to describe preferred building heights as follows: T-3 Suburban transects, Typical Building Height is 1- to 2-Story with some 3-Story; T-4 General Urban transects, Typical Building Height: 2- to 3-Story with a few taller Mixed Use buildings and for T-5 Urban Center transects, Typical Building Height: 2- to 5-Story with some variation (all, excluding attics and raised basements.) It further states, stories may not exceed 14 feet in height from finished floor to finished ceiling, except for a first floor commercial function, which shall be a minimum of 11 feet and may be a maximum of 24 feet. A single floor level exceeding 14 feet, or 25 feet at ground level, shall be counted as two (2) stories.

Kaloko Makai will conform to these design standards. At this stage in the planning process, the specific heights of improvements within the project have not been identified.

3. *Page 1-17. Section 1.7.8, lists unresolved issues related to the DEIS but does not list the uncertainty related to the hydrologic connection between the high-level and coastal groundwater systems. The hydrologic connection between the high-level and coastal groundwater systems is one of the main factors that will control how the withdrawal of fresh groundwater for the proposed development will affect the quantity and quality of groundwater resources in down gradient areas. The DEIS (p. 3-15) states the following, which highlights the uncertainty related to the connection between the high-level and coastal groundwater systems "In addition to it creating a substantial reservoir of potable quality water, this subsurface feature also controls the location and manner of groundwater movement into the down gradient basal lens. While the hydraulic relationship between the two groundwater bodies is not yet understood, it is undoubtedly the reason for the anomalous characteristics of basal groundwater in the Keahole to Kailua area (Nance 2008)." Also on p. 3-15, the DEIS states "Groundwater responses when these wells are ultimately used to their full capacity may shed light on the unknown aspects of this groundwater occurrence, including the geologic feature which creates the high-level water, the hydraulic relationships among the differing high-level groundwater compartments, and where, how and if the high-level groundwater drains into the basal lens (Nance 2008)." Both of these statements indicate that it would be appropriate to list the uncertain hydrologic connection between the high-level and coastal groundwater systems as one of the important unresolved issues in Section 1.7.8.*

   Response: Two deep monitor wells (State Nos. 3858-01 and 3959-01) have provided insight on the occurrence of high level groundwater and its relationship to the brackish basal lens that exists in the nearshore area including Kaloko-Honokohau National Historic Park. These deep monitor wells establish that most, if not all of the high level groundwater passes far beneath the basal groundwater rather than discharging into it. Results of these

two wells indicate that the subsurface "mechanism" creating the high level groundwater and its physical separation from the basal lens is a series of poorly permeable lavas flows which total hundreds of feet thick and create an effective hydrologic separation between the two groundwater bodies.

A deep test well is to be drilled at the upper end of the project site, the results of which will be used to determine the relationship of the high level and basal groundwater in the project's mauka-makai corridor.

The alternatives being considered for the Project's drinking water supply have been narrowed down to those that can be affirmatively demonstrated as having no impact on the basal lens. These are limited to use of the high level groundwater drawn from strata far below the basal groundwater so as not to impact it and desalinizing saline groundwater, also drawn from below the basal lens. The water supply alternatives being considered are described in detail in the 2012 report by Tom Nance Water Resource Engineering, which will be included in the forthcoming Second DEIS. The alternative ultimately implemented will have to have affirmatively demonstrated that its groundwater extraction will not diminish the flow of groundwater into Kaloko-Honokohau National Historic Park.

4. *Page 2-10. "Kaloko Makai would consist of homes, ranging from traditional single-family homes to mixed-use, mid- and higher-density multifamily units." Figure 2-7, County General Plan Land Use Pattern Allocation Guide, does not indicate any medium or high-density zones at or near the proposed project.*

   Response: Almost the entire Kaloko Makai site is designated as Urban Expansion Area under the County General Plan Land Use Pattern Allocation Guide. The County of Hawaii General Plan defines Urban Expansion Areas to allow for a mix of high density, medium density, low density, industrial, industrial-commercial and/or open designations in areas where new settlements may be desirable, but where the specific settlement pattern and mix of uses have not yet been determined.

   Furthermore, section 15.1 of the General Plan (February 2005, as amended) calls for the preparation of community development plans "to translate the broad General Plan statements to specific actions as they apply to specific geographical areas." The General Plan requires CDPs be adopted as an "ordinance", giving the plans force of law. The CDPs are long-term plans with a planning horizon to the year 2020, consistent with the General Plan.

The Kona CDP recognizes that the General Plan LUPAG Urban Expansion Area is larger than needed in order to accommodate the projected growth within the planning

horizon, so it emphasizes that future growth within the urban area is encouraged in a pattern of compact villages at densities that support public transit.

Transit-Oriented Developments (TODs) and Traditional Neighborhood Developments (TNDs) are identified as the planning tool to manage this anticipated growth within the defined "Kona Urban Area." The Kona CDP defines these as compact mixed-use villages, characterized by a village center within a higher-density urban core, roughly equivalent to a 5-minute walking radius (1/4-mile), surrounded by a secondary mixed-use, mixed-density area with an outer boundary roughly equivalent to a 10-minute walking radius from the village center (1/2-mile).

The distinction between a TOD and TND is that the approximate location of a TOD is currently designated on the Official Kona Land Use Map along the trunk or secondary transit route and contains a transit station, while TND locations have not been designated and may be located off of the trunk or secondary transit route at a location approved by a rezoning action.

According to the Kona-CDP, Transit Oriented Development (TOD) and Traditional Neighborhood Design (TND) Village developments shall exhibit the following characteristics and conform to the following design principles:

a) Commercial Village or Neighborhood Villages with mixed uses. A mixture of non-residential and residential uses of various densities, intensities and types designed to promote walking between uses and a variety of transportation modes such as bicycles, transit and automobiles.
b) Functional Villages. Villages are located and designed to embrace a full range of urban facilities including neighborhood retail centers, a variety of housing types, public/civic space and a variety of open space amenities,
c) Walkable streets. Village designs are based on reasonable walking distances, the location of parking and the design of streetlights, signs and sidewalks.
d) Interconnected circulation network. An interconnected street system that prioritizes pedestrians and bicycle features and links neighborhoods to shopping areas, civic uses, parks and other recreational features.
e) Respect for natural and cultural features. Development activity recognizes the natural and environmental features of the area and incorporates the protection, preservation and enhancement of these features.
f) Public Transit. A major public transit stop shall be located within the Village Center of most Villages.

Transit Oriented Development (TOD) would integrate housing, employment, shopping and recreation opportunities. Villages would be designed around transit stations/stops which would reduce the need for daily trips and financially support the expanded transit system. TOD Urban Villages are located a minimum of one mile apart,

between major transit stations, along Ane Keohokalole Highway trunk route in order to preserve the transit efficiency of this route.

Transect Zones (T-Zones) organize the density, complexity and intensity of the land use within the TOD Village. The operating principle is that there is an urban core with a main center focus such as a transit station and plaza. This urban core area, which is spatially defined based on walkable distances called Pedestrian Sheds, has the highest density, complexity and intensity of uses. The land uses transition to less dense uses moving away from the center.

The Transect Zones that correspond to the urban core, secondary area and greenbelt referred to in the Kona CDP and Village Design Guidelines are as follows (also noted are the allowable residential densities in each transect zone):

i. Urban Core
    1. T-5 Urban Center (Maximum density by right - 30 units per acre)
        i. Consists of higher density mixed use building that accommodate retail, offices, row-house and apartments. Shops mixed with townhouses, larger apartment houses, offices, work places and civic buildings,
    2. T-4 General Urban (Maximum density by right - 12 units per acre)
        i. Mixed use but primarily residential urban fabric. Mix of houses, townhouses and small apartment buildings with scattered commercial activity.

ii. Secondary Area
    1. T-3 Suburban (Maximum density by right - 6 units per acre)
        i. Low density residential areas adjacent to higher zones that have some mixed use.
    2. GB1- Greenbelt Natural Zone
        i. Lands approximating a wilderness condition, including land unsuitable for settlement due to topography, hydrology or vegetation.
    3. GB2 Rural (Maximum density by right - .25 units per acre)
        i. Rural zone consists of sparsely settled lands in open or cultivated states. Typical buildings include farmhouses, agricultural buildings, cabins and villas.

iii. Mixed-Use Industrial
    1. SD1 (Maximum density by right - 12 units per acre)

The Kaloko Makai project was conceived, planned and designed to be consistent with the Hawai'i County General Plan, the Keāhole to Kailua Development Plan (K to K Plan) and the Kona Community Development Plan (Kona CDP.) Kaloko Makai is

situated in the Kona Urban Area of the Kona CDP and Urban Expansion Area in the General Plan and serves to implement these planning documents.

Kaloko Makai is a compact, mixed-use, master-planned community offering a wide range of housing types and affordability, and a variety of businesses and employment opportunities, focused around an initial urgent care medical facility with land available (at no cost) for a new Kona regional hospital.

Kaloko Makai has been designated as a Neighborhood Transit Oriented Development (TOD) in the Official Kona Land Use Map of the Kona Community Development Plan.

5. Page 2-16. Section 2.1.5, ¶2 The references for the radiocarbon dates are not given.

   Response: The reference (Walker and Haun, 1988) from CSH report for Kaloko Makai for TMK 7-3-009:017, page 38, has been added to the forthcoming Second DEIS.

6. *Page 2-31 to 2-38 (Figures 2-11 to 2-14). The use of the term "natural zone" is unclear.*

   Response: The forthcoming Second DEIS defines the Natural zone as a landscape buffer or open space area.

7. *Page 2-14. No explanation is provided for the proposed change in land use designation from agriculture land to urban for the dryland forest preserve. If a land use designation change is necessary, conservation would be more appropriate for a forest preserve.*

   Response: Based on comments received, the reclassification of the Dryland Forest Preserve to the Urban district has been dropped from consideration. It will remain in the Agricultural district.

8. *Page 2-44. "Archaeological data created by others makai of the Queen Kaahumanu Highway" should be clarified and the references listed.*

   Response: Studies conducted for areas makai of Queen Kaahumanu (makai of the project site) were conducted for other projects by Donham (1986) and Renger (1971); Cordy et al (1991). See CSH report for TMK 7-3-009:017, page 21. These references have been added to the forthcoming Second DEIS reference list.

9. *Page 2-44. The discussion of where and how the trail will be realigned is unclear.*

Response: The Kohanaiki Trail ("Road to the Sea" Trail) bisects the project site and is well defined for most of its mauka alignment. Below Ane Keohokalole Highway the trail alignment is not certain.

The Alakahakai National Historic Trail (NHT) archeologist, the Petitioner's representatives and others have been on various site visits, including three site inspections with employees of the NPS.

After extensive consultation with the community, an agreement was reached on trail treatment. An archeologist for the Alakahakai NHT also made recommendations on the location of the trail. The Petitioner's representatives discussed these treatment measures with Na Ala Hele and the general consensus by all was that the treatment of the trail was appropriate.

Treatment of Kohanaiki Trail will closely follow the agreement established after extensive discussions with the interested community at Kaloko Heights.

This translates to a 10' wide trail pathway (meandering mauka to makai on what is believed to be the historic alignment) with a 10' wide buffer on each side of the trail (30' wide in total). In places where cut and fill are necessary, the elevation of the trail may change, but the general alignment will not be disturbed.

As noted in the DEIS, "Where the Trail intersects with Hina Lani Drive, Kaloko Makai will realign the remaining lower portion of the Trail from that point to run parallel with and adjoining the Hina Lani Street right-of-way down to Queen Kaahumanu Highway. Since the integrity of the historic trail is lost at that point, due to Hina Lani road construction, the adjoining industrial subdivision and the water tank, the Petitioner will realign the trail and have it run down the southern boundary of the property (fronting Hina Lani,) from the point of intersection with Hina Lani down to Queen Kaahumanu Highway. This alignment gives the users of the trail easy access to cross Queen Kaahumanu or Hina Lani at the bottom, as there are crosswalks with crossing signals at that point." This is also noted on the Site Plan map of the project.

10. *Page 2-45. "Kaloko Makai will also incorporate two trails that run through the dryland forest" is unclear. The reader cannot tell if the trails will be protected. There also should incorporate a preservation corridor to protect the integrity of the trails as historic properties under Section 6E.*

Response: The AIS states "Two (2) of the preserve sites are major intact trail systems (site -26371 and -26418) that run for over 500 meters each. The site -26371 trail (which is in poor condition in some places) is recommended for preservation only in part, with the section that intersects site -26418 of particular

interest for preservation (see Figure 164). Site -26418 is largely in very good condition and is recommended for preservation with certain breaches allowable in the course of the preservation of the trail."

The trails within the interior of the Dryland Forest will be preserved in accordance with the State Historic Preservation Office and be accessible to the public.

11. *Page 2-48; Page 4-106; Page 5-40. The DEIS states that average potable water demand will be approximately 3.2 Mgd and maximum water demand will be 4.8 Mgd. These values are incorrect and underestimate water demand due to several miscalculations in Table 4-24, Pages 2-48, 4-106 and 5-40 should be revised to accurately reflect the estimated water demand for the project.*

Response: The forthcoming Second DEIS will include updated water demand estimates base on revised land uses.

12. *Page 2-48. The preferred alternative to supply potable water for the project involves drilling up to four mid-level wells to tap a fresh water layer underlying the basal aquifer, about 2.5 miles upgradient of the National Park. No reference to credible scientific information is provided to support the sustainability of this new source of potable water. The DEIS acknowledges on p. 3-16 that the depth, inclination and geologic nature of the formation confining this layer of fresh water in this area are not known. The possibility that all, or even some, of the potable water needs of the project can supplied by an "underlying fresh water layer" at the project site is therefore speculative as this resource as never been developed for potable or irrigation water on the Kona Coast. The DEIS should have included information demonstrating that this resource can be developed and used in a manner that can be continued indefinitely, without causing unacceptable environmental, economic, or social consequences.*

Response: The intent of the deep test well to be drilled at the upper end of the project site is to determine: (1) if fresh groundwater exists at depth below the basal lens and saline groundwater regimes; (2) if a sufficient supply can be developed from the fresh water at depth; and (3) if freshwater extraction at that depth will not diminish the flow of brackish basal groundwater flowing through Kaloko-Honokohau National Historic Park. If all three of these conditions are not met, the project's drinking water supply would be provided by desalinization of saline groundwater which would be extracted at a depth so as not to impact the overlying basal lens.

13. *Page 2-48. Several alternatives being investigated to supply potable water for the proposed project, including the preferred alternative, may require an on-site desalination facility, about one mile from the National Park. However, no*

information is presented on the proposed quantity of brackish water needed to produce potable water, nor is any information presented on the quantity or quality of effluent that will be generated as part of the desalination process. Statements indicating that the desalination water system will have "no impact" are unsubstantiated. More specifically:

(a.) Page 2-49; Page 4-114. The statement "The desalination water system will have no impact on potable or brackish groundwater. Likewise, it will not affect nearshore waters and will not affect groundwater used by neighboring projects or anchialine pools and fishponds in the area, including nearby Kaloko-Honokohau National Park" is unsupported by a quantitative analysis and no desalination plants have been used to supply potable water on a large-scale on the Kona Coast. The DEIS should have included credible scientific information to support this conclusion.

Response: Desalinization of brackish basal groundwater is not among the supply alternatives being considered for the project as it would have an obvious and substantial reduction of the basal groundwater flowing through Kaloko-Honokohau National Historic Park. The two desalting alternatives being considered are: (1) desalting the "fresh" groundwater extracted at depth below saline groundwater that, due to its location and depth, is slightly brackish under an applied pumping stress; and (2) desalting saline groundwater extracted at depth below the basal lens. For the first of these possibilities, similar desalinization is being successfully undertaken at relatively large scale at the Hualalai and Kukio Resorts. For the second alternative, the desalinization of saline groundwater, the Honolulu Board of Water Supply has completed a pilot program to determine feasibility and cost. When potable groundwater on Oahu is essentially tapped out, the Honolulu Board of Water Supply plans to desalinize saline groundwater on a large scale (planned 5 MGD increments).

(b.) The DEIS does not state the anticipated number of injection wells, their injection rate, or quality of the injected fluids that will be needed to desalinate brackish groundwater, yet finds there will be no impact on basal groundwater. The DEIS should have included this information to support the conclusion of no significant impact.

Response: For each disposal practice, excess R-1 and, if applicable, concentrate from the RO desalting process, would have two disposal wells, with the second providing back up capacity. The impacts of these practices are dealt with in the 2012 report by TNWRE. In each case, disposal would be below the basal lens and take advantage of density differences and permeability anisotropy to avoid impact of the basal lens.

(c.) The DEIS does not evaluate the cumulative impact of the proposed desalination plant in addition to the The Shores at Kohanaiki desalination plant which began operating in November 2008 immediately downgradient of the proposed project site and adjacent to the National Park. This desalination plant includes eight pumping wells and one injection well and will further complicate the response of the basal aquifer to pumping and injection. The Shores at Kohanaiki are required to report chloride concentrations at all pumping wells and eight monitoring wells on a monthly basis, to monitor water quality at the injection well on a quarterly basis, and to collect a conductivity-temperature-depth profile at the deepest monitor well on a quarterly basis. The DEIS should have included a quantitative analysis of the cumulative effects of the proposed and existing desalination facility. This analysis should include a review of the monitoring data collected at the Kohanaiki desalination plant since it began operating in 2008.

Response: The impact of the Kohanaiki Shores basal extraction and concentrate discharge are not dealt with in the 2012 TNWRE report because the alternatives for Kaloko Makai are completely different. There will be no extraction from the basal lens and concentrate disposal will be at far great depth. As such, Kaloko Makai will not add to the identifiable impacts caused by the groundwater use and disposal at Kohanaiki Shores.

(d.) If desalination is required to produce potable water from on- or off-site wells, then the volume of brackish groundwater that must be pumped to produce potable water will be much greater than the water demand estimated in the DEIS. For example, The Shores at Kohanaiki estimated that the ratio of brackish (46% seawater) groundwater pumped to potable product was about 1.5 (Kohanaiki Non-potable Water Plan). Ooma Beachside Village estimated that the ratio of brackish (78% seawater) groundwater pumped to the potable product water would be about 2.25 (Exhibit 42, LUC Docket A07-774). The DEIS should have quantified the pumping rate of the on- or off-site brackish wells and evaluate the effect of pumping up to 2.25 times the estimated water demand to provide potable water for the project.

Response: The first point to emphasize is that Kaloko Makai would not be pumping brackish basal groundwater as the feedwater supply. It would extract saline groundwater (80% or more of seawater salinity) from below the basal lens and affirmatively demonstrated as having no impact on the basal lens. The salt water supply and disposal wells that have been developed in West Hawaii demonstrate that this can be done. Second, the expectable product water will likely be in the range of 35 to 40 percent of the seawater supply. That means the amount of saline groundwater utilized to create a gallon of potable water may be as much as 2.8 gallons. Third, the supply of saline

groundwater, extracted without impact on the basal lens, is essentially unlimited.

(e.) The DEIS does not estimate or consider the additional source of nitrate-nitrogen to groundwater from RO injection. The actual nitrate-nitrogen added to groundwater from the Kohanaiki injection well is greater than estimated for the project by nearly a factor of three (source: Kohanaiki injection well water quality reports and 2007 Kohanaiki Non-Potable Water Plan).

Response: The desalting process does not add dissolved nitrate -nitrogen. It merely extracts it from the product water and puts it in the concentrate which will be delivered back into the saline groundwater zone with no impact on the basal lens.

(a) There are three alternatives: 1) Utilize wells at 710 foot elevation 2) Utilize wells at 710-feet elevation: saline groundwater and desalination plant 3) desalinization of on-site saline groundwater at lower elevation (363 ft.).
(b) The project may have three types of disposal wells: concentrate from desalting; excess R-1 effluent; and stormwater drywells.
(c) The impact of the Kohanaiki Shores basal extraction and concentrate discharge are not dealt with in the 2012 TNWRE report because the alternatives for Kaloko Makai are completely different. There will be no extraction from the basal lens and concentrate disposal will be at far great depth. As such, Kaloko Makai will not add to the identifiable impacts caused by the groundwater use and disposal at Kohanaiki Shores.
(d) For saline groundwater desalting, the feedwater is expected to have a salinity of 28 parts per thousand (PPT) or greater and the product water will be 40 percent of the feedwater supply.
(e) For each disposal practice, excess R-1 and, if applicable, concentrate from the RO desalting process, would have two disposal wells, with the second providing back up capacity. The impacts of these practices are dealt with in the 2012 report by TNWRE. In each case, disposal would be below the basal lens and take advantage of density differences and permeability anisotropy to avoid impact of the basal lens.

14. *Page 2-48. "Kaloko Makai is committed to water conservation strategies... the goal is to reduce the total water use through a combination of water saving equipment and strategies" The "equipment and strategies" are not discussed or described in any detail, and, therefore, there is no way to tell if this "commitment" is appropriate, effective, or implementable.*

Response: The "equipment and strategies" you reference are included in the Kaloko Makai Sustainability Plan which is included in the forthcoming Second DEIS.

The Sustainability Plan identifies a number of measures that may be implemented to facilitate end-user conservation, including water restrictions during drier periods, public education and more efficient landscaping practices.

Efficient fixtures and appliances will reduce indoor water use. The water distribution system will be maintained to prevent water loss and homeowners and businesses will be encouraged to maintain fixtures to prevent leaks. Landscaping will emphasize climate-adapted native and other appropriate plants suitable for coastal locations. Best management practices will be designed and implemented to minimize infiltration and runoff from daily operations.

Water-efficient fixtures such as high efficiency toilets, flow limiters for faucets, flow control valves, and water efficient showerheads reduce water and sewer costs, reduce demand on water supplies and treatment facilities, and reduce heating energy consumption and associated greenhouse gas emissions.

15. *Page 2-48. The DEIS does not identify how sustainable building design and LEED concepts and certifications will be implemented. There are no specific commitments from the project proponent to actually follow through with implementing sustainable building design and LEED concepts.*

Response: Sustainable building design is discussed in the Kaloko Makai Sustainability Plan which is included in the forthcoming Second DEIS. The Sustainability Plan discuses a variety of recognized sustainability programs and plans.

There are several consistent principles and themes that run through the various programs and plans. While some are broad-based and include several of these, others are focused on single issues. The following are some of the consistent messages found in these programs and plans:

- Soft touch on the land
- Respect and protection of natural and cultural resources
- Use of natural elements (shading, ventilation, lighting, etc)
- Diversity of land uses, housing types, prices
- Live, work, play, shop and learn
- Walking, bicycle and transit transportation focused
- Reuse and minimization of waste
- Renewable and efficient electric
- People and community focused

The Petitioner will implement, to the extent feasible and practicable, measures to promote energy conservation, sustainable design, environmental stewardship and protection of the natural and cultural resources into the project. These actions are in part, based on the recommendations noted in the Sustainability Plan.

16. *Page 2-50. "The projected wastewater generation demand for Kaloko Makai is 2.37 million gallons per day (mgd) average dry weather flow. The WWTP will be designed to reduce the concentrations of Total Nitrogen (TN) to <5 mg/l, and Total Phosphorous (TP) to <2 mg/. Installation of the Private WWTP shall be subject to conditions of approval by the DOH, including any lower concentrations of TN and/or TP in the effluent, and HAR Chapter 11-62. The amount of recycled water produced will be essentially the same as the amount received for processing, or 2.37 mgd." A general rule of thumb for projecting wastewater generation (refer to Wastewater Engineering Treatment, Disposal, and Reuse by Metcalf and Eddy, EPA website, and other sources) is that it will equal the projected water use at full build-out, minus outdoor use (such as car washing and irrigation), minus loss and leakage (should be minimal). Since most of the proposed project's irrigation water is coming from R1 treated watered, the projected wastewater generation demand should be approximately equal to projected water use at full build-out (3.0-3.2 mgd (average) and 4.7-4.8 mgd (max)). Therefore, the DEIS has underestimated wastewater generation by as much as half of what can be expected based on the estimated water use in the DEIS - which is itself substantially underestimated. The amount of wastewater, therefore, will be significantly larger than stated in the DEIS.*

    Response: Although we generally concur with the logic provided, the wastewater demand calculation follows County standard guidelines. Projections have been revised according to updated land use plan and in accordance with County standard guidelines.

The DEIS does not provide any scientific justification for why these concentrations of TN and TP are protective and appropriate, or why lower concentrations would not be more appropriate and protective. The DEIS should provide scientific studies, not solely citations from engineering wastewater manuals, that support the selection of these concentrations. Before an appropriate analysis of the impacts from the disposal of wastewater (whether through irrigation, infiltration basins, or injection wells) on coastal and marine resources, including the resources within the National Park, can be completed, the DEIS must provide a more detailed description of the quality of the water to be discharged including what methods will be used to reduce nutrients and what methods will be used to prevent pharmaceuticals and other contaminants from reaching the National Park. If a hospital is built as part of the project as described, it is especially important to

analyze the full range of potential impacts from a hospital including the fate of pharmaceuticals in treated wastewater from the facility. For a wastewater facility this close to a national park, which will include injection wells as part of waste management, wastewater treatment should include maximum nutrient removal, be treated to tertiary standards including removal of pathogens, and de-chlorination should follow chlorination steps. The DEIS should describe why dry-lining for potential hookup to the Kealakehe WWTP is not an option as was required for Lanihau and TSA developments adjacent or near the project site.

    Response: Wastewater will be treated to meet R-1 water quality standards. The Second DEIS will be modified to include a description on why the project cannot connect to the Kealakehe WWTP.

17. *Page 2-59. Adequate justification is not made in the DEIS to support the density and number of housing units proposed. The NPS questions the need for an additional 4,180 multi-family units in North Kona. Especially since many thousand more single- and multi-family units are planned for construction in the immediate area. Given the impact to the community and the environment, the project proponents have not justified the need for the number and density of housing units in their preferred alternative.*

    Response: The Kaloko Makai Market Assessment clearly notes that "Kaloko Makai has been planned to respond to its community's desires regarding future growth, as expressed in the Kona Community Development Plan. The Kona CDP directed growth to compact, higher density "villages" mostly located north of Kailua-Kona Town along the Ane Keohokalole Highway transit corridor. These growth centers were directed to 10 Transit-Oriented Development (TOD) Urban Villages, of which Kaloko Makai is identified as one."

    That analysis also concluded that "even with aggressive and unprecedented levels of future development, the CRMA could experience a shortfall of some 9,400 primary homes by 2040, if no more lands are entitled and planned for this market."

    It goes on to state, "The first residential product at Kaloko Makai is projected to be available for sale in 2015. Thereafter, it is anticipated that the 5,000 maximum proposed homes could be absorbed over 26 years at an average rate of about 190 units per year." And further concludes, "Actual sales would vary from year to year depending on market and construction cycles, and the types of units available for sale at any given time. At maximum build-out, Kaloko Makai's 5,000 units could provide a solution for about 45% of the anticipated future unplanned and un-entitled demand for primary resident housing units (RHUs) in the CRMA through 2040." The report includes a full explanation of these conclusions.

18. *Page 3-4. The statements that the soils with Kaloko Makai are not suitable for cultivation are not accurate. The project location is known for high productivity of food crops, as evidenced by the numerous examples given within this document. This DEIS notes on page 4-10 that agriculture (including farming, horticulture and subsistence planting) and animal husbandry are "function types commonly encountered in this general area" and that there are "several pervasive agricultural sites in the project area with widespread clearing and planting mounds" (Table 4-2). On page 4-43 of the DEIS, "During the mid 1800s, Captain Charles Wilkes of the American Exploring Team comments on the agricultural use of pahoehoe excavations (similar to the modification of pahoehoe outcrop in the project) which he observed specifically in the Kona region." Page 4-50 of this document notes "During the 1930s to 1940s, the alahe'e along with mango, banana, uhi or yam (Dioscorea alat), and pia, a Polynesian arrowroot (Tacca leontopetaloides) used as medicine and food by Hawaiians, were also widely distributed in the project area."*

Response: The CIA states, "Maly (1993:29) explains that traditional accounts of Kaloko and Kohanaiki describe a lush environment that differs from its current state due to several factors. The Hualalai lava flow in 1801 covered the former agricultural and forested lands, residential areas, and fishponds. The loss of forests began the decrease in rainfall that was exacerbated by the introduction of livestock and ranching. Goats and cattle stripped the vegetation from the lands causing water resources to dry up. Thus, over the last 150 years, the environment has been significantly altered."

As described in the DEIS, various crops were traditionally cultivated within the Kekaha region and the project area. Lava tubes were utilized to capture dripping ground water almost without exception, even when the labor required to do so would have been very significant.

Sweet potato, the most abundantly grown crop, was commonly planted in mounds and in pahoehoe excavations. Accounts of the area note the labor intensive nature of the farming and that the potatoes were grown in lava.

"Wherever the lava could be pounded into scoria, a plantation of sweet potatoes was laboriously formed by digging among the stones and filling in the holes with dried grass brought from the mountainside."

During the mid 1800s, Captain Charles Wilkes of the American Exploring Team commented on the agricultural use of *pāhoehoe* excavations (similar to the modification of pahoehoe outcrop in the project) which he observed specifically in the Kona region:

"Cultivation is carried on in many places where it would be deemed almost impracticable in any other country."

Sweet potatoes were also cultivated within walled fields or depressions in the walls themselves. E.S. Craighill Handy and Elizabeth Green Handy discuss this method from an account that appeared in the Hawaiian newspaper *Ka Nupepa Ku'oko'a* (March 24, 1922):

"Rocky lands in the olden days were walled up all around with the big and small stones of the patch until there was a wall (kuaiwi) about 2 feet high and in the enclosure were put weeds of every kind, 'ama'u tree ferns and so on, and then topped well with soil taken from the patch itself, to enrich ti, or in other words to rot the rubbish and weeds to make soil.

After several months, the rotted weeds were converted into soil of the best grade. The farmer waited for the time when he knew that the rains would fall, then he made the patch ready for planting. If for sweet potatoes, he made mounds for them and for taro too, on some places on Hawaii. (Handy and Handy 1972:131)"

Thus, farming in this area was for subsistence, and not necessarily as a cash crop. As illustrated in past accounts, the terrain was harsh and crop cultivation came at great labor.

Oral histories of the area, ethnographic evidence and archaeological evidence document that the upland Kaloko and neighboring areas are prime for agricultural purposes. Ethnographic and archaeological evidence for the Kaloko ahupua'a is a well developed part of the Kona Field System (Tuggle and Tuggle 2006, Cordy 2000, Newman 1970, Schilt 1984). Crops from this area included sweet potato, taro, banana, mountain apple, wauke and breadfruit historically (Tuggle and Tuggle 2006, Land Commission and Boundary Commission documents) and more recently was known to be plentiful in mango, pineapple and sweet potato. Areas slightly further south at the same elevation as the project area within the Kona field system are known to be fertile for production of sweet potato, wauke, and breadfruit (Kelly 1983).

Response: The forthcoming Second DEIS has been revised with the following sentence added: "Oral histories of the area, ethnographic evidence and archaeological evidence document that the upland Kaloko and neighboring were, in the past, utilized for agricultural purposes."

19. *Page 3-14. The DEIS states that "The groundwater lens in the Keahole vicinity is brackish and discharges freely along the coast in a narrow band of a few feet wide in the intertidal zone." However, later the DEIS states on Page 3-35 that "A*

somewhat unusual finding is that the lowest salinities in the ocean samples were not found nearest to the shoreline off of either fishpond. Rather, the lowest salinities were measured in surface ocean samples approximately 25-50-m offshore." These statements appear to contradict each other. The DEIS should have clarified the area where groundwater discharges into the ocean.

Response: Discharge into the marine environment of the brackish basal lens is generally along the shoreline and possibly, in localized situations due to varying lava flow variability, at a modest distance off shore. Measurements of shoreline and nearshore salinities which are indicative of groundwater discharge reflect these spatial variations. They also reflect temporal variations as the phase of the tide has substantial impacts on this discharge.

20. *Page 3-14. The DEIS states that "Salinity, lens thickness and the diffuse transition zone are all indicative of a modest groundwater flow." The DEIS should define "modest" quantitatively. Also, the listed factors do not preclude the possibility of high groundwater flow (say greater than 5 Mgd per mile of width) with a large amount of mixing caused by hydrodynamic dispersion.*

    Response: The 2012 report by TNWRE uses an estimate of 1.7 MGD per costal mile for the basal groundwater flowrate in the Kaloko Makai mauka-makai corridor. The suggestion that the actual flowrate is much higher (5 MGD or more per mile) but is masked by mixing through hydrodymic dispersion is simply without basis in fact. If this were actually the case, brackish irrigation quality wells could be developed toward the inland margin of the basal lens. Every such well that has been tried encountered water initially too salty for irrigation use (nos. 3959-01 and 4058-01 for example) or became too salty under a modest pumping rate (nos. 4160-01 and 02).

21. *Page 3-15. The DEIS states that "While the hydraulic relationship between the two groundwater bodies is not yet understood, it is undoubtedly the reason for the anomalous characteristics of basal groundwater in the Keahole to Kailua area. (Nance 2008). The DEIS should explain what is meant by "anomalous characteristics".*

    Response: The anomalous characteristics are those which would not be expected for the size of the potentially contributing watershed to the groundwater flow. The two most significant are: (1) groundwater that is substantially colder than in the high level aquifer directly inland; and (2) salinity that is far higher than would be the case if a significant portion of the rainfall-recharge on the upland watershed actually passed through the basal lens.

22. *Page 3-15. The DEIS states that "Use of Well 3857-01 at Wai'aha started in 2005." The State Commission on Water Resource Management lists this well as abandoned and sealed. Perhaps the correct well number should be 3857-04.*

    Response: The Waiaha well that is in use by DWS is State No. 3857-04. The forthcoming Second DEIS will list the correct well number.

23. *Page 3-15. The DEIS states that fresh water was encountered at 1,060 ft below sea level at the Kamakana Villages Well (3959-01), but no information is provided to support this statement. Documenting the source of this information is important because this resource has never been developed for municipal use, yet it is the preferred alternative to supply over 3 Mgd of potable water for the project. The DEIS should have included credible scientific documentation of the circumstances under which fresh water was encountered at the Kamakana Well.*

    Response: The 2012 report by TNWRE provides detailed information on the Kamakana Well (No. 3959-01). Similar information was presented to the Water Professionals group at one of its meetings earlier this year. The data was also made available to Delwyn Oki of the U. S. Geological Survey.

24. *Page 3-25. Section 3.5.1 "Due to high permeability of the natural ground surface across the project site, ...surface runoff does not occur on the project site even during the most intense rainfalls. Natural drainage of the project site consists of rainfall percolation through the layers of very porous lava to the ground water table." The more development at the project site (and on the upslope lands), the more difficult it will be for "green space" to take-in or absorb the surface water runoff water, as the "green space" will not have the same surface area it once did to percolate. Furthermore, the claim that rainfall percolates through the layers of very porous lava to the ground water table (with respect to surface water), is contradictory to the claim that wastewater effluent disposed onsite percolating through the same layers of very porous lava to the ground water table will not have significant impact.*

    Response: The 2012 report by TNWRE provides analyses of the fate of nutrients in R-2 waste water disposed of by the County in a pit upgradient of Honokohau Harbor. Natural nutrient removal rates are very high. Nutrient in wastewater reused for irrigation of the project site will be removed by plant uptake. The small fraction of the applied wastewater that percolates to groundwater below will have nutrients removed naturally in a manner similar to the County's ongoing wastewater disposal. These factors are the basis for the conclusions in the Second DEIS.

25. *Page 3-26. The DEIS states that reverse osmosis concentrate will be injected into the basal aquifer in strata where groundwater salinity is 30 ppt or greater, and asserts on p. 4-110 that "Since the concentrate has a greater density than the surrounding saline groundwater it will flow seaward without rising above the surrounding saline groundwater and will not rise to the basal freshwater layer. It is then discharged into the ocean offshore at a substantial depth and distance from the shoreline." At the same time, the DEIS also notes on p. 3-16 the presence of a saltwater circulation system where "Saltwater flows landward in the deeper parts of the aquifer, rises and then mixes with seaward-flowing groundwater." The predicted fate and transport of the injected reverse osmosis concentrate is speculative and unsubstantiated by references to any credible scientific evidence. The DEIS should have included (1) the estimated salinity of the reverse osmosis concentrate from the proposed project, and (2) a quantitative analysis of the potential for the injected reverse osmosis concentrate to enter the saltwater circulation system and increase the salinity of inland and nearshore marine waters downgradient of the project site.*

Response: The 2012 TNWRE report provides information on the process of desalting with saline groundwater as the feedwater supply. Pragmatic evidence of the lack of an effect of subsurface disposal of hypersaline water is provided by ongoing practices of the cogeneration power plants in Ewa, Oahu. Disposal of their hypersaline cooling tower blowdown, which of comparable salinity to the concentrate from Kaloko Makai's desalting process, is at an average of about 10 million gallons per day (mgd). The practice has been in place for 20 years without any adverse environmental impact.

26. *Page 3-26. The DEIS should have discussed in detail how it will protect NPS resources downslope from the proposed project. The DEIS should have included a thorough and rigorous analysis of potential impacts, direct and cumulative, to groundwater and groundwater-fed ecosystems from termiticides and pesticides used on houses, buildings, grounds, and common areas; added nutrients from irrigation and fertilized green spaces; potential releases of contaminants from commercial businesses in the light-industrial/commercial parks who generate hazardous wastes (e.g., metal finishing, photoprocessing, automotive maintenance, dentistry, pesticide companies, printing, etc); potential releases of medical wastes, pathogens, and pharmaceuticals from the medical facilities; nutrients, pathogens, and pharmaceuticals carried in wastewater; contaminants associated with roadways and other impermeable surfaces including petroleum products, metals, pesticides, nutrients, and other pollutants.*

Response: The 2012 TNWRE report presents a complete analysis of the impact to groundwater flowrate, salinity, and nutrients. (Note: TNWRE report is limited to DOH water quality parameters. It does not address the other contaminants listed

in the comment, although these are not in DOH's standards and are not known to have caused an issue anywhere in North Kona).

27. *Page 3-26. "As the excess irrigation water percolates downward through the unsaturated zone to the groundwater, natural removal of nitrogen and phosphorus from the water will be significant." The DEIS should have quantified "significant." It is not possible to analyze impacts to NPS resources without an accurate understanding of the increased flow of nitrogen and phosphorous into NPS waters.*

Response: The 2012 TNWRE report quantifies the natural nutrient removal rates using data of the County's wastewater disposal in a pit nominally upgradient of Honokohau Harbor.

28. *Pages 3-26 and 3-74. Details regarding stormwater management and impacts to NPS aquatic resources are not provided in the DEIS. Surface runoff from impermeable surfaces associated with this development will occur. DOH and County drainage regulations do not address polluted runoff, only volume of runoff. Drywells are nothing more than holes in the ground; conduits for polluted runoff to groundwater. No specific pollution reduction devices or methods with numerical removal efficiencies are proposed beyond stating BMPs will be used. Moreover, there is no discussion of how the BMPs will be implemented, who will monitor the BMPs, or how they will be enforced. It is not adequate for purposes of an EIS to merely state "Innovative and more natural ways to handle drainage improvements will be sought to comply with the County drainage standards." The details of these "innovative" means should be explained. Potential environmental impacts to coastal and marine resources, including the resources in the National Park, have not been evaluated and the statement that "Kaloko Makai is not expected to have an adverse effect on groundwater or coastal marine waters" is completely unsupported. No data have been presented to support this conclusion.*

Response: BMP description will be revised to include compliance with local Permanent and Construction implementation standards. Prior to disposal into drywells, removal of solids and other pollutants from stormwater runoff will include natural methods, such as retention basins, grass swales, biofilters and sediment basins. Where applicable, mechanical methods will be utilized, including, but not limited to, filter inserts, sand filters, or hydrodynamic filter units.

The design concept for the drainage system is to eliminate surface runoff from leaving the site. Natural areas, pits, and dry wells will collect runoff and allow it to infiltrate rather than leave the site as surface water. The passage of such runoff from the ground surface to the groundwater below, though the unsaturated

(vadose) zone, provides natural filtration and adsorption. Surface runoff from most of the developed areas in Kailua-Kona is handled in a similar manner without identifiable adverse impacts to groundwater or the Makai environment.

The 2012 TNWRE report includes an analysis of the potential impact of the subsurface disposal of stormwater runoff.

29. *Page 3-27. "Control of contaminated surface water can be achieved through the development of a PPP designed to address all pollutants associated with the development and to identify measures that will contain and treat such pollutants in order to prevent any release into the environment, including the groundwater. There will be no anticipated adverse impact on groundwater quality from the development of this project." These statements are highly speculative with no analysis to support the conclusion that there will be no adverse impacts to groundwater quality, and are not substantiated by any data presented. PPPs, although a statement of good intentions, are difficult to implement, monitor, or enforce. PPPs, even good ones, cannot guarantee that no contaminated surface water will reach the groundwater. There is no discussion of how the project proponent will implement the PPP, which is especially problematic given the multitude of land uses (industrial, recreational, and single and multi-family housing units) and length of time to complete this development. CCRs are an inadequate mechanism to prevent pollution offsite of the development as there is no reason for landowners to self-police for offsite damages and no governmental agency - local, state or federal - can enforce them.*

Response: The design concept for the drainage system is to eliminate surface runoff from leaving the site. Natural areas, pits, and dry wells will collect runoff and allow it to infiltrate rather than leave the site as surface water. The passage of such runoff from the ground surface to the groundwater below, though the unsaturated (vadose) zone, provides natural filtration and adsorption. Surface runoff from most of the developed areas in Kailua-Kona is handled in a similar manner without identifiable adverse impacts to groundwater or the Makai environment.

30. *Page 3-28. The DEIS states: "Nutrient loading and its subsequent impact is one of the more important issues concerning conservation and protection of coral reefs" and then goes on to say "However, according to Atkinson (2003) [sic], the conclusion that nutrients are deleterious to a reef ecosystem is incorrect." Although some of the statements made in this section of the DEIS are indeed in Atkinson and Falter (2003) book chapter (cited in the DEIS as Atkinson 2003), this statement must be taken in context with other statements in Atkinson and Falter that are not mentioned in the DEIS. Overall the comments in the DEIS that were derived from Atkinson and Falter (2003) are one sided, incomplete, and are not*

fully supported for Kaloko-Honokohau marine waters. Atkinson and Falter (2003) focuses on the flux of nutrients in and out of coral systems, not on indirect effects of nutrients on the coral. In fact, the Atkinson and Falter (2003) states that significant anthropogenic impacts of nutrients on coral tend to occur "in areas of groundwater or surface water where relatively large areas are discharge into shallow reef flats." This is the situation at the National park, where approximately three million gallons per day of groundwater discharge to marine waters in Honokohau and Kaloko Bays. Atkinson and Falter also state there is a need for more studies in which the organism or community responses are a function of actual nutrient loading, per area of bethos, not a function of concentration. The DEIS should have stated that nutrient impacts to coral reefs are probably indirect and long term and that it is possible that nutrients can stimulate bacteria and other disease vectors that might harm coral. Overall, the statements that are quoted from Atkinson and Falter in the DEIS seem to have been selectively picked to include only the ones that support the hypothesis that excess nutrients have little or no impacts on coral health in order to mislead the reader. The statements that tell the other side of the story, such as those quoted just above, are not included in the DEIS. There are many cases in the publish scientific literature where excess nutrients, as well as the pathogens that will be associated with this development, can result in coral reef degradation due to various indirect processes. There is no conclusive evidence presented in the DEIS that corals cannot be harmed by excess nutrients and/or an unnatural ratio of organic to inorganic nutrients on human pathogens. Excessive nutrients cause excess algae growth that can lead to depletion in oxygen available for other organism associated with a coral reef and can lead to depletion in oxygen available for other organisms associated with a coral reef and can lead to algae blooms that take over sections of coral, blocking the sunlight and hurting its ability to thrive. The state of Hawaii is experiencing a significant decline in some of Maui's coral reefs experiencing a significant decline where excess nutrients are implicated in invasive algae blooms. Although the factors influencing Maui's reef decline are complex, the DAR reported (Williams et al 2007) "strong indications that human impacts have been very important." Supporting data include proximity of private and county sewage injection wells, which place nutrient loads close to the coral substrate, high levels of nitrogen and phosphorus, and stable isotope ratios indicative of animal waste (presumably sewage) in algae. The potential for a hospital associated with this development is another concern. Pathogens, pharmaceuticals, and endocrine disrupting compounds are associated with hospital waste, many of these are unlikely to be fully eliminated by the proposed sewage treatment plan. The effects of these pathogens and compounds on coral reefs were not mentioned or analyzed in the DEIS, therefore the DEIS is seriously inadequate to evaluate impacts to coral reefs.

Response: Naturally occurring groundwater nutrient discharge to the ocean in many areas of West Hawaii is far greater (at least twice) than that at Kaloko-Honokohau area with no negative effect to coral reef development. The shallow reef flat fronting the Kaloko-Honokohau area (project site) results in vigorous mixing action owing to breaking waves that thoroughly mix nutrient concentrations to background oceanic values within meters of the shoreline. Hence, even with the small increase of projected groundwater nutrients in groundwater flux there is likely to be little or no effective increases to offshore areas where reefs occur. Should such vigorous mixing not occur, then incoming groundwater would be maintained as a buoyant surface lens, with no contact with benthos (corals grow on the bottom). There is much scientific literature documenting coral growth in areas of high nutrients, such as in areas of upwelling, or the Waikiki Aquarium, where corals growing in saline groundwater with substantially elevated nutrient concentrations grow at rates higher than measured in natural areas.

31. *Page 3-29 to 3-34. "3.5.3.1.1. Assessment of Coral Ecosystem Health of Kealakekua Bay and Honokohau Bay." The discussion in this section supports the conclusion that inputs of nutrients from the Kaloko Makai development will likely result in adverse impacts to the natural and cultural resources within the National Park. None of the arguments or information presented supports the assertion that more nutrients and other pollutants will not result in impacts to the NPS natural and cultural resources. Furthermore, none of the other sites discussed in the DEIS for comparison are in pristine conditions. The NPS mission is to maintain its marine waters in as pristine conditions as possible.*

Response: *An Assessment of Marine and Pond Environments* was prepared for the Project by Marine Research Consultants report. The report will be included in the forthcoming Second DEIS.

According to the assessment, it is unlikely that there will be any effect to the nearshore marine environment as a result of increases in nutrient concentrations in groundwater. Dollar and Atkinson (1992) modeled input of nutrients to the ocean downslope from two golf courses in West Hawaii over a four year period. In summary, nitrates and phosphorous increased in Keauhou Bay, however with rapid circulation along the Bay, the benthos was not exposed to the nutrients and prevented phytoplankton blooms. These results indicated that even with long-term input of high nutrient subsidies, there are situations where there are no negative effects to the receiving environment. Similar lack of impact is expected at the Kaloko-Honokohau region where nutrient subsidies are less than Keauhou.

Seasonal long-period swells result in turbulence along Kaloko-Honokohau National Historic Park shoreline. Such turbulence is the reason coral communities

are poorly developed along this area. Hence, owing to the high and consistent rates of mixing, as well as minimal input of materials from the land to the ocean, it not likely that nutrient concentrations in the waters downslope from the project site have any effect on marine communities.

It is perceived that nutrients damage coral reef. However scientific literature does not show this. Corals have been observed growing successfully in area(s) with high nutrient concentrations as discussed in MRC's report.

32. *Pages 3-33 and 3-34. "Coral ecosystems will not normally recover from chronic stresses until the stressors are removed (Grigg, 1995; Edinger et al., 1998). If elevated nutrients and/or algal cover are chronic stressors to the coral ecosystems of this study as the results indicate, and future human population growth and development continue to increase nutrient inputs to these bays, then it is likely that future degradation is imminent..." The DEIS did not discuss how the coral reef ecosystems within NPS boundaries, or North Kona, will be affected by cumulative nutrient stresses associated with the proposed development and other nearby developments. Compare these pages with lack of any discussion on pages 8-2 to 8-4.*

Response: See response above. With respect to algal cover, there is essentially no "algal cover" on reefs in West Hawaii today, including in areas with far greater nutrient input than projected for the Kaloko-Honokohau area.

33. *Page 3-34. "3.5.2.2. Endangered Marine Species" The presence of endangered species, and the difficulty of assigning specific impacts to specific causes in these complex environments, argues for using the precautionary principle to significantly limit additional inputs of human sewage including organic nutrients, pharmaceuticals, and other contaminants into the groundwater that flows through, under, and in the National Park.*

Response: As mentioned previously, an *Assessment of Marine and Pond Environments* and an *Assessment of the Potential Impact on Water Resources* was prepared for the Project by Marine Research Consultants and Tom Nance Water Resource Engineering, respectively. Both reports will be included in the forthcoming Second DEIS.

Excess R-1 treated wastewater effluent will be disposed of in injection wells located at the Project's on-site wastewater treatment plant. This may require the injection wells to deliver the water at depths of 300 feet or more below sea level. The disposal depth is warranted to avoid having a significant impact on basal groundwater moving through the Kaloko-Honokohau region or the Park's nearshore waters. Results of the analysis is further discussed in TNWRE's report.

34. *Section 3.5.2.3. This section of the DEIS is a long review of very old, non-peer reviewed reports, containing in large part data collected nearly a decade or more ago. These reports and the data therein were presented in the TSA and Lanihau Dockets and were refuted by the LUC at those hearings. (TSA FFCLDO 2002, Lanihau FFCLDO 2002). The discussion and conclusions regarding nutrients, pond characteristics and groundwater level and flow in this section are wholly unsupported even by the reports cited. In addition, as in these previous proceedings, the developer and its consultants failed to conduction an environmental risk analysis. Even the most basic facts in this section are wrong; for example, Kaloko Fishpond waters are becoming less saline and are experiencing higher residence times, not the other way around. Groundwater flows into both ponds, not around them. Both ponds do not function as anchialine ponds, Kaloko is connected to the ocean. No effort was made to accurately portray the current status of the coastal water resources and ecosystems, or the endangered species that inhabit those ecosystems, nor was any effort put forward to assess direct, indirect, and cumulative impacts to the endangered species dependent upon the park's water resources.*

Response: The 2012 TNWRE report presents an updated assessment of groundwater conditions in the mauka / makai corridor that includes the Kaloko Makai project site and Kaloko-Honokohau National Historic Park. The calculated potential changes to groundwater in that report have been used.

All of the statements made in Marine Research Consultants (2012) are based on recently acquired data and rely on information provided by TNWRE as well as other scientific documentation. Many of the statements in the comment above are reiterated in these reports based on these data.

Both reports will be included in the forthcoming Second DEIS.

The DEIS states "the potential exists that the development could pose secondary threats to the National Park and to its endangered birds if noxious substances such as petroleum, oils, lubricants, and sewage were to migrate downslope (makai) from the project into the Park" (p. 3-57) but then makes no attempt to analyze these threats. The DEIS also does not assess the cultural impact to Native Hawaiian traditional and customary activities resulting from degraded water quality and a restricted quantity of water. The project proponent appears to take the approach throughout the discussion of marine and brackish water resources that if the resources are currently experiencing degradation. The DEIS does not consider the proposed project in the context of other projects occurring in the National Park and elsewhere with regard to these resources. Moreover, the DEIS does not even attempt to analyze the amount of nutrients and other contaminants

that will come from the proposed project, the fate and transport of those contaminants, or the risk posed to receptors (i.e. flora and fauna). The conclusions of no impact from the proposed development to water quality in the DEIS are unanalyzed and unsupported, and the document is utterly inadequate for decision makes and the public to understand the real consequences that will occur if the project is completed. It is pure speculation, contradictory to both common sense and logic, and unsupported by any credible scientific study to state that "It is unlikely that there would be any effects to the nearshore marine environment as a result of increases in nutrient concentrations in groundwater."

Response: The 2012 TNWRE report provides the analysis of potential impacts requested. Along with the analysis in Makai Research Consultants (2012), sufficient information for decision making is provided. Both reports will be included in the forthcoming Second DEIS.

The NPS is concerned that the cumulative effects of the combination of restricted groundwater flow from over-withdrawal and additional nutrient/pollutant inputs when the proposed developments in close proximity to the Park are built out, poses a significant threat to endangered species at 'Aimakapa Fishpond. The U.S. Fish and Wildlife Service has identified 'Aimakapa Fishpond as recovery habitat for endangered Hawaiian waterbirds. The endangered Hawaiian stilt (Himantopus mexieanus knudseni) and endangered Hawaiian coot (Fuliea alai) are found at two fishponds at Kaloko-Honokohau National Historical Park. An avian botulism outbreak was documented there in 1994. The coot population was decimated, but the stilt population appeared to have been less impacted. Morin (1996) suggests that anthropogenic changes to water quality and quantity are likely to increase the potential for further botulism outbreaks. Because of the historical nature of the fishpond, the restoration actions are complex and traditional methods of draining and dredging are not readily available to the NPS, therefore additional nutrients and contaminants should be prevented from entering the fishponds.

Response: If there is a link between anthropogenic changes to water quality and quantity and the potential for the outbreak of avian botulism, we concur that draining and dredging the fishpond would be the most effective solution. Nevertheless, the project will not be utilizing the brackish basal groundwater that flows through Kaloko-Honokohau National Historic Park. The Second Draft EIS assesses three alternative water sources now being considered for the project's drinking water supply.

1. On-site wells at 710-foot elevation
2. On-site wells at 710-foot elevation with reverse osmosis (RO) Treatment

3. Desalinization of saline groundwater from 363-foot elevation on-site wells

These alternatives can be affirmatively demonstrated as having no impact on the basal lens. They are limited to use of the high level groundwater drawn from strata far below the basal groundwater so as not to impact it, and desalinizing saline groundwater, also drawn from below the basal lens. Brine from the desalinization alternative would also be discharged far below the basal groundwater.

35. *Page 3-43. "Future developments will be required to utilize the County wastewater treatment plants, hence eliminating the major source of nutrient subsidies." However, in Section 4.10.2, pg 4-24, the DEIS states, "The Kealakehe Wastewater Treatment Plant shall be expanded to accommodate the project sewage volume from the Urban Area extending south of Hina Lani Street to the Keauhou WWTP.... Representatives from the County DEM noted that there are no plans for construction of (a) decentralized WWTP in the immediately future." To our knowledge, there is no planned expansion of the Kealakehe WWTP. It is likely that most or all of the private developments surrounding the Park will be disposing their wastewater onsite before the County can improve their wastewater treatment capabilities; therefore, Kaloko Makai has significantly underestimated the "cumulative changes to groundwater from the total assemblage of existing and proposed projects with the potential to alter pond and marine environments."*

Response: Flow in the brackish basal lens proceeds from mauka to makai, is discharged into the marine environment at or near the shoreline, and is then rapidly mixed to background levels. For this circumstance, the analytical methods in TNWRE (2012) and Makai Resources Consultants (2012) appropriately quantify the impact to groundwater and the marine environment in Kaloko Makai's Mauka/Makai corridor.

36. *Page 3-45 (and pages 3-66-67 and 3-75) the DEIS also mentions a groundwater monitoring plan to detect contaminants in the groundwater below the proposed project. The proposed groundwater-monitoring plan will include monitoring wells, and a sampling and analysis plan. Parameters to be analyzed include: pH, temperature, salinity, nitrate, ammonia, dissolved organic nitrogen, TDS, TN, phosphate, dissolved organic phosphorus and TP and any other parameters required by the DOH. The project proponents are proposing to start water sampling prior to the start of grading activity, and to sample quarterly for two years, or as required by the DOH. Two years of sampling starting at the initial grading of this project means that water quality will last through the initial phases of construction and no monitoring would happen for any part of the actual use of the project site, including the use of the WWTP. Two years of sampling,*

regardless of when it started, is insufficient to monitor the impacts to groundwater from this project and inform decision makers and the public on how the project is adversely affecting the environment. Furthermore, DOH water monitoring protocols are designed to protect human health, not the ecological integrity of aquatic ecosystems. It is unlikely that all of the effluent generated by the WWTP will be used for irrigation. Furthermore, systems breakdown and backup systems need to be in place. The DEIS does not mention what type of back-up system will be used to dispose of wastewater. The DEIS should disclose to the Kona community that injection wells will be used and to what extent. The DEIS must analyze the potential impacts to coastal resources from injection wells (utilizing the information from Maui). The DEIS does mention infiltration basins as a means of disposing of treated wastewater not needed for irrigation during wet periods. Infiltration basins should be well defined and described. The impacts of infiltration basins and injection wells on the coastal and marine resources along the Kona coast, including the resources within the National Park, were not mentioned, discussed or analyzed in the DEIS.

Response: The 2012 TNWRE report provides complete information on potential groundwater impacts. The developer will conduct quarterly monitoring prior to the start of construction, monthly during initial construction and one year following, and then quarterly thereafter for five years.

37. *Page 3-62. The information cited on this page regarding groundwater resources within the National Park suffers the same problems as identified for section 3.5.2.3.*

Response: The 2012 TNWRE report provides updated water quality data, descriptions of the groundwater occurrence, and a qualification of potential groundwater impacts.

38. *Page 3-62. The statement in the DEIS that "No adverse groundwater effects have been observed from any of the existing wells in the regions, individually or cumulatively. There, no adverse effect is anticipated under the Kaloko Makai on or off-site groundwater wells" is unsupported by references to existing scientific evidence relevant to the conclusion. The conclusion ignores the rise in chlorides due to pumping and saltwater intrusion at the Kahaluu shaft wellfield (3557-01 to 05), which skims water from the basal lens and provides much of the drinking water for the North Kona System. The conclusion also ignores reasonable foreseeable significant adverse impacts from groundwater withdrawals based upon theoretical approaches or research methods generally accepted in the scientific community, including but not limited to USGS Water Resources Investigations Report 99-4070 and State Hawai'i Department of Land and Natural Resources 2008 Hawai'i Water Plan. The DEIS should have included references*

to credible scientific information to support the statement that existing groundwater development has had no adverse effects.

Response: The 2012 TNWRE report provides updated water quality data, descriptions of the groundwater occurrence, and a qualification of potential groundwater impacts. The over pumping of the Kahaluu Shaft and its consequent rising salinity is irrelevant to the Kaloko Makai project which will develop its own source of supply.

39. *Page 3-63. Alternatives to supply potable water to the proposed project include utilizing new and existing off-site high-level wells upgradient from the National Park. According to USGS Water Resources Investigations Report 99-4070, groundwater withdrawals from wells directly upgradient of the National Park will have a greater effect on freshwater discharge within the National Park, According to the DEIS, an analytical model developed by Tom Nance, Water Resources Engineering, indicates that pumping from high-level wells in the vicinity of the proposed project has the potential to raise the salinity of groundwater within the National Park by up to 53% (Table 3-6). This predicted effect may cause unacceptable impacts to groundwater-dependent cultural and natural resources in the National Park and along the Kona coast. The NPS seeks to maintain the flow of fresh groundwater to all inland and nearshore marine waters in the National Park to fulfill the specific purposes for which the Park was established, including traditional and customary Native Hawaiian practices and the protection of endangered species. Groundwater pumping has the potential to limit both the productivity and distribution of culturally important flora and fauna. For these reasons, pumping of high-elevation wells upgradient from the National Park is not an acceptable alternative to supply water to Kaloko Makai.*

Response: Impacts to groundwater based on the alternative sources of water supply being considered are quantified in the 2012 TNWRE report. The previous analysis you cite, USGS Report 99-4070 and the analytical model developed by TNWRE, were based on assumed full flow of high level groundwater into the basal lens which does not actually appear to be occurring. In any event, the water supply alternative that will ultimately be implemented will not draw from or otherwise reduce the flowrate in the basal lens, meaning that the predictions in the two analyses you cite are not applicable to the Kaloko Makai project.

40. *Page 3-63. The DEIS states that "With the addition of Palani Well No. 1, combined with the anticipated projects proposed in the region, salinity levels are estimated to increase" in the National Park. The analysis upon which this predicted cumulative impact is based, however, did not include groundwater development associated with the proposed Kaloko Makai project (see Table 1, Appendix 7, Palani Well No. 1 (State Well No. 4158-03) North Kona, Island of*

Hawai'i, State of Hawai'i, Final Environmental Assessment). The DEIS should include the additional pumping of at least 4.8 Mgd (but this is probably an underestimate) from the high-level wells upgradient from the National Park, because this alternative is being investigated to supply water to Kaloko Makai.

Response: As stated in the previous response above, impacts to groundwater based on the alternative sources of water supply being considered are quantified in the 2012 TNWRE report. The previous analysis you cite, USGS Report 99-4070 and the analytical model developed by TNWRE, were based on assumed full flow of high level groundwater into the basal lens which does not actually appear to be occurring. In any event, the water supply alternative that will ultimately be implemented will not draw from or otherwise reduce the flowrate in the basal lens, meaning that the predictions in the two analyses you cite are not applicable to the Kaloko Makai project.

41. *Page 3-63. The DEIS references "Montgomery 2009" in several locations but this reference is not included in Chapter 11 References.*

Response: The reference, Montgomery, Steven L. Ph. D. (2009) "Memorandum to Jimmy Greenwell, Subject: Comments on NPS Letter ref. Palani Well" Honolulu, has been added to the forthcoming Second DEIS.

42. *Page 3-64. The DEIS implies that the native orange-black damselfly can tolerate increasing salinity and temperature in anchialine pools due to the effects of pumping high-level wells. This assertion conflicts with the results of controlled laboratory experiments, which reveal that the eggs and naiads of the candidate-endangered orange-black Hawaiian damselfly (Megalagroin xanthomelsas) are sensitive to increased salinity and temperature, and that naiads exhibit a threshold response to salinity above 15 ppt, with no naiads surviving at 20 ppt (Tango, L.K.K., 2010, The effect of salinity and temperature on survival of the orange-black Hawaiian damselfly, Megalagrion xanthomelas. Master's Thesis, University of Hawai'i at Hilo, 46 p).*

Response: The Second Draft EIS assesses three alternative water sources now being considered for the project's drinking water supply.

1. On-site wells at 710-foot elevation
2. On-site wells at 710-foot elevation with reverse osmosis (RO) Treatment
3. Desalinization of saline groundwater from 363-foot elevation on-site wells

These alternatives can be affirmatively demonstrated as having no impact on the basal lens. They are limited to use of the high level groundwater drawn from strata far below the basal groundwater so as not to impact it, and desalinizing saline groundwater, also drawn from below the basal lens. Brine from the desalinization alternative would also be discharged far below the basal groundwater. Therefore, no impact on the damselfly could be attributed to the proposed project.

43. *Page 3-65. While it may be true that marine water within the National Park are already in violation of the State's water quality standards for nutrients, including nitrates, ammonia, and phosphate, and chlorophyll-a and turbidity, this does not mean more nutrients (especially organic nutrients) would not further degrade the ecological integrity of the aquatic ecosystems within the National Park. It is pure speculation, contradictory to both common sense and logic, and unsupported by and credible scientific analysis to state that "It is unlikely that there would be any effects to the nearshore marine environment as a result of increases in nutrient concentrations in groundwater." Some of the conclusions from these older studies have been contradicted in testimony and comments on previously proposed nearby developments.*

    Response: An *Assessment on Potential Impact on Water Resources* and *Assessment of Marine and Pond Environments* were prepared for the project by TNWRE and MRC, respectively. Both reports will be included in the forthcoming Second DEIS. According to these studies, there will be little effect to the nearshore environment as a result of increases in nutrient concentrations in groundwater.

44. *Page 3-65 and 3-66 "Atkinson (1992) modeled the input of nutrients to the ocean down slope from two golf courses in West Hawai'i over a four-year period. Results of the studies showed that at a location where fertilizer nutrients entered an embayment "Keauhou Bay" with restricted circulation relative to open coastal shorelines, nitrates increased by about 100% and phosphate increased by about 20% over natural input (Marine Research Consultants 2002)." To our knowledge, this model has never been validated. Model results should not be accepted as facts without sufficient validation.*

    Response: This paper was based on long-term evidential data collection. The "model" in this case is not a numerical model, but was simply using salinity as a conservative tracer to determine fate of nutrients in two areas of West Hawaii. The references in the publication and data (e.g., model) is widely validated in the scientific literature. Hence, utilization of this data treatment was a complete validation of the model.

45. *Page 3-66. "These results indicated that even with long-term input of extremely high nutrient subsidies, there are situations where there are no negative effects to the receiving environment." This is a false conclusion. Only a subset of the environment was reported to be sampled; no evidence offered that the proposed development is comparable to this case. The DEIS should have provided details on which nutrients, into what volume of water and coastline.*

    Response: Refer to Response no. 31. There are real "situations" occurring in West Hawaii (Honokohau Harbor, Keauhou Bay) where this statement is true. The use of "situations" makes it clear that this is not necessarily a universal occurrence.

46. *Page 3-67. "The physical and hydraulic characteristics of the vadose zone dampen the flux of water and contaminants to the water table. While transiting the vadose zone, contaminants such as fertilizers, pesticides, herbicides and industrial chemicals can be degraded by a process known as natural attenuation." While natural attenuation does occur in areas that are more mesic and have deeper and more developed soil profiles, with the shallow soils, young geology and arid conditions at the proposed project site, natural attenuation is unlikely to remove all of the pollutants before they reach NPS resources. The DEIS should have contained peer-reviewed sources describing the "natural attenuation" capability of this area's geological and climatic conditions.*

    Response: The "natural attenuation" that is referred to is quantified in the 2012 TNWRE report using the County's ongoing practice of disposing of R-2 wastewater from the Kealakehe WWTP in a pit upgradient of Honokohau Harbor. Based on the calculations in that report, natural removal rates during passage through the vadose zone and movement with groundwater to the shoreline is substantial.

47. *Pages 3-68 to 4-74. The DEIS presents a summary of neighboring developments and concludes that upgradient wells and resorts have not had a negative impacts to the surround ecosystems. These conclusions are not supported by references to credible scientific analysis nor are the conclusions supported by any reference to scientific data. As stated, the conclusions are the unsubstantiated opinions of consultants for the Kaloko Makai project proponent. The DEIS should include credible scientific evidence to support conclusions that upgradient wells and development have not had a negative impacts. It is unclear how the discussion of three resorts is relevant to the discussion of how the proposed project will adversely impact the coastal and marine resources within the National Park and along the Kona coast. Information dealing with impacts to the National Park or from situations posing similar threats (i.e. Maui) is more relevant.*

Response: An Assessment of the Potential Impact on Water Resources and Assessment of Marine and Pond Environments were prepared for the Project by TNWRE and MRC. Both reports will be included in the forthcoming Second DEIS. Please reference the TNWRE report (2012) and Marine Research Consultants, Inc. Report (2012). Citations regarding other areas of West Hawaii and Maui are relevant as they are analogous to the project at hand in that human activities change the composition and flux of groundwater. Response of the environment over years to decades of such human inputs provides a useful comparison.

48. *Pages 3-74 and 3-75. As mentioned before, a PPP is a statement of good intentions and is not very self-executing or enforceable. PPP's are difficult to enforce and monitor the effectiveness, and in fact, we know that they are sometimes simply ignored.*

Response: According to the EPA "Pollution prevention (P2) is reducing or eliminating waste at the source by modifying production processes, promoting the use of non-toxic or less-toxic substances, implementing conservation techniques, and re-using materials rather than putting them into the waste stream. Since pollution prevention is a key policy in national environmental protection activities EPA has developed a 2010-2014 Pollution Prevention Program Strategic Plan. A number of Partnership Programs and other EPA initiatives utilize pollution prevention approaches in their work."

"Preventing pollution offers important benefits, as pollution never created avoids the need for expensive investments in waste management and cleanup. By anticipating the future, Pollution Prevention reduces both financial costs (waste management and cleanup) and real environmental costs (health problems and environmental damage). As a result, Pollution Prevention holds the exciting potential of protecting the environment and strengthening economic growth through more efficient production and natural resource use."

"Pollution Prevention has been declared the "environmental policy of the United States." Under Section 6602(b) of the Pollution Prevention Act of 1990, Congress established a national policy to prioritize environmental management. Pollution Prevention was identified as the *highest priority*." http://www.epa.gov/region09/waste/p2/whatis.html

49. *Page 3-75. Since this project is so large and includes a hospital, there should be reporting for pharmaceuticals and endocrine disrupting compounds, in addition to reporting requirements to the DOH's, Wastewater Branch.*

Response: The builder and future operator of the hospital will be responsible for conforming to all DOH standards, as well as all other applicable standards, rules and laws.

50. *Page 4-2. "Based on available information about the proposed development and the visual gravity of industrial/commercial development flanking the project area to the north and south, and Queen Kaahumanu to the west (makai), the proposed project is considered to add to an established urban trend in coastal North Kona." This sentence is inaccurate regarding the visual gravity of industrial/commercial development flanking the project area. The majority of the areas surrounding the proposed project area is now open space.*

Response: The "established urban trend in coastal North Kona, Kailua", would appear beyond dispute. The comment regarding "visual gravity" sought only to point out that much of the north side of the project area is flanked by the Hulikoa Drive light industrial area and that the southwest corner is flanked by the Kaloko light industrial complex southeast of the intersection of Queen Kaahumanu Highway and Hinalani Street). Much of the viewplane of the project area from Queen Kaahumanu Highway is presently blocked by these industrial/commercial developments.

51. *Page 4-4. "Summary of Previous Archaeological Studies" this section (including Figure 4-1) needs to be updated to include more information, including but not limited to the data recorded in the following survey reports (list).*

Response: Several specific reports referenced are discussed in the archaeological inventory survey reports themselves. At least one report referenced was completed two years after the project's archaeological inventory survey reports were written. Your request to include additional references in the final AIS is acknowledged.

52. *Page 4-4. Summary of Previous Archaeological Studies, Information needs to be provided clarifying whether these sites have assigned SIHP numbers.*

Response: Cultural Surveys Hawaii looks forward to attempting to provide clarification whether sites previously reported have assigned SIHP numbers or not, as well as including that information in the final archaeological inventory survey reports. Sometimes SIHP numbers were assigned retroactively and sometimes they were not.

53. *Page 4.8. A total number of lava tubes encountered, including synopses of caves containing cultural materials found within the project area should be presented so that the public and decision makers can make an informed decision.*

Response: Determination of "a total number of lava tubes" is a somewhat subjective task as lava tube systems in the project area often have collapsed segments, bifurcate, and/or are often braided. Cultural Surveys Hawaii will attempt to quantify the number of lava tubes and the relative frequency and nature of evidence of use in the final archaeological inventory survey reports.

54. *Page 4-12. Table 4-4, this table, along with site types, functions, and mitigations should not be considered finalized until the AIS is approved by SHPD. Regarding all the trail remnants listed with mitigations of "no further work," NPS supports the SHPD stance that trail segments should be preserved and incorporated into development plans whenever possible. These trails are prehistoric and fall under the Highways Act of 1892 (HRS 264b).*

Response: It should be understood that all discussion of site types, functions, and mitigations should not be considered finalized until the AIS is approved by SHPD. A total of 57 trail remnants are described. While many of these are recommended for preservation it is true that many are recommended for no further work. Many of these trail segments are on the order of 10 m. long. The SHPD has always supported judicious consideration of site preservation typically on a case by case basis.

55. *Page 4-18. The DEIS states that "the archaeological surveys have been submitted to SHPD for their review. At the time of the preparation of this DEIS, SHPD was still reviewing the archaeological inventory surveys." Until SHPD approval has been received, the information provided in the DEIS cannot be considered final as it is currently based on the unapproved AIS. If the AIS changes as a result of the SHPD's review and approval, then a new analysis will be required to analyze impacts to NPS lands, resources and associated landscapes.*

Response: The AIS reports were prepared pursuant to the applicable legal requirements. Typically SHPD requires some revisions to an AIS before deeming it final. Nevertheless, until SHPD approval has been received, the information provided in the DEIS cannot be considered final. If the AIS changes significantly as a result of the SHPD's review and approval, it is conceivable that a new analysis could be required to analyze impacts to NPS lands, resources and associated landscapes.

56. *Page 4-30 "Historic properties north and south of the project area are of less concern due to the extensive industrial/commercial developments separating the project area from the potential sites there." This statement is inaccurate. The majority of the areas to the north and south are now open space, with a high concentration of historic properties. The background research for these sections*

should be included in this study and the analysis of impacts to the cultural resources and cultural landscape of the area.

Response: The findings of studies for adjacent areas have been included in the analyses of the archaeological inventory survey reports. This will be revisited prior to submittal of the final archaeological inventory survey reports

57. *Page 4-33, ¶6 All appropriate parties, including the NPS, should be allowed to comment on the burial treatment plan(s) for the proposed project area.*

Response: State law will be followed in regard to burial treatment plan(s) for the project area.

58. *Page 4-33. ¶6 The first sentence is contradictory to the information provided on page 4-29, the "Off-Site Potable Well Field" section, paragraph two "The AIS recommended that seven burial sites (10701, 10717, 10722, 10728, 10740, and 10754) and one heiau with a burial (10736) be preserved. Four of these sites are located within parcel 062 and the remaining are located on parcels 057, 058, and 059. SHPD concurred with the recommendations on October 24, 2005. As a result, a preservation plan was submitted a Declaration of Archaeological Easements for the preservation of all seven sites." This is unclear. There should be an explanation of which surveys correlate to the offsite well field.*

Response: The off-site potable well site has been omitted from consideration.

59. *Page 4-84. The vehicle emissions study only reports using traffic at intersections, while the proposed project is on a significant hill between two highways. Vehicles utilize greater amounts of fuel climbing up hill; the plans include 3 plus 2 lanes entering the project from the bottom of the hill vs. 1 lane entering the project from the top of the hill. The fuel usage and emissions from the bulk of a 5,000-home community driving vehicles must be analyzed.*

Response: The air quality study focused on maximum carbon monoxide concentrations near roadway intersections and assessed compliance with air quality standards. There are no specific standards that apply to overall emissions from traffic using Hina Lani Street. Nevertheless, while it is true that traffic traveling up hill will emit more emissions than traffic traveling over level terrain, traffic traveling downhill will tend to emit less. The net emissions from traffic traveling up hill and downhill may not be significantly different from traffic traveling over level terrain. In general, carbon monoxide concentrations are a concern when severe traffic congestion occurs during extremely calm wind conditions. Stationary idling cars in such conditions can raise carbon monoxide

levels in the immediate vicinity. Moving cars disperse emissions as do winds, reducing carbon monoxide levels.

60. *Page 4-52. Near Queen Ka'ahumanu Highway, near the present water tank, there are major sections of trail which are still intact and should be preserved, Kaloko Makai should consult with NPS, lineal and cultural descendants, Na Ala Hele and SHPD on this. These trail sections are not shown in any of the figures within this document and are within the Conservation area.*

Response: The Petitioner's representatives have had numerous discussions and consultations with the State Na Ala Hele Program.

The archaeological inventory survey for TMK [3] 7-3-009:017 (Bell et al. 2008) addresses the portion of the project lands adjacent to Queen Kaahumanu Highway. This study identifies twenty-one trails (21.2 percent of the total features) encountered during the inventory survey that were encompassed within sixteen sites (State sites 13493, 15324, 15325, 20704, 20722, 20724, 20726, 20732, 20733, 20736, 20737, 20739, 20744, 20745, 20747, and 26259). Six of these trail segments lie within 200 m. to the northeast of the westernmost water tank. This study has not been finalized. We will continue to consult with NPS, lineal and cultural descendants, Na Ala Hele and SHPD on this." for SHPD consideration.

Figure 4-3 shows trails identified during the AIS. We acknowledge that a segment of the western portion of Road to Sea Trail and other trail segments are within the Conservation District.

61. *Page 4-53. The "Mitigation Measures" section is inadequate and does not provided specific mitigations. This section directly quotes what is outlined in the "recommendations" section of the CIA. However, no specifics are mentioned about how the Kaloko Makai project plans to use the recommendations as mitigation measures. For instance, the third bullet in this section notes that "Efforts should be made to protect...water collection lava tubes" yet many of these features are listed to receive no additional work in the AIS. It is unclear how these features will be protected. The DEIS should have stated if these features will be avoided as a mitigation measure.*

This section should specifically address the concerns outlined in the community consultations, i.e. how Kaloko Makai will implement the recommendations into planning development.

Response: The need for "specific mitigations" is noted. None of the four archaeological inventory surveys have been accepted at this time. Detailed

mitigation plans will be prepared following SHPD acceptance of the archaeological inventory surveys.

62. *Page 4-54. "The trail entirely traverses pahoehoe and is generally well defined throughout the eastern portion of the parcel, except near the makai parcel boundary where bulldozing and grading has nearly destroyed the ahupua'a wall and eliminated any definitive sign of the trail." This statement is inaccurate. There are definitive signs of trail in the makai parcel. The trail within the project area is clearly visible up until it crosses Hina Lani (near the intersection of Hina Lani and Kamanu). Furthermore, although in some areas, the wall has been historically robbed for rock, some sections may have fallen over, or been bulldozed, the remnants of the wall are in clear view and the footprint (i.e. form and outline) of the original wall remain.*

Response: The Kohanaiki Trail bisects the project site and is well defined for most of its mauka alignment; below Ane Keohokalole Highway the trail alignment is not certain.

The Alakahakai NHT archeologist (Mr. Rick Gmirkin), the Petitioner's representatives and others have been on various site visits, including three site inspections with employees of the NPS.

After extensive consultation with the community, an agreement was reached on trail treatment. An archeologist for the Alakahakai NHT also made recommendations on the location of the trail. The Petitioner's representatives discussed these treatment measures with Na Ala Hele and the general consensus by all was that the treatment of the trail was appropriate.

Treatment of Kohanaiki Trail will closely follow the agreement established after extensive discussions with the interested community at Kaloko Heights.

This translates to a 10' wide trail pathway (meandering mauka to makai on what is believed to be the historic alignment) with a 10' wide buffer on each side of the trail (30' wide in total). In places where cut and fill are necessary, the elevation of the trail may change, but the general alignment will not be disturbed.

As noted in the DEIS, "Where the Trail intersects with Hina Lani Drive, Kaloko Makai will realign the remaining lower portion of the Trail from that point to run parallel with and adjoining the Hina Lani Street right-of-way down to Queen Kaahumanu Highway. Since the integrity of the historic trail is lost at that point, due to Hina Lani road construction, the adjoining industrial subdivision and the water tank, the Petitioner will realign the trail and have it run down the southern boundary of the property (fronting Hina Lani,) from the point of intersection with

Hina Lani down to Queen Kaahumanu Highway. This alignment gives the users of the trail easy access to cross Queen Kaahumanu or Hina Lani at the bottom, as there are crosswalks with crossing signals at that point." This is also noted on the Site Plan map of the project.

63. *Page 4-54. "Archaeological data created by others makai of the Queen Ka'ahumanu Highway" should be clarified. What are the citations.*

Response: Regarding "Archaeological data created by others makai of the Queen Kaahumanu Highway" (archaeological documentation of trails within NPS lands) we will include references to Cordy et. al (1991), Donham (1986) and Renger (1971).

- Cordy, Ross and Joseph Tainter and Robert Renger and Robert Hitchcock. 1991 An Ahupua'a Study: The 1971 Archaeological Work at Kaloko Ahupua'a North Kona, Hawai`i: Archaeology at Kaloko-Honokohau National Park, Western Archaeological and Conservation Center Publications in Anthropology No. 58. Tucson: National Park Service, 1991.
- Renger, Robert. 1971 Archaeological Surface Survey of the Coastal Areas of Kaloko and Kukio, North Kona, Hawaii.
- Donham, Theresa K. 1986. Full Archaeological Reconnaissance Survey, Kohana-Iki Development Project Area, Land of Kohana-Iki, North Kona, Island of Hawaii (TMK: 3-7-9: 3, 14), PHRI Report 216-04020861, Hilo, HI.

64. *Page 4-55. ¶4 First Sentence "Since the integrity of the historic trail is lost at that point, due to Hina Lani road construction.." is misleading. The lower portion of the trail has been identified and the NPS has recommended appropriate preservation measures.*

Response: See response to comment no. 62 above.

65. *Page 4-55. Community members and groups responsible for the long-term care of the Kohanaiki and Kaloko Ahupua'a, as well as cultural practitioners who utilize the area for gathering and for cultural and educational activities, should be further consulted regarding the above issues and other concerns throughout the planning, development and operation of the proposed housing development. This consultation should include all interested community groups and individuals who have a stake in the project area. Using Kaloko Heights' treatment measures that were reached between the "community" and Kaloko Heights is grossly inadequate as a treatment plan for Kaloko Makai's preservation of the Kohanaiki/Road to the Sea Trail. NPS believes that the agreement that was accepted for Kaloko Heights is not acceptable for the remainder of the trail. Kaloko Makai has a responsibility*

to meet with community members, groups and cultural practitioners, as well as formally consult with the NPS to determine the best treatment for this and other trails within the project area. This trail is eligible for the National Register of Historic Places as a contributing element to the National Park and the National Historic Landmark.

Response: As stated previously, the Petitioner has been in regular communication with Na Ala Hele regarding the Kohanaiki Trail. Additionally, the Petitioner has consulted with community members and cultural practitioners who were involved in the development of Kaloko Heights' treatment measures.

Kaloko Heights' mitigation measures were negotiated between State representatives, cultural practitioners and community members. In addition, these mitigation measures were brought before the Board of Land and Natural Resources and were approved by them.

The final archeological inventory survey will include reference to the NPS finding that "This trail is eligible for the National Register of Historic Places as a contributing element to the National Park and the National Historic Landmark."

66. *Page 4-56 - 4-57. Potential Impacts and Mitigation Measures, NPS recommends rewriting this section to preserve the existing trail and buffer zone rather than altering it.*

#1. The DEIS should explain how the trail will be "retained in perpetuity."

#2. There should be a preservation corridor to be used such that school children, community members, etc. experience a more meaningful sense of place when using this ancient trail. The thirty foot trail right of way will not provide the user an authentic experience within the unique cultural landscape of this area, part of the historically significant lifeline between the historic mauka village and the makai coastal villages of Kaloko and Honokohau, which now comprise the National Historical Landmark. Instead of a rigid thirty foot buffer, the corridor should be fluid to include significant cultural and natural features along the route. NPS archaeological staff from Ala Kahakai National Historic Trail, working with descendent communities and the State Historic Preservation Division and local communities should be consulted to establish an appropriate corridor. Trail buffer areas should not be physically altered whatsoever. Altering the landscape within buffers negates the purpose of the trail buffer and adversely impacts the setting and character of the trail, as well as the integrity of the trail as a historic property.

#3. No physical scarring or alteration of existing trail features or buffer zones should take place. The priority should be that the trail is preserved. One option may be overpasses and bridges.

Cutting and filling within the trail corridor is not acceptable and should not be allowed. Altering the entire landscape and then marking where the trail used to be is not an adequate preservation measure for this trail. Removing the trail materials and replacing them in the same horizontal alignment is not acceptable treatment of a historic property under 6E or Section 106 preservation standards. State Historic Preservation Division and the NPS should be consulted as to the treatment plan for the trail. Cut and fill stepping of the landscape is not the only alternative for land modification in a subdivision. As an example, the developer could design grading pad areas only for planned structures; post and pier construction is also a method used to minimize destruction of the natural landscape and cultural features.

#4. The trail should not be physically altered. No vertical or any other changes to this historic trail are acceptable. The text should be revised to read "The original trail surface, and other cultural resources located within the trail corridor, including, but not limited to, existing native trees will be retained."

#5. The NPS agrees that cultural features along the existing trail shall be preserved and incorporated into the preservation corridor. When significant cultural resources are located further away from the Trail, the Trail preservation corridor should be adjusted to incorporate and preserve them. Cultural and natural resources should be preserved in place, as moving them destroys the spatial context and integrity of the resource.

#6. First sentence should read "in further consideration of existing governmental rules and regulations pertaining to preservation of historic and cultural resources any trail crossing will not physically scar or alter the original trail fabric, features or corridor in any way." For example: Metal (e.g., marine aluminum) grate crossings-bridges can be built for any trail crossings. Metal grates can allow the entire original trail and buffer land surface to be preserved intact, allow people to view the original trail surface and walk the original trail route within inches of the tread elevation. In many cases only two tire width grates would be needed to allow automobiles to cross trails; large trucks and heavy construction equipment can be directed to alternative entrances for their occasional access needs on the two sides of the trail. Heavy construction equipment should not cross the trail, heavy equipment entry to areas near the trail should be made from adjacent land, not across the trail. Recommend defining heavy as the weight of a horse or cow (which are likely to have used or crossed the trail before).

Recommend if the developers are not willing to proposed crossings that no trailcrossings, except pedestrian traffic be allowed, without another environment assessment; roadways already exist on both sides of the trail.

The NPS requests to be consulted with in regards to any and all Trail crossings.

#7. The NPS recommends that such details should be determined in the Final Preservation Plan for the Trail after the necessary and appropriate consultation with descendants, Na Ala Hele, the SHPD and the NPS.

#8. Existing rock walls should be preserved in situ. Replace existing text with "No rock walls will be moved or altered." These are historic cultural structures to be preserved. Routes around existing rock walls will be developed or small bridges constructed for pedestrian crossing.

#6, 7 and 8. The sentence "At this early stage of the planning process for Kaloko Makai it is premature for SCD to propose the number and location of specific Trail crossings." is inconsistent with the detailed figures provided in the EIS and the concept of an EIS. The numbers and locations of trail and wall crossings as well as changes in walls, trails, and buffer zones need to be disclosed so that their individual and cumulative effects can be evaluated in the EIS. A map-plan is provided in the DEIS. Does the above comment imply that Kaloko Makai does not intend to follow these plans? If the figures and the calculations in the DEIS are wrong, then the analysis presented of impacts to resources is premature and inadequate.

#9. This section's connection to the trail is unclear. Above it is noted that any native trees within the trail corridor will be preserved in place. NPS recommends removal of this point from this section of the EIS. In this harsh dry landscape the location where a tree can survive is uncommon and very unique. The spacing and location of the native trees can survive is uncommon and very unique. The spacing and location of the native trees can be vital to the survival of organisms that depend on them for shelter and food. Without specific details, removal of trees from this landscape is not advisable.

#11. Where the Trail intersects with Hina Lani Street, SCD will realign the remaining lower portion of the Trail from the point to run parallel with and adjoining the Hina Lani right-of-way down to Queen Ka'ahumanu Highway. No existing historical structures or artifact (i.e. fragments of existing trail) should be altered; nothing existing should go away. New trails leading from the historic trail to the intersection, crosswalks, and walkways along the roads can be constructed where they do not physically alter existing historic trails and buffers.

NPS should be consulted on the alignment of the trail between Ka'ahumanu Highway and the trail/Hina Lani intersections.

#12. Kaloko Makai should incorporate Hawaiian cultural perspectives into the overall planning and execution of the development including the treatment of the 'aina within the project area by preserving the natural contours, geologic features and existing cultural features, not transforming the project area into a state unrecognizable from the original landscape.

Response: As requested, the forthcoming Second DEIS has been revised to read "The original trail surface, and other cultural resources located within the trail corridor, including, but not limited to, existing native trees will be retained."

As stated previously, the Petitioner has been in regular communication with Na Ala Hele regarding the Kohanaiki Trail. Additionally, the Petitioner has consulted with community members and cultural practitioners who were involved in the development of Kaloko Heights' treatment measures.

Kaloko Heights' mitigation measures were negotiated between State representatives, cultural practitioners and community members. In addition, these mitigation measures were brought before the Board of Land and Natural Resources and were approved by them.

The Petitioner stands by these mitigation measures and will continue using them as the project moves forward.

67. *Page 4-57. "Roadways and Traffic". As noted in the DEIS the existing traffic conditions are currently highly impacted and this proposed project will further add congestion. Park visitors use these roads to access the Park and traffic contributes to their overall park experience. No impact analysis of traffic, or its mitigation, to the National Park is made in the DEIS.*

    Response: the Petitioner acknowledges that a project of this size will increase traffic and impact nearby roadways. Mitigation measures, including roadway improvements have been proposed and are included in the forthcoming Second DEIS.

68. *Page 4-73. Noise impacts to Kaloko-Honokohau National Historical Park are not discussed. Significant noise increases are mentioned but only mentions that these impacts are to undeveloped property. The analysis needs to describe the impacts to the NPS resources. What are the Leq levels at 50 and 100 ft on Park property (Table 4, page 13)? Based on the information in the tables in Appendix N, there appear to be significant additional noise impacts from project related traffic*

increases. Since Kaloko-Honokohau National Historical Park is a noise-sensitive area, there should be discussion of how traffic noise and construction noise will impact activities at the Park and what measures will be implemented to mitigate noise impacts.
a. Appendix N Table 6 Discussion needs to identify where the 65 DNL and 75 DNL setback contours fall on Park property for Year 2011 and 2035.

Response: As previously mentioned, the Petitioner is preparing a Second DEIS to address changes in the proposed project that will be reassessed, as needed, in the forthcoming document. As a result, several of the studies, including the Traffic Impact Study and Noise Study have been updated.

b. Appendix N Page 32 Chapter VII should discuss project-related noise impacts (traffic noise and construction noise) to Kaloko-Honokōhau National Historical Park and possible mitigation measures.

Response: Noise levels during construction activities on the project site will probably be highest at the northeast corner of the Kaloko-Honokohau National Historical Park during site preparation work north of the existing Kaloko Industrial Park. Minimum separation distances between the construction activities and the northeast boundary of the park are 300 to 400 feet, with construction noise levels of 62 to 75 dBA anticipated along the northeast park boundary. These construction noise levels are similar to existing traffic noise levels along the Queen Kaahumanu Highway ROW, and represent a relatively small portion of the total construction activities planned over the entire project site. The vast majority of potential construction work sites on the Kaloko Makai project site are at 1,000 to 11,000 feet distance from the east park boundary, with corresponding construction noise levels of 60 to 22 dBA.

The Park Visitor Welcoming House is located at least 4,200 feet from the potential construction work areas of the project. As a result, predicted construction noise levels at the Park Visitor Welcoming House are 40 dBA or less.

If noise sensitive park activities or functions are planned near the northeast corner of the park property, it may be possible to schedule the project's construction work north of Kaloko Industrial Park during periods mutually acceptable to the NPS and the Kaloko Makai Project construction contractor. The use of quiet machinery, broadband backup alarms instead of high frequency, beeper type alarms, cast in place piles instead of impact driven piles, and alternatives to the use of hoe rams for breaking rock may be considered for use in order to minimize potential noise impacts during project construction.

69. *Page 4-81. Six-foot high sound attenuation "walls" along roadways are likely to look out of place in with the existing landscape, while six-foot piles of lava rock can likely be made to look like native 'a'a lava and edges of pāhoehoe flows. Native plants on the sides and top such a constructed lava barrier would contribute to sound attenuation and appearance of such a structure. Utility conduits and access points could be incorporated into lava rock if extensive sound barriers are necessary.*

    Response: There are several materials that can be used for sound attenuation walls. The rock walls utilized along Hina Lani Street and within the Kaloko Industrial Park will be considered when designing sound attenuation walls for the proposed project.

70. *Page 4-84. The NPS disagrees with the conclusion that there "may potentially result in a long-term increase in emissions." There will be a long-term increase in emissions. Assuming that each household on average owns 1-2 vehicles, it is safe to say that this development will mean 5-10,000 additional vehicles in the vicinity which will mean a significant amount of pollutants being introduced into the air and water in the area. The DEIS contains no analysis of impacts to NPS resources and Native Hawaiian cultural practices from increased emissions.*

    Response: You are correct in that Kaloko Makai will result in increased motor vehicle traffic in the project area and increased emissions from motor vehicles. Computerized emission and atmospheric dispersion models were used to predict the impacts from these emissions on ambient carbon monoxide concentrations in the project area. The results of this analysis indicate that although carbon monoxide concentrations will increase with the project, worst-case concentrations should remain within state and federal ambient air quality standards.

    Although the DEIS does not specifically address the potential impacts to NPS resources and Native Hawaiian cultural practices from increased air pollution emissions related to project traffic, it is expected that these emissions would not cause or contribute to the exceedance of any ambient air quality standards. State and federal ambient air quality standards are designed to protect both human health and welfare. Although the standards do not specifically address the issues of impacts on NPS resources and Native Hawaiian cultural practices, it is believed that the expected adherence to ambient air quality standards will serve to protect NPS resources and Native Hawaiian cultural practices.

    It should be noted that the air quality study for this project has been revised since the DEIS and was completed to include additional future scenarios both with and without the project. The basic conclusions remain unchanged, and that is that any

    increases in air pollution emissions related to project traffic would not result in any violations of state or federal ambient air quality standards. The revised air quality study will be included in the forthcoming Second Draft EIS.

71. *Page 4-86. Section 4.7, this section needs to address the major visual impacts that this project will have on Kaloko-Honokohau National Historical Park and the Honokohau Settlement National Historic Landmark. The Park and Landmark house over 400 archaeological sites, numerous ethnographic resources as protected resources. These resources are also protected under Section 106 of the National Historic Preservation Act. Under this act visual impacts must be taken into consideration as they can affect the setting of historic properties eligible for the National Register of Historic Places. These sites, ethnographic resources, the Park and the NHL as a whole will be significantly impacted by the alteration of the viewshed by this project. Mitigation measures will need to address these impacts.*

    Response: The development will change the visual appearance of the property from vacant land to a built environment. The project area is flanked by light industrial uses along Hulikoa Drive and Kaloko Industrial Park to the south. In addition, the Kaloko Heights development is proposed immediately mauka of Kaloko Makai. Much of the viewplane of the project area from Queen Kaahumanu Highway is presently blocked by industrial/commercial developments.

72. *Page 4-86. Project lighting will also have a negative effect on visual resources and nightscape in the National Park. Light pollution of the night sky will interfere with visitor experience and evening traditional cultural practices. No impact analysis of light pollution, or its mitigation, to the National Park is made in the DEIS.*

    Response: Kaloko Makai will result in an increase of streetlights. Appropriate outdoor lighting will be used and adhere to Hawaii County Ordinance.

73. *Page 4-87. "The proposed project will not impact significant mountain or mauka views..." This statement is inaccurate. Currently, this proposed project area consists of large expanses of open space, this project will drastically change the viewshed and visual resources of open space, highly valued in the Kona community, to an urban landscape and thus will have major impacts on both mauka and makai views of the area. In addition, the mauka changes to viewshed from the Park and National Landmark from over 400 National Register-eligible historic properties affects the integrity of these sites by affecting the setting, feeling and association of these resources.*

Response: The statement will be corrected to state "The proposed project will not obstruct views from Queen Kaahumanu Highway or from the shoreline to the summit of Hualalai because of its location on the lower slope of the mountain.

The development will change the visual appearance of the property from vacant land to a built environment. The project area is flanked by light industrial uses along Hulikoa Drive and Kaloko Industrial Park to the south. In addition, the Kaloko Heights development is proposed immediately mauka of Kaloko Makai. Much of the viewplane of the project area from Queen Kaahumanu Highway is presently blocked by industrial/commercial developments.

74. *Page 4-91. Section 4.8.5., this section does not analyze the impacts to the Park or Landmark or Ala Kahakai National Historic Trail. The plan does not address impacts that the influx of 5000 new residences in the immediate vicinity will have on resources in the park. Major impacts to Park facilities and resources will occur as a result of the Park becoming a "recreational facility" to many thousands of people. The NPS will be impacted at many levels responding to the inevitable damage to resources and increased facility demands. Protected green sea turtle habitat is dependent on low levels of human disturbance, as is other endangered waterbird habitat. The National Park is already experiencing high levels of visitation and dealing with overcrowding of facilities and overuse of resources along the coast. The introduction of thousands of new regular users would mean overextension of staff, rapid depletion of ocean resources, impacts to cultural practices and high potential of damage to cultural resources such as archaeological sites. The analysis in this section is inadequate.*

Response: Should Kaloko Makai not be developed, residents whose demand for housing would have drawn them to Kaloko Makai would likely have their demand met by other developments in neighboring areas. While Kaloko Makai's proximity to the Park and Historic Trail may create somewhat greater demand on those particular resources, given the mobility of residents in the area, the difference would likely be relatively small. In recent years, the booming population growth in West Hawaii has tempered. Nevertheless, even at a slower pace of growth, demand on park resources will likely increase over time. As a result, the NPS will need to protect their integrity by appropriately managing their use by the public, regardless of whether Kaloko Makai is developed or not.

75. *Page 4-99. The National Park Service questions the need for 5,000 more homes in North Kona. During the 2010 census, one fifth of the homes on Hawai'i Island were vacant (West Hawai'i Today, June 15, 2011).*

Response: The Kona Community Development Plan (Kona CDP) seeks to direct future growth patterns toward compact villages, preserving Kona's rural, diverse

and historical character. The majority of future growth should be directed north of Kailua, with some future growth in the Kailua to Keauhou area, in the form of compact villages that offer increased density and mixture of homes, shops and places to work.

76. *Page 4-107. Water demand calculated in Table 4-24 is incorrect due to several errors and results in a significant underestimation of water demand for the proposed project. Errors in Table 4-24 should be corrected to provide an accurate estimate of the water demand for this proposed project. More specifically:*
    a. *The 20-acre wastewater treatment plant and 1.7-acre desalination plant are not explicitly listed in Table 4-24. Revise Table 4-24 to include water demand of 4,000 gpd/acre, per Hawai'i County Department of Water Supply guidelines, or explain why a different rate was used.*
    b. *Water demand for Phase 1 Parks is 54,000 gpd/acre but is 6,000 gpd/acre for Phase 3 Parks in Table 4-24. These values are not consistent with the rate of 4,000 gpd/acre listed under "Assumptions" for Table 4-24. Correct the water demand for Parks or explain why different rates were used in Table 4-24. c. Water demand for Phase 2 Parks is not included in Table 4-24. Table 2-6 indicates that Phase 2 will include a 13-acre park. Revise Table 4-24 to include the water demand for a 13-acre Phase 2 Park.*
    c. *The acreage for the Phase 2 School in Table 4-24 is not consistent with Table 2-6. Revise Table 4-24 to include water demand for an 18-acre Phase 2 middle school.*
    d. *Water demand for the Phase 2 School in Table 4-24 is 6,000 gpd/acre, which is not consistent with water demand of 4,000 gpd/acre used for Schools in Phases 1 and 3. Revise Table 4-24 to use a consistent water use rate for Schools or explain why different values were used.*
    e. *A rate of 400 gpd per unit is used to estimate residential water demand in Table 4-24. This rate is not consistent with the rate used by the Hawai'i County Department of Water Supply to estimate water demand for North Kona. The 2011 Water Use and Development Plan Update (p. 2-12) uses a value of 1,000 gpd per unit for single family residential units in North Kona based upon actual historic consumption data. Revise the residential water demand in Table 4-24 to be consistent with the Department of Water Supply guidelines for North Kona.*

Response: The water demand calculated in Table 4-24 has been revised in the forthcoming Second DEIS.

77. *Page 4-107. Table 4-24, total water demand was recalculated based upon information presented in Table 2-6 of the DEIS and the Hawai'i County Water Use and Development Plan Update water consumption guidelines (p. 2-12). The*

revised table below indicates that the average daily water demand for the proposed project could be as high as 6.9 Mgd, over two times that estimated in the DEIS. The DEIS should have (1) evaluated whether the proposed alternatives to supply potable water are sufficient to meet this water demand, and (2) evaluated the potential effects of each alternative on the water resources and groundwater-dependent ecosystems in the area of the proposed project.

Response: If the water supply implemented is to desalinize saline groundwater, the feedwater supply is essentially unlimited. If the implemented alternative is to be high level groundwater extracted from below saline groundwater and affirmatively demonstrated to have no impact the basal lens, the available supply will be pragmatically determined during the project's build out. Toward this end, however, recent recharge calculations by the USGS for the Keauhou Aquifer indicate that the sustainable supply is substantially greater than previously thought.

The water demand calculated in Table 4-24 has been revised in the forthcoming Second DEIS.

78. *Page 4-110. The DEIS states that reverse osmosis concentrate will be discharged in on-site disposal wells at depths sufficient to reach groundwater with "30 parts per trillion (ppt) salinity." The notation is also defined on Page G-5 as "parts per trillion." This is inconsistent with the more feasible definition given on Page 3-26, which states that the concentrate will be disposed in strata where groundwater salinity is "30 parts per thousand (ppt) or greater." The DEIS should be revised to confirm the targeted salinity of the strata into which reverse osmosis concentrate will be disposed.*

Response: The forthcoming Second DEIS will be revised to confirm and consistently refer to the targeted salinity of the strata into which reverse osmosis concentrate will be disposed is "30 parts per thousand (ppt) or greater."

79. *Page 4-126. "Wastewater Treatment Alternatives" While the use of recycled water to the R-1 level is the appropriate treatment to reduce viral and bacterial pathogens for irrigation uses around residential areas, the stated level of nutrients contained in the wastewater effluent is a significant concern.*

Response: The standards established by the State Department of Health for nutrient levels in R-1 reclaimed water is appropriate for irrigation purposes. Application of reclaimed water is regulated to assure total uptake by plants within the root zone.

80. *Page 4-129. "During periods of wet weather, excess R-1 water will be disposed of via infiltration basins." The DEIS has no analysis of impacts to aquatic ecosystems resulting from the disposal of sewage effluent via infiltration basins.*

Response: The forthcoming Second DEIS has been revised to note that during periods of wet weather, excess R-1 water will be disposed of via disposal wells.

81. *Page 4-129. Table 4-25 lists potential uses for treated wastewater, however, there are no calculations for the actual amount of wastewater that will be disposed of via irrigation or other methods. The project will occur in phases and it is unlikely that the supply of treated wastewater and the demand for treated wastewater will be in synch. Considering the cost of installing separate waterlines for the treated wastewater will be in synch. Considering the cost of installing separate waterlines for the treated wastewater, without specific volumes of wastewater and timelines, there is no guarantee that all the treated wastewater will not be disposed of via the infiltration basins.*

Response: Storage capacity for reclaimed water is based on projected use rates and wet weather frequency and duration. In the earlier phases of development, the potential for disposal of excess reclaimed wastewater during wet-weather may be greater due to smaller volumes and irrigation areas. In the later phases, however, demand is projected to exceed volume produced. The project is committed to installing R-1 water infrastructure to meet ultimate demand as well as interim demand.

82. *Page 4-132. "It is assumed that approximately 15% of applied irrigation water will percolate down to the basal ground water. As the excess irrigation water percolates downward through the unsaturated zone to the groundwater, removal rates of nitrogen and phosphorus from the water will be significant." No scientific data or scientific studies are provided to support the assumptions that 1) fifteen percent of irrigation water will reach groundwater and 2) nitrogen and phosphorus removal rates will be "significant." Public review and decision-making actions cannot rely upon unsupported claims and assumptions regarding potential impacts to nationally significant resources.*

Response: The 2012 TNWRE report identifies and quantifies the sources of water that will percolate to and impact the basal lens using actual field data.

83. *At the proposed O'oma Beachside Village development, less than 1 mile from the proponent's project, Waimea Water Services estimated that approximately 54% of the total irrigation water used would infiltrate into the aquifer. (The Water Development Impacts Study for the Shores of Kohanaiki, Figure 6, Waimea Water Services, Inc., 2007). There is a large discrepancy in the estimates for the two*

developments that are located in the same general area with the same soil composition. The DEIS should have explained this discrepancy and provide data to support the stated assumption of 15%.

Response: We have not seen the basis of the assertion that 54 percent of applied irrigation water would percolate to groundwater and cannot be responsible for it. That would mean applying more than twice the plant evaporation requirement during irrigation, a highly unlikely practice. Actual percolation at Kaloko Makai will be on the order of 10 to 15 percent of the applied irrigation water. No reasonable person would apply more than twice the plant evaporation requirement.

84. *Page 8-1. "Relationship Between the Short-Term Uses of the Environment and the Maintenance and Enhancement of Long-Term Productivity" The DEIS fails to capture the cumulative impacts, secondary impacts, irreversible commitments of resources, and probable adverse environmental effects to the area, especially at Kaloko-Honokohau, as suggested by the comments listed above.*

Response: The forthcoming Second DEIS will revisit the assessments cited above in the context of changes in project description and impacts, to comply with the EIS content requirements established by Chapter 343, Hawaii Revised Statutes and Title 11, Chapter 200, Hawaii Administrative Rules.

Your letter, along with this response, will be reproduced and included in the forthcoming Second Draft EIS. We appreciate your participation in the EIS review process.

Sincerely,

Earl Matsukawa, AICP
Project Manager

cc: Mr. Jay Nakamura, Stanford Carr Development
Mr. Daniel Orodenker, State Land Use Commission

NEIL ABERCROMBIE
GOVERNOR

BRUCE A. COPPA
COMPTROLLER

JAN S. GOUVEIA
DEPUTY COMPTROLLER

STATE OF HAWAII
DEPARTMENT OF ACCOUNTING AND GENERAL SERVICES
P.O. BOX 119, HONOLULU, HAWAII 96810-0119

(P)1182.1

AUG 23

EM

Mr. Earl Matsukawa, AICP
Wilson Okamoto Corporation
1907 South Beretania Street, Suite 400
Honolulu, Hawai'i 96826

Dear Mr. Matsukawa:

Subject: Draft Environmental Impact Statement
Kaloko Makai
Kaloko and Kohanaiki, North Kona, Island of Hawai'i
TMK: (3) 7-3-009: 017, 019 (por.), 026, 026, 028, 062 (por.), 63

This is in response to your letter dated August 3, 2011 regarding the subject project. The proposed project does not impact any of the Department of Accounting and General Services' projects or existing facilities, and we have no comments to offer at this time.

If you have any questions, please call me at 586-0400 or have your staff call Mr. David DePonte of the Public Works Division at 586-0492.

Sincerely,

BRUCE A. COPPA
State Comptroller

c: Mr. Orlando Dan Davidson, DBEDT SLUC
Mr. Peter Phillips, SCD-TSA Kaloko Makai, LLC

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7469-01
July 25, 2013

Mr. Dean H. Seki, Acting Comptroller
Department of Accounting and General Services
State of Hawaii
P.O. Box 119
Honolulu, HI 96810-0119

Subject: Draft Environmental Impact Statement (DEIS)
Kaloko Makai
Kaloko and Kohanaiki, North Kona, Hawaii
Tax Map Key: (3) 7-3-09: 017, 025, 026, and 028

Dear Mr. Seki:

Thank you for your letter dated August 23, 2011 (Ref No. P1182.1). The Petitioner is preparing a Second DEIS to address changes in the proposed project that will be reassessed, as needed, in the forthcoming document. You will be notified of its availability for review and comment pursuant to Chapter 343, Hawaii Revised Statutes (HRS) and Title 11, Chapter 200 Hawaii Administrative Rules (Department of Health).

With regard to your comments on the subject DEIS, we acknowledge that the proposed project does not impact any of the Department's projects or existing facilities and you have no comments to offer at this time.

Your letter, along with this response, will be reproduced and included in the forthcoming Second DEIS. We appreciate your participation in the EIS review process.

Sincerely,

Earl Matsukawa, AICP
Project Manager

cc: Mr. Jay Nakamura, Stanford Carr Development
Mr. Daniel Orodenker, State Land Use Commission

NEIL ABERCROMBIE
Governor

LAND USE COMMISSION
Department of Business, Economic Development & Tourism
State of Hawaii

ORLANDO "DAN" DAVIDSON
Executive Officer

September 12, 2011

EM
TF

Mr. Earl Matsukawa
Ms. Tracy Fukuda
Wilson Okamoto Corporation
1907 South Beretania Street, Suite 400
Honolulu, Hawaii 96826

RECEIVED
SEP 13 2011
WILSON OKAMOTO CORPORATION

Dear Mr. Matsukawa and Ms. Fukuda:

Subject: Docket No. A07-778/SCD Kaloko Makai, LLC
Draft Environmental Impact Statement (DEIS)
Kaloko Makai
Kaloko and Kohanaiki, North Kona, Hawaii
Tax Map Key: 7-3-09: 17, por. 25, 26, 28, and 63
Offsite Well Field: 7-3-09: por. 19 and por. 62

We have reviewed the DEIS for the subject project and have the following comments to offer:

1) In accordance with subsection 11-200-17(e), Hawaii Administrative Rules (HAR), a project description should be provided. Based on our review of the DEIS, we note that the Petition Area has decreased from 952.165 acres as represented in the Petition for Land Use District Boundary Amendment (Petition) filed on December 28, 2007, to 948.866 acres despite the subsequent addition of Tax Map Key: 7-3-09: 63 to the Petition Area.[1] We further note that Tax Map Key: 7-3-09: 25 is designated within both the Urban and Agricultural Districts, and that the exact acreage within the Agricultural District is subject to a boundary interpretation. If Petitioner has not already done so, we suggest that the request for this interpretation be filed with our office as soon as possible as our determination may impact the description of the Petition Area identified in the Final EIS.

[1] The acreage of the Petition Area cited on page 1-3 of the *Introduction and Summary* reflects a mathematical error as the area of the proposed land use designation is identified as 948.666 acres.

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Mailing Address: P. O. Box 2359, Honolulu, Hawaii 96804

Review of the Kaloko Makai Land Use Plan in the DEIS also reveals various changes to the proposed development since the filing of the Petition, including but not limited to the addition of a hospital, light industrial uses, and a wastewater treatment plant.[2]

Given the extent of these changes, please be advised that an amendment to the Petition will need to be filed with the necessary narrative/maps documenting the current description of the Petition Area and the proposed development.

By letter dated January 23, 2008, we provided comments on the Petition in which we requested that additional information be provided to specifically address how affordable housing will be provided within the context of the applicable housing policies of the State and County of Hawaii. We acknowledge that the DEIS includes information on conforming affordable housing prices relative to the County guidelines effective September 1, 2010, and that of the 5,000 housing units proposed in the development, 700 will be affordable units. Further clarification should be provided on the projected breakdown of these 700 units between single-family and multi-family units and their respective sales prices/rental rates.

Finally, we note that the development timetable for the construction of infrastructure improvements has changed since the filing of the Petition. According to the Petition, the primary infrastructure systems necessary to accommodate substantial development were projected to be completed within ten years. The DEIS, on the other hand, states that the major infrastructure will be developed by 2025, with the development implemented in three phases and completed in approximately 30 years. We acknowledge that the DEIS includes three maps generally depicting each phase. As you may know, subsection 15-15-50(c)(3), HAR, requires that a metes and bounds map and description of the Petition Area as well as of the increments/phases be provided when incremental development is proposed as it is in this case. As such, as part of the content requirements for the Petition, the above maps should be supplemented with the applicable metes and bounds of the boundaries of each phase.

[2] Although an onsite wastewater treatment plant now appears to be the preferred alternative for processing wastewater generated by the development, according to the Petition it was anticipated that the development would connect to the County's wastewater system and be served by the Kealakehe Wastewater Treatment Plant.

To the extent that easements are present on the Petition Area, they should be reflected on any metes and bounds map submitted as we pointed out in our January 23, 2008, comment letter on the Petition. Additionally, since Phases 1 and 2 involve other lands previously urbanized under Docket No. A84-566/TSA International, Ltd., metes and bounds should be provided for the acreage of each phase within the Agricultural District in conjunction with the aforementioned boundary interpretation.

2) In accordance with subsection 11-200-17(h), HAR, a statement of the proposed action to land use plans, policies, and controls for the affected area should be provided. We acknowledge that the DEIS includes an assessment of the proposed development in relation to the applicable objectives, policies, and priority guidelines of the State Plan. Please be advised that SB 283, SD 1, HD 1, CD 1, was recently signed into law as Act 181. The Act added a new section to Part III of chapter 226, Hawaii Revised Statutes, which provides, among other things, priority guidelines and principles to promote sustainability. We request that the current assessment in the DEIS be amended to include a discussion of how the proposed development conforms to these sustainability criteria.

The status of each identified approval should also be described. We acknowledge that the DEIS includes a listing of anticipated permits and approvals. We request that to the extent possible the projected submittal dates (i.e., by month/year) of the various applications be provided.

3) In accordance with subsection 11-200-17(i), HAR, a discussion of the probable impact of the proposed action on the environment shall be provided, including an assessment of the interrelationships and cumulative environmental impacts of the proposed action and other related projects. We acknowledge that the DEIS contains a section on cumulative impacts, including a table of planned residential and commercial developments in the vicinity of the Petition Area. We further acknowledge this section states that a discussion of existing human and natural environmental conditions in the project area is found in Chapters 3 and 4. However, given that this section is entitled *Cumulative Impacts*, we request that in addition to the impacts from the proposed development, this section addresses the specific impacts from each of the identified developments to determine the extent of their cumulative impacts on the environment.

We also note that there is no discussion in the DEIS on the existing civil defense facilities in the area as well as on the potential impacts on such facilities from the proposed development. We request that the Final EIS address this matter, including any plan to fund and construct adequate civil defense measures (sirens) to serve the Petition Area as may be required by the State Department of Defense, Office of Civil Defense.

4) In accordance with subsection 11-200-17(n), HAR, the DEIS shall include a separate and distinct section that summarizes unresolved issues. We acknowledge that the DEIS includes such a section. However, discussion is needed to address how the unresolved issue of transportation improvements to address cumulative traffic impacts will be resolved prior to commencement of the action or the overriding reasons for proceeding without resolving the matter. This discussion should include the provision of a timetable(s) for resolution and the options available to Petitioner if the matter is not resolved in a timely manner relative to the commencement of the proposed development.

5) We acknowledge that a Motion to Amend Conditions (Motion) for the approximately 190-acre portion of the proposed development in the Urban District will be filed with our office to conform this acreage (previously proposed for golf course use and related facilities) to the development. We strongly recommend that coordination with our office be done prior to the filing of the Motion to ensure its orderly processing.

6) In the DEIS, there are numerous references to the terms *potable water* and *non-potable water*. We request that it be replaced by the term *drinking water* and *non-drinking water*, respectively. We have been advised that although potable water has generally been used to mean drinking water, the Department of Health (DOH) uses the latter term specifically to indicate water for human consumption that is derived from surface water and/or groundwater and is regulated by the DOH pursuant to chapter 11-20, HAR.

7) We note that SCD Kaloko Makai, LLC, is the Petitioner of record in the Petition. However, the name of the Petitioner/Applicant identified in the DEIS is SCD – TSA Kaloko Makai, LLC. Clarification should be provided on the distinction, if any, between the two entities, so that the record in the district boundary amendment proceeding including, but not limited to, the landowner's authorization, affidavits, balance sheet, and

notification of petition filing reflects the appropriate entity seeking relief from the Land Use Commission.

8) For your information, a portion of the Petition Area, identified as TMK: 7-3-09: por. 17, was the subject of a previous boundary amendment petition filed under Docket No. A95-716/Tokyo Green Hawaii, Inc., which proposed to reclassify the parcel to the Urban District for residential, commercial, school, and park uses. The request was subsequently withdrawn by the Petitioner.

We have no further comments to offer at this time. Thank you for the opportunity to comment on the subject DEIS.

Should you have any questions, please feel free to call me or Bert Saruwatari of our office at 587-3822.

Sincerely,

ORLANDO DAVIDSON
Executive Officer

c: Peter Phillips

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7469-01
July 25, 2013

Mr. Daniel Orodenker, Executive Officer
Land Use Commission
State of Hawaii
234 South Beretania Street. Suite 406
Honolulu, HI 96813

Subject: Draft Environmental Impact Statement (DEIS)
Kaloko Makai
Kaloko and Kohanaiki, North Kona, Hawaii
Tax Map Key: (3) 7-3-09: 017, 025, 026, and 028

Dear Mr. Orodenker:

Thank you for your letter dated September 12, 2011. The Petitioner is preparing a Second DEIS to address changes in the proposed project that will be reassessed, as needed, in the forthcoming document. You will be notified of its availability for review and comment pursuant to Chapter 343, Hawaii Revised Statutes (HRS) and Title 11, Chapter 200 Hawaii Administrative Rules (Department of Health).

With regard to your comments on the subject DEIS, we offer the following in response to your comments:

(1) In accordance with subsection 11-200-17(e), HAR, a project description should be provided. Based on our review of the DEIS, we note that the Petition Area has decreased from 952.165 acres as represented in the Petition for Land Use District Boundary Amendment (Petition) filed on Dec. 28, 2007, to 948.866 acres despite the subsequent addition of TMK 7-3-09:063 to the Petition Area. We further note that TMK 7-3-9:25 is designated within both Urban and Ag Districts, and that the exact acreage within the Ag District is subject to boundary interpretation. If Petitioner has not already done so, we suggest that the request for this interpretation be filed with our office as soon as possible as our determination may impact the description of the Petition Area identified in the FEIS. (* The acreage of the Petition area cited on pg 1-13 of the Introduction and Summary reflects a mathematical error as the area of the proposed land use designation is identified as 948.666 acres)*

Response: The difference in land area between what is stated in the initial petition and what is reported in the DEIS results from approximately five acres of land that was conveyed to the County of Hawaii for the Ane Keohokalole Highway.

Additionally, 150 acres will not be subject to the petition because the dryland forest preserve will remain in Agricultural District, as will be documented in the forthcoming Second DEIS.

Discrepancies in the acreage for the petition area have been corrected throughout the Second DEIS.

In addition, a request for a boundary interpretation was submitted to the State Land Use Commission and found the survey map to be consistent (Boundary Interpretation No. 07-41).

Review of the Kaloko Makai Land Use Plan in the DEIS also reveals various changes to the proposed development since the filling of the Petition, including but not limited to the addition of a hospital, light industrial uses, and a WWTP. (*Although an onsite wastewater treatment plant now appears to be the preferred alternative for processing wastewater generated by the development, according to the Petition it was anticipated that the development would connect to the County's wastewater system and be served by the Kealakehe Wastewater Treatment Plant.)*

Given the extent of these changes, please be advised that an amendment to the Petition will need to be filed with necessary narrative/maps documenting the current description of the Petition Area and the proposed development.

Response: The site plan has undergone further revisions since the filling of the Petition. A Second DEIS has been prepared as a result of the changes to the site plan, project description and impact assessment.

Once the HRS Chapter 343 environmental review process is complete, Petitioner will prepare an amendment to the Petition to incorporate all of the appropriate changes.

By letter dated January 23, 2008, we provided comments on the Petition in which we requested that additional information be provided to specifically address how affordable housing will be provided within the context of the applicable housing policies of the State and County of Hawaii. We acknowledge that the DEIS includes information on conforming affordable housing prices relative to the County guidelines effective September 1, 2010, and that of the 5,000 housing units proposed in the development, 700 will be affordable units. Further clarification should be provided on the projected breakdown of these 700 units between single-family and multi-family units and their respective sales prices/rental rates.

Response: Kaloko Makai will comply with the County of Hawaii's ordinances concerning affordable housing requirements. Moving through the entitlement process, the Petitioner will continue to work with Hawaii County's Office of Housing and Community Development on the appropriate amount, price points and rental amounts that are appropriate for this development.

Finally, we note that the development timetable for the construction of infrastructure improvements has changed since the filing of the Petition. According to the Petition, the primary infrastructure systems necessary to accommodate substantial development were projected to be completed within 10 years. The DEIS on the other hand, states that the major infrastructure will be developed by 2025, with the development implemented in 3 phases and completed in 30 years. We acknowledge that the DEIS includes three maps generally depicting each phase. As you may know, subsection 15-15-50(c)(3), HAR, requires that a metes and bounds map and description of the Petition Area as well as of the increments, phases be provided when incremental development is proposed as it is in this case. As such, as part of the content requirements for the Petition, the above maps should be supplemented with the applicable metes and bounds of the boundaries of each phase.

Response: Applicable metes and bounds descriptions and mapping will be filed with the Land Use Commission when Petitioner files its Amendment to State Land Use District Boundary Amendment Petition.

To the extent that easements are present on the Petition Area, they should be reflected on any metes and bounds map submitted as we pointed out in our Jan. 23, 2008 comment letter on the Petition. Additionally, since Phases 1 and 2 involve other lands previously urbanized under Docket No. A84-566/TSA International Ltd., metes and bounds should be provided for the acreage of each phase within the Ag District in conjunction with the aforementioned boundary interpretation

Response: As stated above, appropriate mapping will be provided when Applicant submits State Land Use Boundary Amendment Petition

(2) In accordance with subsection 11-200-17(h), HAR, a statement of the proposed action to land use plans, policies, and controls for the affected area should be provided. We acknowledge that the DEIS includes an assessment of the proposed development in relation to the applicable objectives, policies, and priority guidelines of the State Plan. Please be advised SB 283, SD 1, HD 1, CD 1, was recently signed into law as Act 181. The Act added a new section to Part III Chapter 226, HRS, which provides, among other things, priority guidelines and principles to promote sustainability. We request that the current assessment in the DEIS be amended to

include a discussion of how the proposed development conforms to these sustainability criteria.

Response: Attached within the Appendices of the forthcoming Second DEIS is a Sustainability Plan which includes a discussion of priority guidelines and principles to promote sustainability within the project.

The forthcoming Second DEIS fully complies with the requirements set forth in Title 11, Chapter 200 of the Hawaii Administrative Rules (HAR) and includes a discussion of the proposed project's conformance with sustainability criteria outlined in Act 181.

The status of each identified approval should also be described. We acknowledge that the DEIS includes a listing of anticipated permits and approvals. We request that to the extent possible the projected submittal dates (ie, by month/year) of the various applications be provided.

Response: The forthcoming Second DEIS will discuss the status of each identified approval. Furthermore, the listing of anticipated permits and approvals within the Second DEIS will include anticipated submittal dates, to the extent that such dates can be projected at this time.

(3) In accordance with subsection 11-200-17(i), HAR, a discussion of the probable impact of the proposed action on the environment shall be provided, including an assessment of the interrelationships and cumulative environmental impacts of the proposed action and other related projects. We acknowledge that the DEIS contains a section on cumulative impacts, including a table of planned residential and commercial developments in the vicinity of the Petition Area. We further acknowledge this section states a discussion of existing human and natural environmental conditions in the project area is found in Chp. 3 & 4. However, given that this section is entitled cumulative impacts, we request that in addition to the impacts from the proposed development, this section addresses the specific impacts from each of the identified developments to determine the extent of these cumulative impacts on the environment.

Response: As requested, in the forthcoming Second DEIS, Section 8.2 Cumulative Impacts will address cumulative impacts from other proposed developments.

We also note that there is no discussion in the DEIS on the existing civil defense facilities in the area as well as on the potential impacts of such facilities from the proposed development. We request that the FEIS address this matter, including any

plan to fund and construct adequate civil defense measures (sirens) to serve the Petition Area as may be required by the State Dept. of Defense, Office of Civil Defense.

Response: The forthcoming Second DEIS will include a discussion of existing and proposed civil defense facilities in the area.

(4) In accordance with subsection 11-200-17(n), HAR, the DEIS shall include a separate and distinct section that summarized unresolved issues. We acknowledge that the DEIS includes such a section. However, discussion is needed to address how the unresolved issue of transportation improvements to address cumulative traffic impacts will be resolved prior to commencement of the action or the overriding reasons for proceeding without resolving the matter. This discussion should include the provision of a timetable(s) for resolution and the options available to Petitioner if the matter is not resolved in a timely manner relative to the commencement of the proposed development.

Response: Transportation improvements to address cumulative traffic impacts is no longer an "unresolved issue." Therefore, the forthcoming Second DEIS will reflect this. An updated traffic study has been prepared for the Second DEIS. The roadway system will conform to County design standards and intersections improvements with State roadways will be consistent with State design standards.

(5) We acknowledge that a Motion to Amend Conditions (Motion) for the approximately 190-acre portion of the proposed development in the Urban District will be filed with our office to conform this acreage (previously proposed for golf course use and related facilities) to the development. We strongly recommend that coordination with our office be done prior to the filing of the Motion to ensure its orderly processing.

Response: The Petitioner will coordinate with the LUC prior to filing a Motion to Amend Conditions for the approximately 190-acre portion of the proposed project in the Urban District.

(6) In the DEIS, there are numerous references to the terms potable water and non-potable water. We request that it be replaced by the term drinking water and non-drinking water, respectively. We have been advised that although potable water has generally been used to mean drinking water, the DOH uses the latter term specifically to indicate water for human consumption that is derived from surface water and/or groundwater and is regulated by the DOH pursuant to Chapter 11-20, HAR.

Response: References to the terms "potable water" and "non-potable water" have been replaced by the terms "drinking water" and "non-drinking water" in the forthcoming Second DEIS.

(7) We note that SCD Kaloko Makai, LLC is the Petitioner of record in the Petition. However, the name of the Petitioner/Applicant identified in the DEIS is SCD-TSA Kaloko Makai, LLC. Clarification should be provided on the distinction, if any, between the two entities, so that the record in the district boundary amendment proceeding including, but not limited to, the landowner's authorization, affidavits, balance sheet, and notification of petition filing reflects the appropriate entity seeking relief from the LUC.

Response: The name of the Petitioner has changed since the original filing of the Petition. The appropriate documents will be submitted to the LUC regarding this change, and the current name of the landowner will be identified as the Petitioner in the Amendment to Land Use District Boundary Amendment, which will be filed with the Commission after the HRS Chapter 343 process is completed..

(8) For your information a portion of the Petition Area, identified as TMK: 7-3-9: por. 17, was the subject of a previous boundary amendment petition filed under Docket No. A95-716/Tokyo Green Hawaii, Inc., which proposed to reclassify the parcel to the Urban District for residential, commercial, school, and park uses. The request was subsequently withdrawn by the Petitioner.

Response: The Petitioner acknowledges that parcel 17 was subject to a previous boundary amendment, which was subsequently withdrawn.

Your letter, along with this response, will be reproduced and included in the forthcoming Second DEIS. We appreciate your participation in the EIS review process.

Sincerely,

Earl Matsukawa, AICP
Project Manager

cc: Mr. Jay Nakamura, Stanford Carr Development

NEIL ABERCROMBIE
GOVERNOR
RICHARD C. LIM
DIRECTOR
MARY ALICE EVANS
DEPUTY DIRECTOR
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Ref. No. P-13425

October 7, 2011

Mr. Orlando Davidson, Executive Officer
State Land Use Commission
Department of Business, Economic Development and Tourism
P.O. Box 2359
Honolulu, Hawai'i 96804

Dear Mr. Davidson:

Subject: Draft Environmental Impact Statement
Land Use Commission Docket No. A07-778, Kaloko Makai
Tax Map Key Nos. (3) 7-3-009: 017, 025, 026, and 028
Kaloko and Kohanaiki, North Kona, Hawai'i

The Office of Planning (OP) has reviewed the Draft Environmental Impact Statement (DEIS) prepared for the above referenced project. Petitioner, SCD-TSA Kaloko Makai, LLC, proposes to reclassify a total of approximately 952.165 acres of land from the State Agricultural and Conservation Districts to the State Urban District, for the development of the Kaloko Makai project, a mixed-use urban center planned for approximately 1,142.165 acres within the designated Kona Urban Area of the County of Hawai'i's Kona Community Development Plan.

The Office represents the State as a mandatory party in proceedings before the Land Use Commission (LUC) for amendments to district boundaries involving land areas greater than fifteen acres, pursuant to Section 205-4(e), Hawai'i Revised Statutes (HRS). The Office evaluates proposed projects and petitions with respect to the LUC decision-making criteria in Section 205-17, HRS, and Chapter 15-15, Hawai'i Administrative Rules (HAR). In addition, the Office strongly encourages petitioners to review their proposals with respect to the Administration's priorities in implementing the goals of the Hawai'i State Plan, Chapter 226, HRS. These priorities are set out in the Administration's New Day Comprehensive Plan, which is available at http://hawaii.gov/gov/about/a-new-day.

The Office offers the following comments on the subject DEIS. These comments are intended to ensure that the Final Environmental Impact Statement (FEIS) provides a more complete and accurate discussion of project impacts pertinent to LUC decision-making criteria.

1. **Act 181, Session Laws of Hawai'i 2011, Priority guidelines for sustainability.** Act 181, signed into law on July 5, 2011, sets forth in Part III of Chapter 226, HRS, new priority guidelines to promote sustainability in Hawai'i. The new priority guidelines should be included in FEIS Section 5.1.4, and the FEIS should discuss how the project addresses the priority guidelines for sustainability.

2. **Sustainable development and resource use.** OP reviews proposed projects with respect to their demonstrated commitment to incorporating and implementing sustainable design and development practices that align with State energy initiatives and the Administration's priorities to move toward clean energy, energy independence, and a green economy. The DEIS discusses a variety of green building practices that will be "considered" in project design and development. OP recommends that the FEIS identify those measures that are proposed to be or will be incorporated in project design and construction to reduce resource use and energy demand, maximize energy efficiency and resource reuse and recycling, promote use of alternative, renewable energy sources.

   OP also recommends that petitioners consider preparing a sustainability plan that outlines guidelines, actions, and performance standards to be implemented in the design, development, and operation of projects to minimize and mitigate the long-term energy and resource impacts of proposed projects. Castle and Cooke Homes Hawai'i (Koa Ridge) and DR Horton-Schuler Homes (Ho'opili) have prepared sustainability plans for their respective projects; these documents are available for review at the LUC website.

3. **Groundwater and coastal water quality.** The section on groundwater resources would be improved by including a brief description of the project's estimated potable and non-potable water demand, potential recharge or infiltration due to wastewater effluent disposal, irrigation, and stormwater runoff, and preferred water source, to provide a context for evaluating reasonably foreseeable impacts. On page 3-27, the statement regarding no anticipated impacts to groundwater sources should be qualified to read that with appropriate mitigation there are no anticipated impacts.

   Given comments received from the State Department of Land and Natural Resources' Division of Aquatic Resources and the U.S. National Park Service (NPS), that the evidence to date is inconclusive as to the potential impacts—adverse or otherwise—that may result from development of the project and other projects in the region on the Class AA and Class A coastal receiving waters and the water quality of the anchialine ponds and other coastal resources found at the Kaloko-Honokōhau National Historical Park (NHP) and Monument makai of the proposed project. The NPS is concerned about the quality of groundwater and

surface runoff entering the NHP. To strengthen the evaluation of the reasonably foreseeable impacts, the FEIS should include the following:

a. All studies referenced in the groundwater section should be fully cited in the References section, e.g., Dollar 2002 is not listed in the References.

b. As recommended by the NPS, the FEIS should include an analysis of preventative measures such as restricted use of termiticides, pesticides, and herbicides and the incorporation of water quality treatment features, like filtration devices, that can be incorporated in drainage improvements to remove potential contaminants like petrochemicals before disposal in drywells or infiltration into groundwater underlying the project site.

c. The project proposes to adopt mitigation measures including a pollution prevention plan and groundwater monitoring plan, similar to plans worked out between the NPS and other developers in area. The FEIS should provide an update on consultations with the NPS and whether there is substantive agreement about the scope and content of the plans. The FEIS should also identify what entity will be responsible for preparing and implementing these plans.

d. The DEIS states that the groundwater monitoring plan will be implemented for a two-year period. Given the questions and concerns as to the long-term, cumulative impacts of urban development of this and other projects on coastal waters, it is more reasonable for the groundwater monitoring plan to be long-term, to enable an assessment of conditions with full buildout of the project.

4. **Proposed dryland forest preserve.** The FEIS should discuss potential impacts and possible mitigation measures related to increased accessibility due to urban development and the trail restoration proposed in the remnant forest. The FEIS should also clarify and/or discuss, in the appropriate section, preservation and management of the dryland forest with respect to the following:

a. Habitat conservation plan. The FEIS should clarify whether the habitat conservation plan is of similar or narrower scope than the management plan the U.S. Fish and Wildlife Service recommended be prepared and implemented for the preserve in its October 29, 2010 letter.

b. Implementation of habitat conservation plan or management plan. The FEIS should clarify who will be responsible for managing the preserve? How will management activities be funded over the long-term?

c. Phasing of implementation. Figure 2-12 includes the dryland forest in Phase 1 of the project. Table 2-6 lists the dryland forest in Phase 3. Given the sensitivity of the forest ecosystem and protected plant species within, it would be preferable for the dryland forest preserve to be established and

management measures in place in Phase 1, early in the project prior to major construction activity.

d. Consistency with County Plan land use designation and variant for Alternatives section. The County General Plan Land Use Allocation Pattern Guide Map designates much of the dryland forest area as 'Conservation'. The FEIS should discuss consideration of reclassification of the lands underlying the proposed preserve to the State Conservation District as a reasonable alternative to reclassification to the Urban District.

5. **Archaeological and cultural resources.** The northeastern portion of the project property features numerous archaeological and cultural resources, such as burials in lava tubes, which are proposed for preservation. Low-density residential uses are proposed for development in Phase 3 of the project; the residential units are proposed to be interspersed among the preservation clusters. As a reasonable alternative, the final EIS should consider avoiding development in this area, reallocating planned units to other residential and mixed use areas within the project property, and creating a much larger cultural preserve to ensure that residential development and future residents do not encroach on these resources and to provide an open space buffer for the proposed mixed-use urban center.

OP recommends that the State Na Ala Hele Program be consulted to determine whether Program staff concurs with the DEIS finding that the Road to Honokōhau trail does not traverse the project property.

6. **Highways and roads.** The FEIS should identify which of the recommended planned roadway improvements, if not all, the project developer will undertake as mitigation of project impacts.

7. **Water source and system improvements.** The FEIS should clarify in the discussion of the preferred alternative for an off-site well field whether a long-term agreement for use of the land for this purpose will be required. It should also clarify whether pumping will be required to distribute water produced by the desalination plant, should one be needed for the project.

8. **Agricultural lands.** The FEIS should identify and describe any existing or planned agricultural activities on lands in the State Agricultural District adjoining or in proximity to the proposed project, and discuss what impact, if any, the project will have on agricultural use and viability on these lands.

9. **Biota.** The FEIS should describe precautionary measures that may be required during development and after buildout to avoid adverse impacts on Hawaiian hoary bat populations that may forage or transit the project property.

10. **Development timetable, Section 2.4.** The DEIS states that "major infrastructure" will be developed by 2025, although elsewhere in the section associated infrastructure will also be included in each of the project's proposed phases. The FEIS should clarify what will constitute "major infrastructure."

11. **Approvals and permits.** The FEIS should include in the list of approvals and permits those required for the development of a private water system, including those for a desalination system.

12. **Miscellaneous Comments, Clarifications, and Corrections.**

    a. The FEIS should correct the non-substantive typographic and spelling errors found in Volume 1 of the DEIS.
    b. The FEIS preparer should carefully review the comment letters to ensure that the FEIS is responsive to substantive concerns and comments in the comment letters. In particular, OP reviews the FEIS for evidence of ongoing consultation with impacted State agencies and responsiveness to State agency concerns.
    c. Conventional strategies for noise mitigation and maintenance of traffic flow and safety along the proposed Ane Keohokālole Highway may conflict with the creation of a pedestrian-friendly, vibrant mixed-use center and the successful integration and use of the mauka-makai Kohanaiki Trail, which will cross the new highway. The FEIS may want to note that special attention, perhaps the use of complete streets strategies, will be needed to create a successful streetscape for all modes of transportation and promote community livability in alignment with the Kona Community Development Plan.
    d. Page 1-8, Section 1.7.1. The FEIS should provide a brief explanation of the need for a boundary interpretation for the amount of acreage being proposed for reclassification from the Agricultural to the Urban District.
    e. Page 1-14, State Functional Plans. The correct number of State functional plans is thirteen.
    f. Page 1-17, Rationale for Proceeding. This section could include the preservation and restoration of the Kohanaiki Trail as well as preservation of archaeological and cultural sites, including burials.
    g. Figure 2-11, Land Use Plan. Consideration should be given to revising this figure to provide a graphic treatment of Kohanaiki Trail like that in Figure 2-1 of the Environmental Impact Statement Preparation Notice (EISPN), which illustrates the trail alignment with its open space buffer and better reflects the archaeological, cultural, recreational, and place-making significance of restoration and preservation of this trail.
    h. Page 2-30, Table 2-5, footnote for interchange. We recommend that "taking" be replaced with "land acquisition" or a more neutral term.

    i. Figures 2-12 through 2-14 and related phasing table/discussion on page 2-59. It might be helpful if one or more of the phasing maps were revised to display the approximate location of the planned Queen Ka'ahumanu Highway interchange, and to identify, if possible, in the phasing table the appropriate timeframe for interchange improvements. It would provide a clearer picture if the extent of the general neighborhoods described in Section 2.4 were delineated on the phasing maps.
    j. Page 3-1, Climate. The FEIS should acknowledge that the project will help offset the loss of vegetation, but will result in a significant change in land cover, replacing vegetation with heat-absorbing materials and impervious surfaces.
    k. Page 3-2, National Pollutant Discharge Elimination System permit. The FEIS should replace "stormwater construction activities" with "stormwater discharges associated with construction activities."
    l. Page 3-4, Offsite well field. Soils of the potable well field include rKED soils.
    m. Figure 3-2 might read better if the rating class was symbolized using a color ramp with consistently lighter gradations from 'A' to 'E".
    n. Page 3-8, Section 3.4, Hazards. The FEIS should reference any concerns and planned actions contained in the County Hazard Mitigation Plan that are relevant for development in the proposed project area and region.
    o. Page 3-8, Sections 3.4 and 3.4.1. The introduction states the project site is susceptible to hazards including flooding; the section goes on to state the project is not anticipated to result in flooding of the project site or lands downslope of the project. The FEIS should clarify the flood risk posed by the proposed development. The FEIS should also clarify whether a stormwater management program and guidelines will be adopted for the proposed project, or whether the narrative in Section 3.4.1 is simply reporting the Kona Community Development Plan Policy for urban stormwater management.
    p. Page 3-10, Section 3.4.3. The FEIS should clarify whether the "Prescriptive Details for Hurricane-Resistant Construction" is part of the County's adopted Uniform Building Code or is a set of higher standards yet to be adopted.
    q. Figure 4-3, Archaeological Sites. It might be helpful to display the parcel boundaries and label with their tax map key numbers, since the sites are discussed by parcel.
    r. Page 4-81, Aircraft noise. The DEIS notes that there are occasional aircraft overflights of the project property. The FEIS should reflect the recommendations of the State Department of Transportation, Airports Division regarding disclosure of aircraft noise.
    s. Page 4-82, Table 4-16. The notes for the table are missing.

t. Page 4-87, Fire protection. The text notes a 30-mile radius for fire protection service for the Kailua-Kona Fire Station. This seems rather large for an urban or urbanizing area.

u. Page 4-89, Schools. This section should note that the project is within the West Hawai'i School Impact Fee District, and provide an update on consultations with the State Department of Education. The capacity of Kealakehe High School should be provided.

v. Pages 4-89 through 4-102. There are some discrepancies in the numbers used in the text and those in Tables 4-21 and 4-23, which should be resolved or explained.

w. Page 4-9.2.1.2. Fiscal impacts. The FEIS should clarify whether the fiscal analysis assumed dedication of infrastructure to the County or not.

x. Page 4-105, Second paragraph. Your conclusions should be supported by findings and facts.

y. Table 4-24. It would be helpful if the table showed water demand by potable vs. non-potable water. There are redundant school footnotes.

z. Page 4-123, Section 4.10.2, Wastewater system and Figure 4-20. The colors in the legend and map shown in Figure 4-20 are confusing and make this map difficult to read with respect to the narrative. We recommend the map and text be reviewed to see how the figure and legend might be improved, for example, in distinguishing between the petition area and the County's financing district, etc.

aa. Page 4-126, Wastewater treatment alternatives. This section could be improved by stating at the outset that the preferred alternative for the project is to develop a private wastewater treatment plant.

bb. Pages 4-124 through 4-132. The FEIS should be consistent in the numbers used for average wastewater flow, average dry weather flow, and design peak flow and the number of acres that can be irrigated with recycled water flow.

cc. Page 4-132, Section 4.10.3, Drainage. This section should include estimates of potential stormwater runoff at buildout and the volume of runoff at buildout that will be required to be retained onsite under County drainage standards.

dd. Page 5-8, Comment for Section 5.1.3, Chapter 205A, HRS, Scenic and Open Space Resources. The comment should be revised to discuss the project's impact on open space resources as well as views mauka-makai in the coastal viewshed. The comment should also acknowledge that the project is not coastal dependent and is located inland.

ee. Page 5-9, Economic Uses. The policy emphasis here is on the appropriate siting of coastal dependent facilities and improvements. Since the project is not coastal dependent, no comment is really necessary here.

ff. Page 8-2, Section 8.2, Cumulative impacts. With the exception of traffic, the impacts on the identified issue areas are not discussed in a cumulative context.

gg. Page 8-6, Section 8.4. This section should include the irretrievable and irreversible commitment of State and County funds to operate and maintain induced public facility growth and services, such as schools, public libraries, highways and roads dedicated to the State or County, potential residential refuse collection, etc.

hh. Page 8-7, Section 8.5, Environmental effects that cannot be avoided. This section should include the taking of endangered species and the potential threat to other protected plant species, potential threats and alteration to archaeological and cultural sites, and the contribution of vehicular emissions and emissions from power generation to air quality.

The Office appreciates the opportunity to comment on the DEIS. We look forward to receiving the FEIS. If you have any questions, please call Ruby Edwards, Land Use Division, at 587-2817.

Sincerely,

Jesse K. Souki
Director

c: Mr. Peter Phillips, SCD-TSA Kaloko Makai, LLC
✓Mr. Earl Matsukawa, Wilson Okamoto Corporation
Ms. Bobbie Jean Leithead Todd, County of Hawai'i Planning Department

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7469-01
July 25, 2013

Mr. Jesse K. Souki, Director
Office of Planning
Department of Business, Economic Development, & Tourism
State of Hawai'i
235 South Beretania Street, 6th Floor
Honolulu, Hawai'i 96804

Subject: Draft Environmental Impact Statement (DEIS)
Kaloko Makai
Kaloko and Kohanaiki, North Kona, Hawaii
Tax Map Key: (3) 7-3-09: 017, 025, 026, and 028

Dear Mr. Souki:

Thank you for your letter dated October 7, 2011. The Petitioner is preparing a Second DEIS to address changes in the proposed project that will be reassessed, as needed, in the forthcoming document. You will be notified of its availability for review and comment pursuant to Chapter 343, Hawaii Revised Statutes (HRS) and Title 11, Chapter 200 Hawaii Administrative Rules (Department of Health).

With regard to your comments on the subject DEIS, we offer the following in response to your comments:

(1) *Act 181, Session Laws of Hawaii 2011, Priority Guidelines for Sustainability - Act 181, signed into law on July 5, 2011, sets forth in part III Chapter 226, HRS, new priority guidelines to promote sustainability in Hawaii. The new priority guidelines should be included in the FEIS Section 5.1.4 and the FEIS should discuss how the project addresses the priority guidelines for sustainability.*

Response: The forthcoming Second DEIS includes a discussion of the proposed project's conformance with sustainability criteria outlined in Act 181. It will also include a Sustainability Plan establishing priority guidelines and principles to promote sustainability within the project

(2) *Sustainable development and resource use - OP reviews proposed projects with respect to their demonstrated commitment to incorporating and implementing sustainable design and development practices that align with State energy initiatives and the Administration's priorities to move toward clean energy, energy independence, and a green economy. The DEIS discusses a variety of green building practices that will be "considered" in project design and development. OP recommends that the FEIS identify those measures that are proposed to be or will be incorporated in project design and construction to reduce resource use and energy demand, maximize energy efficiency and resource reuse and recycling, promote use of alternative, renewable energy sources.*

OP also recommends that petitioners consider preparing a sustainability plan that outlines guidelines, actions, and performance standards to be implemented in the design, development, and operation of projects to minimize and mitigate the long-term energy and resource impacts of proposed projects. CCH (Koa Ridge) and DR Horton (Hoopili) have prepared sustainability plans for their respective projects, these documents are available for review at the LUC website.

Response: As noted above, the forthcoming Second DEIS includes a Sustainability Plan which establishes priority guidelines and principles to promote sustainability within the project and green building practices that will be considered in project design and development.

(3) *Groundwater and coastal water quality - The section on groundwater resources would be improved by including a brief description on the projects estimated potable and non-potable water demand, potential recharge or infiltration due to wastewater effluent disposal, irrigation, and stormwater runoff, and preferred water source, to provide a context for evaluating reasonably foreseeable impacts. On pg 3-27, the statement regarding no anticipated impacts to groundwater sources should be qualified to read that with appropriate mitigation measures there are no anticipated impacts.*

Response: Pursuant to your recommendation, revisions have been made to the Groundwater and Coastal Water Quality section in the forthcoming Second DEIS.

Given comments received from DLNR Div. of Aquatic Res and the NPS, that the evidence to date is inconclusive as to the potential impacts - adverse or otherwise - that may result from development of the project and other projects in the region on the Class AA and Class A coastal receiving waters and the water quality of the anchialine ponds and other coastal resources found at the Kaloko Honokohau NHP and Monument makai of the proposed project. The NPS is concerned about the quality of groundwater and surface runoff entering the NHP. To strengthen the evaluation of the reasonably foreseeable impacts, the FEIS should include the following:

a. *All studies referenced in the groundwater section should be fully cited in the References section, eg, Dollar 2002 is not listed in the References*

Response: All references in the text of the DEIS have been cross-checked and will be appropriately cited in the reference section of the forthcoming Second DEIS.

b. *As recommended in by NPS, the FEIS should include an analysis of preventative measures such as restricted uses of termiticides, pesticides, and herbicides and the incorporation of water quality treatment features, like*

filtration devices, that can be incorporated in drainage improvements to remove potential contaminants like petrochemicals before disposal in drywells or infiltration into groundwater underlying the project site.

Response: An analysis of preventive measures discussed above, is included in the forthcoming Second DEIS. Analysis of sediment from fishponds and anchialine pool showed no presence of any pesticide or herbicide. The present lack of these materials in pond sediments indicates that existing methods of disposal are adequate for prevention of reaching Kaloko-Honokohau National Historic Park assets. Continued monitoring can be one of the preventive measures to promote continual lack of presence.

As mentioned in the Draft EIS, all drainage improvements will be developed in accordance with the applicable Department of Health (DOH) and County drainage requirements regarding runoff and non-point source pollution.

To reduce the potential for non-point source pollution to impact groundwater and marine waters Kaloko Makai will:

- Design and construct best management practices (BMPs) to prevent violation of State water quality standards as a result of storm runoff discharges originating from Kaloko Makai. To the extent practicable and consistent with applicable laws, Kaloko Makai will design storm and surface runoff BMPs to treat the first flush runoff volume to remove pollutants from storm and surface runoff.
- Where applicable, design sub-surface drainage structures with a debris catch basin to allow the detention and periodic removal of rubbish and sediments deposited by runoff. Storm water runoff shall first enter the debris catch basin before flowing into any subsurface drainage structures. The debris catch basin's volume will be designed using current industry and engineering standards.
- Design and construct to the extent practicable and consistent with applicable laws, landscaped areas, including grassed or vegetative swales, grass filter strips, vegetated open space areas, or other advance storm water BMPs.
- Provide signs for all subsurface drainage structures with warnings such as "Dump No Wastes. Goes to Groundwater and Ocean. Help Protect Hawaii's Environment."
- Develop Pollution Prevention Plan (PPP), before constructing Kaloko Makai that: 1) addresses environmental stewardship and non-point sources of water pollution that can be generated in residential areas, 2) provides BMPs for pollution prevention. The PPP will include water conservation, landscape runoff, erosion control, use of fertilizers and other chemicals, environmentally safe automobile maintenance, and management of household chemicals. The PPP will also include information on the

National Park and the significant natural and cultural resources within the Park.

c. *The project proposes to adopt mitigation measures including a pollution prevention plan and groundwater monitoring plan, similar to plans worked out between the NPS and other developers in the area. The FEIS should provide an update on consultations with NPS and whether there is substantive agreement about the scope and content of the plans. The FEIS should also identify what entity will be responsible for preparing and implementing these plans.*

Response: We are aware of a pollution prevention plan and groundwater monitoring plan that the National Park Service (NPS) negotiated with other developers in the area, and the terms of those agreements have informed some of the mitigation measures proposed in the Second DEIS. Although it is premature for SCD-TSA Kaloko Makai to be negotiating terms of an agreement with NPS, we anticipate that SCD-TSA Kaloko Makai will enter into an agreement similar to those entered into by other developers as the project moves forward. We also anticipate that SCD-TSA Kaloko Makai, or its designee, will be responsible for preparing the implementation of such plans.

d. *The DEIS states that the groundwater monitoring plan will be implemented for a two year period. Given the questions and concerns in the long-term, cumulative impacts or urban development of this and other projects on coastal waters, it is more reasonable for the groundwater monitoring plan to be long-term, to enable an assessment of conditions with full build out of the project.*

Response: The specific timeframe for groundwater monitoring will be determined in consultation with a variety of entities including NPS, DLNR and the County of Hawaii.

(4) *The FEIS should discuss potential impacts and possible mitigation measures related to increased accessibility due to urban development and the trail restoration proposed in the remnant forest.*

Response: There are two trails that start near the same point on Hina Lani Street; one is an old stepping stone trail that leads mauka and the other runs across the dryland forest. Should the project get developed, these trails are intended to be open for public use.

However, the trail system within the dryland forest will allow it to be accessed by residents and visitors and afford the opportunity to conduct educational programs as well. Appropriate signage will be developed to encourage public cooperation and discourage trespassing, vandalism or arson within the Kaloko Makai Dryland

Forest Preserve. In addition, in connection with project development, SCD-TSA Kaloko Makai has plans to fence the Preserve in order to prevent ungulates, and to remove all ungulates from the Preserve area when the fencing is installed.

The FIES should also clarify and/or discuss, in the appropriate section, preservation and management of the dryland forest with respect to the following:

a. *HCP- The FEIS should clarify whether the HCP is of similar or narrower scope than the management plan the USFWS recommended to be prepared and implemented for the preserve in its October 29, 2010 letter.*

Response: No listed threatened or endangered plant species will be "taken" in the development and construction of the Kaloko Makai project. Therefore, a HCP will not be required.

Three individual endangered plants (two hala pepe and one 'aiea) found outside the dryland forest preserve will be buffered by setbacks and enclosures (fence/wall). Kaloko Makai will develop a 50-ft. buffer between the two hala pepe and one 'aiea and any structure. The plants will be incorporated into landscaping within the 50-ft. buffers.

Based on comments received during the DEIS, reclassification of the 150-acre Dryland Forest to the Urban district is no longer being considered. It will remain in the Agricultural district.

If the Kaloko Makai petition to the LUC is successful, the Petitioner will seek to subdivide the preserve into a single parcel through the applicable County processes. The Petitioner is also considering incorporating a restrictive covenant or condition into the property deed to assure that the parcel containing the preserve shall remain undeveloped and that appropriate access shall be provided in perpetuity.

b. *Implementation of HCP or management plan - The FEIS should clarify who will be responsible for managing the preserve? How will management activities be funded over the long-term?*

Response: See previous response no. 4a.

Should the necessary land use entitlements be obtained to allow for development of the Kaloko Makai project, it is anticipated that long-term management of the preserve will be funded by residents and business owners within Kaloko Makai. Alternatively, management may become the responsibility of a conservation group, similar to the arrangements utilized in the establishment of a conservation easement. .

c. *Phasing of implementation - Figure 2-12 includes the dryland forest in Phase I of the project. Table 2-6 lists the dryland forest in Phase 3. Given the sensitivity of the forest ecosystem and protected plant species within, it would be preferable for the dryland forest preserve to be established and management measures in place in Phase I, early in the project prior to major construction activity.*

Response: The Dryland Forest will be established during Phase 1 of the project as shown in Figure 2-12. Table 2-6 has been revised in the Second DEIS.

d. *Consistency with County Plan land use designation and variant for alternative section - The County GP LUPAG designates much of the dryland forest area as "conservation". The FEIS should discuss consideration of reclassification of the lands underlying the proposed preserve to the State Conservation District as a reasonable alternative to reclassification to the Urban District.*

Response: Based on comments received, reclassification of the Dryland Forest Preserve to the Urban District is no longer being considered. It will remain in the Agricultural District. Retaining the preserve area in the Agricultural District is a more reasonable alternative than seeking to reclassify the preserve to the Conservation District due to the cumbersome permitting requirements in effect within the Conservation District, which could inhibit the installation of signs and fencing, and make subdivision of the preserve are more difficult.

If the Kaloko Makai petition to the LUC is successful, the Petitioner will seek to subdivide the preserve into a single parcel through the applicable County processes. Irrespective of the State Land Use designation, the proposed preserve will remain consistent with the Conservation designation under the County General Plan LUPAG.

(5) *Archeological and cultural resources. The northeastern portion of the project property features numerous archaeological and cultural resources, such as burials in lava tubes, which are proposed for preservation. Low-density residential uses are proposed for development in Phase 3 of the project; the residential units are proposed to be interspersed among the preservation clusters. As a reasonable alternative, the FEIS should consider avoiding development in this area, reallocating planned units to other residential and mixed use areas within the project property, and creating a much larger cultural preserve to ensure that residential development and future residents to not encroach on these resources and to provide an open space buffer for the proposed mixed-use urban center.*

Response: In consideration of your comments, Phase 3 of the project has been redesigned around the archaeological and cultural preserve sites, and the amount

of developed space has been reduced. An updated land use plan reflecting this is included in the Second DEIS.

OP recommends that the State Na Ala Hele Program be consulted to determine whether Program staff concurs with the DEIS finding that the Road to Honokōhau trail does not traverse the project property.

Response: The Petitioner's representatives have been in the field with State Na Ala Hele staff and have had numerous discussions with the State Na Ala Hele Program. Na Ala Hele has not indicated that there are any discrepancies in the DEIS finding that the Road to Honokohau trail does not traverse the project property. The Honokōhau Trail is in the Honokohau ahupua'a, not within the project area.

The Petitioner will preserve the Kohanaiki Trail (Road to the Sea) within the project area as discussed in the DEIS and forthcoming Second DEIS.

(6) *Highways and Road - The FEIS should identify which of the recommended planned roadway improvements, if not all, the project developer will undertake as mitigation of project impacts.*

Response: An updated traffic impact study (TIS) has been incorporated into the forthcoming Second DEIS. The roadway system will conform to County design standards and intersections improvements with State roadways will be consistent with State design standards. The TIS describes the improvements needed at each phase of project development.

(7) *Water Source and system improvements - The FEIS should clarify in the discussion of the preferred alternative for an off-site well field whether a long-term agreement for use of the land for this purpose will be required. It should also clarify whether pumping will be required to distribute water produced by the desalination plant, should one be needed for the project*

Response: The off-site well field mauka of the Project Site will not be pursued.

The alternatives now being considered for the project's drinking water supply have been narrowed down three alternatives that can be affirmatively demonstrated as having no impact on the basal lens. These are limited to use of the high level groundwater drawn from strata far below the basal groundwater so as not to impact it and desalinizing saline groundwater, also drawn from below the basal lens. The three alternatives are:

1. On-site wells at 710-foot elevation within the project site (
2. On-site wells at 710-foot elevation with reverse osmosis (RO) treatment
3. Desalinization of saline groundwater from 363-foot elevation on-site wells

The preferred alternative as described in the forthcoming Second DEIS is on-site wells.

Depending on the results of the test well to be drilled at the upper end (710 ft. elevation) of the project site, reverse osmosis or desalinization of groundwater might be undertaken. The first might be RO treatment of high level groundwater which, due to the location and depth from which it is extracted, is slightly brackish. In this case, the fraction of the well water supply converted to potable water is likely to be about 65% based on the current desalinating being done at the Kukio and Hualalai resorts. The 30% remainder, referred to as concentrate, would be disposed of in wells located makai of the UIC line and designed to deliver the concentrate into a groundwater zone of equivalent or greater salinity.

In the event that Alternatives 1 and 2 are not feasible, desalination of on-site saline groundwater extracted from beneath the basal lens in wells that would be located at about mid-elevation or 363-foot elevation on the project site. Based on prototype testing conducted by the Honolulu Board of Water Supply using saline groundwater from wells at the makai end of Campbell Industrial Park on Oahu, the recovery of potable water may be on the order of 40% of the saline feedwater supply, in effect pumping about 2.85 gallons of saline groundwater to produce one gallon of potable water. The other 65 % of the feedwater supply would be hypersaline concentrate (salinity of about 1.5 times that of seawater) that would be disposed of in deep wells makai of the UIC line. To reduce the desalination plant power requirements, pressure transfer devices would be installed to recover energy from the RO concentrate stream.

Potential pumping demands required to distribute water produced by the desalination plant have been included in the Second DEIS.

Since elevation pressure will be used to force water through the RO membrane, the desalinated water comes out at a lower elevation. It will need to be pumped up to higher elevation reservoir(s) to achieve required pressure for fire protection / domestic use.

An Assessment of the Potential Impact on Water Resources has been prepared by Tom Nance Water Resource Engineering (TNWRE) and will be included in the forthcoming Second DEIS.

(8) *Agricultural lands - The FEIS should identify and describe any existing or planned agricultural activities on land in the State Agricultural District adjoining or in proximity to the proposed project, and discuss what impact, if any, the project will have on agricultural use and viability on these lands.*

Response: Although a portion of the property is within the Agricultural land use district, there is currently no agricultural use on the property. Areas to the east (Kona Heavens) and south (Lanihau and Kona View Estates) of Kaloko Makai are designated State Agricultural District, but these lands have residential or commercial / industrial uses.

While most of the property adjoining or in proximity to the Kaloko Makai lands are not classified in the State Agricultural District, SCD-TSA Kaloko Makai will comply with HRS § 205-3.5 with respect to lands that are "contiguous or adjacent to lands in the agricultural distrct." That is to say, there will be prohibitions on any action that would interfere with or restrain farming operations; provided the farming operations are conducted in a manner consitent with generally accepted agricultural and management practices' and, to the extent applicable, notification will be given to all prospective developers or purchasers of land that farming oprations and practices on adjacent or contiguous land in the agricultural distrct are protected under Chapter 165, the Hawaii Right to Farm Act.

(9) *Biota - The FEIS should described precautionary measures that may be required during development and after build out to avoid adverse impacts on Hawaiian hoary bat populations that may forage or transit the project property.*

Response: The principal potential impact that the project pose to Hawaiian hoary bat is during the clearing and grubbing phases of the project. Clearing of dense vegetation should not occur between June 1 – September 15, when bats may be carrying young and potentially could be at risk as a result of such clearing activities. In addition, the clearing of dense vegetation, including woody plants beyond 15 feet should also not be cleared during this period.

(10) *Development Timetable, Section 2.4 - The DEIS states that "major infrastructure" will be developed by 2025, although elsewhere in the section associated infrastructure will also be included in each of the project's proposed phases. The FEIS should clarify what will constitute "major infrastructure."*

Response: The term "major infrastructure" is clarified in the forthcoming Second DEIS.

(11) *Approvals and Permits - The FEIS should include in the list of approvals and permits those required for the development of a private water system, including those for a desalination system.*

Response: The forthcoming Second DEIS includes an updated list of approvals and permits.

(12) *Miscellaneous Comments, Clarifications, and Corrections.*

a. *The FEIS should correct the non-substantive typographic and spelling errors found in Volume 1 of DEIS.*

Response: The forthcoming Second DEIS corrects the non-substantive typographic and spelling errors found in Volume 1 of the DEIS.

b. *The FEIS preparer should carefully review the comment letters to ensure that the FEIS is responsive to substantive concerns and comments in the comment letters. In particular, OP reviews the FEIS for evidence of ongoing consultation with impacted State agencies and responsiveness to State agency concerns.*

Response: All comments to the DEIS have been carefully reviewed to ensure that the forthcoming Second DEIS is responsive to substantive concerns. The Second DEIS documents on-going consultation with impacted State agencies regarding State agency concerns.

c. *Conventional strategies for noise mitigation and maintenance of traffic flow and safety along the proposed Ane Keohokalole Highway may conflict with the creation of pedestrian friendly, vibrant mixed-use center and the successful integration and use of the mauka-makai Kohanaiki Trail, which will cross the highway. The FEIS may want to note that special attention, perhaps the use of complete streets strategies, will be needed to create a successful streetscape for all modes of transportation and promote community livability in alignment with the Kona CDP.*

Response: Kaloko Makai will be developed under the eight Kona CDP guiding principles and strategies, which will enhance the ability to develop the project with streetscapes for all modes of transportation The Sustainability Plan, to be appended to the forthcoming Second DEIS, includes a discussion on complete streets and multi- modal modes of transportation. Concepts are discussed in the Kona CDP and will be applicable to KalokoMakai.

d. *Page 1-8, Section 1.7.1 - The FEIS should provide a brief explanation of the need for a boundary interpretation for the amount of acreage being proposed for reclassification from the Agricultural to Urban Districts.*

Response: A request for a boundary interpretation was submitted to the State Land Use Commission and they found the survey map to be consistent (Boundary Interpretation No. 07-41).

e. *Page 1-14, Station Functional Plans - The correct number of State Functional Plans is 13.*

Response: The forthcoming Second DEIS has been revised to accurately reflect the number of State Functional Plans.

f. *Page 1-17, Rational for Proceeding - This section could include the preservation and restoration of the Kohanaiki Trail as well as preservation of archaeological and cultural sites, including burials.*

Response: The preservation and restoration of the Kohanaiki Trail and the preservation of archaeological and cultural sites, including burials have been added to the list in section 1.7.7.of the forthcoming Second DEIS.

g. *Figure 2-11 Land Use Plan - Consideration should be given to revising this figure to provide graphic treatment of Kohanaiki Trail like that in Figure 2-1 of the EISPN, which illustrates the trail alignment with its open space buffer and better reflects the archaeological, cultural, recreational and place making significance of restoration and preservation of this trail.*

Response: The Kohanaiki Trail will be preserved through the project site, as noted in the DEIS and the forthcoming Second DEIS.

The Kohanaiki Trail bisects the project site and is well defined for most of its alignment until the trail reaches the TMK 7-3-009:017. The Petitioner and their archaeological consultant, Cultural Surveys Hawaii, have been consulting with and Na Ala Hele to determine the location of the remaining alignment. The alignment shown in Figure 2-11 is the alignment determined based on consultation with Na Ala Hele.

Treatment of Kohanaiki Trail will follow the agreement established after extensive discussions with the interested community at Kaloko Heights. This translates to a 10' wide trail pathway (meandering mauka to makai on what is believed to be the historic alignment) and will be bordered by perpetual open space buffers of at least 10- feet wide on each side of the trail (30' wide in total). In places where cut and fill are necessary, the elevation of the trail may change, but the general alignment will not be disturbed.

Where the Trail intersects with Hina Lani Drive, Kaloko Makai will realign the remaining lower portion of the Trail from that point to run parallel with and adjoining the Hina Lani Street right-of-way down to Queen Ka'ahumanu Highway. Since the integrity of the historic trail is lost at that point, due to Hina Lani road construction, the adjoining industrial subdivision and the water tank, Kaloko Makai will realign the trail and have it run down the southern boundary of the property (fronting Hina Lani,) from the point of intersection with Hina Lani down to Queen Ka'ahumanu Highway. This alignment gives the users of the trail easy

access to cross Queen Ka'ahumanu or Hina Lani at the bottom, as there are crosswalks with crossing signals at that point.

Figure 2-11 has been revised to show 10-foot buffers on each side of the trail.

h. *Page 2-30, Table 2-5, footnote for interchange - We recommend that "taking" be replaced with "land acquisition" or a more neutral term.*

Response: Your recommended change in terminology has been used in the forthcoming Second DEIS text.

i. *Figures 2-12 to 2-14 and related phasing table/discussion on page 2-59 - It might be helpful if one or more of the phasing maps were revised to display the approximate location of the planned Queen Kaahumanu Highway interchange, and to identify if possible, in the phasing table the appropriate timeframe for interchange improvements. It would provide a clearer picture if the extent of the general neighborhoods described in Section 2.4 were delineated on the phasing maps.*

Response: The planned Queen Kaahumanu Highway interchange is being initiated by the Department of Transportation. They have not indicated a timeframe for interchange improvements. However, the Petitioner has accommodated the future interchange in its road system plan.

j. *Page 3-1 - Climate - The FEIS should acknowledge that the project will help offset the loss of vegetation, but will result in significant change in land cover, replacing vegetation with heat absorbing materials and impervious surfaces.*

Response: The forthcoming Second DEIS includes discussion on the projects change in land cover, as noted in your comment above.

k. *Page 3-2 NPDES Permit - The FEIS should replace "stormwater construction activities" with "stormwater discharges associated with construction activities"*

Response: The term "stormwater construction activities" has been replaced with "stormwater discharges associated with construction activities" in the forthcoming Second DEIS.

l. *Page 3-4 Off Site Well Field - Soils of the potable well field include rKED soils.*

Response: The off-site well field alternative has been eliminated from consideration. The preferred alternative as described in the Second DEIS is on-site wells.

m. *Figure 3-2 might read better if the rating class was symbolized using a color ramp with consistently lighter gradations from "A to E"*

Response: Figure 3-2 in the forthcoming Second DEIS has been revised, based on your comment above.

n. *Page 3-8 Section 3.4 Hazards - The FEIS should reference any concerns and planned actions contained in the County Hazard Mitigation Plan that are relevant for development in the proposed project area and region.*

Response: The text in section 3.4 Hazards of the forthcoming Second DEIS has been revised based on your comment above.

o. *Page 3-8 Sections 3.4 and 3.4.1 - The introduction states the project site is susceptible to hazards including flooding; the section goes on to state the project is not anticipated to result in flooding of the project site or land downslope of the project. The FEIS should clarify the flood risk posed by the proposed development. The FEIS should also clarify whether a stormwater management program and guidelines will be adopted for the proposed project, or whether the narrative in Section 3.4.1 is simply reporting the Kona CDP policy for urban stormwater management.*

Response: The text in sections 3.4 and 3.4.1 of the forthcoming Second DEIS has been revised based on your comments above.

p. *Page 3-10, Section 3.4.3 - The FEIS should clarify whether the "Prescriptive Details for Hurricane-Resistant Construction" is part of the County's adopted Uniform Building Code or is a set of higher standards yet to be adopted.*

Response: The project will adhere to Section 5 Building of the Hawaii County Building Code. The text in section 3.4.3 of the forthcoming Second DEIS has been revised.

q. *Figure 4-3 Archaeological Sites- It might be helpful to display the parcel boundaries and label with their TMK numbers, since the sites are discussed by parcel.*

Response: Figure 4-3 in the forthcoming Second DEIS has been revised to include parcel boundaries and TMK numbers.

r. *Page 4-81 Aircraft Noise - The DEIS notes that there are occasional aircraft over flights of the project property. The FEIS should reflect the recommendations of the State DOT Airports Division regarding disclosure of aircraft noise.*

Response: The Kaloko Makai project is located approximately 3-miles south of the Kona International Airport at Keahole.

Because the project's planned noise sensitive land uses are clearly beyond the most conservative 55 DNL contours for Kona International Airport at Keahole, disclosure of aircraft noise over the project site should not be required under Chapter 508D, Hawaii Revised Statutes (Reference 5 of noise study report).

To date, the State DOT Airports Division has not made a recommendation regarding such disclosures.

s. *Page 4-82, Table 4-16 - The notes for the table are missing*

Response: Notes for Table 4-16 are included in the forthcoming Second DEIS.

t. *Page 4-87 Fire Protection - The text notes a 30-mile radius for fire protection service for the Kailua-Kona Fire Station. This seems rather large for an urban or urbanizing area.*

Response: A parcel within the Kaloko Makai project site will be made available for the development of a fire station, if the County sees the need for an additional station.

The Hawaii County Fire Department did not raise any issue with the 30-mile radius for fire protection service for the Kailua-Kona Fire Station in their DEIS comment letter.

u. *Page 4-89 Schools - This section should note that the project is within the West Hawaii School Impact Fee District, and provide an update on consultations with the State DOE. The capacity of Kealakehe High School should be provided.*

Response: The Petitioner has been in regular communication with the DOE concerning school impacts. The referenced discussion on school impacts has been revised in the forthcoming Second DEIS to include an update on consultations with the State DOE as well as the capacity of Kealakehe High School.

v. *Pages 4-89 to 4-102 - There are some discrepancies in the numbers used in the text and those in Table 4-21 and 4-23, which should be resolved or explained.*

Response: Numerical discrepancies between the text and Tables 4-21 and 4-23 have been resolved in the forthcoming Second DEIS.

w. *Page 4-9, Section 2.1.2 Fiscal Impacts - The FEIS should clarify whether the fiscal analysis assumed dedication of infrastructure to the County or not.*

Response: The fiscal analysis did not allocate any value for infrastructure to be dedicated to the County (public). The forthcoming Second DEIS has been clarified.

x. *Page 4-105, Second paragraph - Your conclusions should be supported by findings and facts.*

Response: Kaloko Makai will contribute to ameliorating Kona's housing supply issues through (a) market-priced housing aimed primarily at working families rather than off-shore buyers, and (b) 700 "affordable" units with pricing to be determined in consultation with government agencies. These contributions cannot totally reverse the high land and development costs that have kept Hawai'i among the most expensive housing markets in the nation for the past 50 or 60 years. However, failure to provide housing supply in pace with increasing demand by local residents would worsen rather than help the overall housing affordability situation. The forthcoming Second DEIS incorporates this statement.

y. *Table 4-24 - It would be helpful if the table showed water demand by potable vs. non-potable water. There are redundant school footnotes.*

Response: The forthcoming Second DEIS has been revised based on your suggested comments.

z. *Page 4-123, Section 4.10.2 Wastewater system and Figure 4-20 - The colors in the legend and map shown in Figure 4-20 are confusing and make this map difficult to read with respect to the narrative. We recommend the map and text be reviewed to see how the figure and legend might be improved, for example, in distinguishing between the petition area the County's financing district, etc.*

Response: Figure 4-20 is the Kona CDPs Official Public Facilities Map. This is the County's official map and it would be inappropriate for us to revise it.

However, the text associated with the map has been revised in the Second DEIS based your comment.

aa. *Pages 4-126 Wastewater treatment alternatives - This section could be improved by stating at the outset that the preferred alternative for the project is to develop a private wastewater treatment plant.*

Response: The forthcoming Second DEIS has been revised to clearly state that the preferred alternative is to develop an on-site private WWTP.

bb. *Pages 4-124 to 4-132 - The FEIS should be consistent in the numbers used for average wastewater flow, average dryweather flow, and design peak flow and the number of acres that can be irrigated with recycle water flow.*

Response: The forthcoming Second DEIS provides consistent numbers for wastewater flows and irrigation requirements for reclaimed water.

cc. *Page 4-132, Section 4.10.3 Drainage - This section should include estimates of potential stormwater runoff at buildout and the volume of runoff at buildout that will be required to be retained onsite under County drainage standards.*

Response: The forthcoming Second DEIS includes estimates of stormwater runoff and requires retention/detention at build out.

dd. *Page 5-8 Comment for Section 5.1.3 Chapter 205A Scenic and Open Space Resources - The comment should be revised to discuss the project's impact on open space resources as well as views mauka-makai in the coastal viewshed. The comment should also acknowledge that the project is not coastal dependent and is located inland.*

Response: The forthcoming Second DEIS acknowledges that the project is not coastal dependent and located inland and will address the project's impact on open space resources and mauka-makai views in the coastal viewshed.

ee. *Page 5-9 Economic Uses - The policy emphasis here is on the appropriate siting of coastal dependent facilities and improvements. Since the project is not coastal dependent, no comment is really necessary here.*

Response: The forthcoming Second DEIS will state that the project is not coastal dependent and located inland.

ff. Page 8-2, Section 8.2 Cumulative Impacts. With the exception of traffic, the impacts on the identified issue areas are not discussed in a cumulative context.

Response: The forthcoming Second DEIS has been revised to include a discussion on cumulative impacts where anticipated.

gg. Page 8-6, Section 8.4 - This section should include the irretrievable and irreversible commitment of State and County funds to operate and maintain induced public facility growth and services, such as schools, public libraries, highways and roads dedicated to the State or County, potential residential refuse collection, etc.

Response: The forthcoming Second DEIS has been revised based on the above comments.

hh. Page 8-7, Section 8.5 Environmental effects that cannot be avoided - This section should include the taking of endangered species and the potential threat to other protected plant species, potential threats and alteration to archaeological and cultural sites, and the contribution of vehicular emissions and emissions from power generation to air quality.

Response: The forthcoming Second DEIS has been revised to include a discussion on environmental effects that cannot be avoided.

Your letter, along with this response, will be reproduced and included in the forthcoming Second DEIS. We appreciate your participation in the environmental review process.

Sincerely,

Earl Matsukawa, AICP
Project Manager

cc: Mr. Jay Nakamura, Stanford Carr Development
Mr. Daniel Orodenker, State Land Use Commission

NEIL ABERCROMBIE
GOVERNOR

PATRICIA McMANAMAN
DIRECTOR

PANKAJ BHANOT
DEPUTY DIRECTOR

STATE OF HAWAII
DEPARTMENT OF HUMAN SERVICES
Benefit, Employment & Support Services Division
820 Mililani Street, Suite 606
Honolulu, Hawaii 96813

EM
TF

August 30, 2011

Refer to: 11-0555

Mr. Orlando Dan Davidson
State Land Use Commission
Dept. of Business, Economic Development & Tourism
P.O. Box 2359
Honolulu, Hawaii 96804

RECEIVED
SEP 26 2011
WILSON OKAMOTO CORPORATION

Dear Mr. Davidson:

SUBJECT: DEIS for Project - Kaloko Makai, Kaloko and Kohanaiki, North Kona, Island of Hawaii

The Department of Human Services (DHS) has received a request from Earl Matsukawa, Project Manager for Wilson Okamoto Corporation, to review and submit comments to you on the Draft Environmental Impact Statement (DEIS) for the above named project. The Director of the Department of Human Services (DHS) has forwarded Mr. Matsukawa's letter to me for a response.

After a review of the DEIS, we have no comments or recommendations as to approval of the project. However, we foresee a potential impact on the need for additional early education and care services for children under kindergarten-age, commensurate with the DEIS' projected increase in the number of school-aged students and potential need for additional public schools due to new residents moving into the project area. "Day care" is mentioned as a possible service but we believe there needs to be intentional planning to support families with children ages birth to five years old concurrent with planning for elementary schools.

If you have any questions or need further information, please contact Ms. Marja Leivo, Child Care Program Specialist, at (808) 586-7112.

Sincerely,

Scott Nakasone

Scott Nakasone
Acting Division Administrator

c: Patricia McManaman, Director
Peter Phillips, SCD – TSA Kaloko Makai, LLC
Earl Matsukawa, Wilson Okamoto Corporation

AN EQUAL OPPORTUNITY AGENCY

WILSON OKAMOTO CORPORATION
ENGINEERS | PLANNERS | CONSULTANTS

1907 South Beretania Street
Artesian Plaza, Suite 400
Honolulu, Hawaii, 96826 USA
Phone: 808-946-2277
FAX: 808-946-2253
www.wilsonokamoto.com

7469-01
July 25, 2013

Ms. Patricia McManaman
Department of Human Services
State of Hawaii
820 Mililani Street, Suite 606
Honolulu, HI 96813

Attention: Benefit, Employment & Support Services Division

Subject: Draft Environmental Impact Statement (DEIS)
Kaloko Makai
Kaloko and Kohanaiki, North Kona, Hawaii
Tax Map Key: (3) 7-3-09: 017, 025, 026, and 028

Dear Ms. McManaman:

Thank you for your letter dated August 30, 2011 (Ref No. 11-0555). The Petitioner is preparing a Second DEIS to address changes in the proposed project that will be reassessed, as needed, in the forthcoming document. You will be notified of its availability for review and comment pursuant to Chapter 343, Hawaii Revised Statutes (HRS) and Title 11, Chapter 200 Hawaii Administrative Rules (Department of Health).

With regard to your comments on the subject DEIS, we acknowledge and thank DHS for their comments.

Your letter, along with this response, will be reproduced and included in the forthcoming Second DEIS. We appreciate your participation in the EIS review process.

Sincerely,

Earl Matsukawa, AICP
Project Manager

cc: Mr. Jay Nakamura, Stanford Carr Development
Mr. Daniel Orodenker State Land Use Commission

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

COPY

WILLIAM J. AILA, JR.
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

EM
TF

September 22, 2011

RECEIVED
SEP 26 2011
WILSON OKAMOTO CORPORATION

State Land Use Commission
Department of Business, Economic Development & Tourism
Attention: Mr. Orlando Dan Davidson, Executive Officer
P.O. Box 2359
Honolulu, Hawaii 96804

Dear Mr. Davidson:

SUBJECT: Draft Environmental Impact Statement – Kaloko Makai –
Kaloko and Kohanaiki, N. Kona, Island of Hawaii
TMKs: (3) 7-3-009:017, 019, por., 025, 026, 028, 062 (por.) and 063

Thank you for the opportunity to review and comment on the subject matter. The Department of Land and Natural Resources' (DLNR) Land Division distributed or made available a copy of your report pertaining to the subject matter to DLNR Divisions for their review and comments.

At this time, enclosed are comments from (a) Engineering Division; (b) Division of State Parks; (c) Commission on Water Resource Management; and (d) Land Division – Hawaii District on the subject matter. Should you have any questions, please feel free to call Darlene Nakamura at 587-0417. Thank you.

Sincerely,

Russell Y. Tsuji
Land Administrator

Enclosures
cc: SCD – TSA Kaloko Makai, LLC (w/copies)
Attention: Mr. Peter Phillips
Wilson Okamoto Corporation (w/copies)
Attention: Mr. Earl Matsukawa, AICP

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

WILLIAM J. AILA, JR.
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

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2011 SEP 13 P 3:26
DEPT OF LAND & NATURAL RESOURCES
STATE OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

August 23, 2011

'11 AUG 24 PM 01:31 ENGINEERING

MEMORANDUM

TO: **DLNR Agencies:**
__Div. of Aquatic Resources
X Div. of Boating & Ocean Recreation
X Engineering Division
X Div. of Forestry & Wildlife
X Div. of State Parks
X Commission on Water Resource Management
X Office of Conservation & Coastal Lands
X Land Division – Hawaii District
__Historic Preservation

FROM: Russell Y. Tsuji, Land Administrator
SUBJECT: Draft Environmental Impact Statement – Kaloko Makai
LOCATION: Kaloko and Kohanaiki, N. Kona, Hawaii; TMK: (3) 7-3-009:017, 019, port., 025, 026, 028, 062 (port.) and 063
APPLICANT: Wilson Okamoto Corporation on behalf of SCD – TSA Kaloko Makai, LLC

Transmitted for your review and comments on the above referenced document. We would appreciate your comments on this document. Please submit any comments by September 16, 2011.

If no response is received by this date, we will assume your agency has no comments. If you have any questions about this request, please contact Darlene Nakamura at 587-0417. Thank you.

Attachments

( ) We have no objections.
( ) We have no comments.
(✓) Comments are attached.

Signed:
Date: 9/12/11

cc: Central Files

DEPARTMENT OF LAND AND NATURAL RESOURCES
ENGINEERING DIVISION

DL/DarleneNakamura
RE: DEISKalokoMakai
Hawaii.529

( ) We confirm that the project site, according to the Flood Insurance Rate Map (FIRM), is located in Flood Zone ___.

( ) Please take note that the project site, according to the Flood Insurance Rate Map (FIRM), is located in Zone ___.

( ) Please note that the correct Flood Zone Designation for the project site according to the Flood Insurance Rate Map (FIRM) is ___.

( ) Please note that the project must comply with the rules and regulations of the National Flood Insurance Program (NFIP) presented in Title 44 of the Code of Federal Regulations (44CFR), whenever development within a Special Flood Hazard Area is undertaken. If there are any questions, please contact the State NFIP Coordinator, Ms. Carol Tyau-Beam, of the Department of Land and Natural Resources, Engineering Division at (808) 587-0267.

Please be advised that 44CFR indicates the minimum standards set forth by the NFIP. Your Community's local flood ordinance may prove to be more restrictive and thus take precedence over the minimum NFIP standards. If there are questions regarding the local flood ordinances, please contact the applicable County NFIP Coordinators below:

( ) Mr. Robert Sumitomo (808) 768-8097 or Mr. Mario Siu Li at (808) 768-8098 of the City and County of Honolulu, Department of Planning and Permitting.
( ) Mr. Carter Romero at (808) 961-8943 of the County of Hawaii, Department of Public Works.
( ) Mr. Francis Cerizo at (808) 270-7771 of the County of Maui, Department of Planning.
( ) Ms. Wynne Ushigome at (808) 241-4890 of the County of Kauai, Department of Public Works.

( ) The applicant should include water demands and infrastructure required to meet project needs. Please note that projects within State lands requiring water service from the Honolulu Board of Water Supply system will be required to pay a resource development charge, in addition to Water Facilities Charges for transmission and daily storage.

( ) The applicant should provide the water demands and calculations to the Engineering Division so it can be included in the State Water Projects Plan Update.

( ) Additional Comments: _____

(X) **Other: Our previous comments dated September 29, 2010, which was reflected in the Draft Environmental Impact Statement, still apply.**

Should you have any questions, please call Ms. Suzie S. Agraan of the Planning Branch at 587-0258.

Signed: _____
CARTY S. CHANG, CHIEF ENGINEER

Date: 9/12/11

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

WILLIAM J. AILA, JR.
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

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2011 AUG 24 A 11: 22
DEPT. OF LAND & NATURAL RESOURCES
STATE OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

August 23, 2011

MEMORANDUM

TO: **DLNR Agencies:**
__Div. of Aquatic Resources
X Div. of Boating & Ocean Recreation
X Engineering Division
X Div. of Forestry & Wildlife
X Div. of State Parks – CD IN LAND DIVISION, RM 220
X Commission on Water Resource Management
X Office of Conservation & Coastal Lands
X Land Division – Hawaii District
__Historic Preservation

FROM: Russell Y. Tsuji, Land Administrator
SUBJECT: Draft Environmental Impact Statement – Kaloko Makai
LOCATION: Kaloko and Kohanaiki, N. Kona, Hawaii; TMK: (3) 7-3-009:017, 019, port., 025, 026, 028, 062 (port.) and 063
APPLICANT: Wilson Okamoto Corporation on behalf of SCD – TSA Kaloko Makai, LLC

Transmitted for your review and comments on the above referenced document. We would appreciate your comments on this document. Please submit any comments by September 16, 2011.

If no response is received by this date, we will assume your agency has no comments. If you have any questions about this request, please contact Darlene Nakamura at 587-0417. Thank you.

Attachments

( ) We have no objections.
( ) We have no comments.
( ) Comments are attached.

Signed: _____
Date: 9-8-11

cc: Central Files

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

WILLIAM J. AILA, JR.
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

August 23, 2011

2011 AUG 24 PM 3: 04

MEMORANDUM

~~TO:~~ From: **DLNR Agencies:**
__Div. of Aquatic Resources
X Div. of Boating & Ocean Recreation
X Engineering Division
X Div. of Forestry & Wildlife
X Div. of State Parks
X Commission on Water Resource Management
X Office of Conservation & Coastal Lands
X Land Division – Hawaii District
__Historic Preservation

~~FROM:~~ To: ~~Russell~~ Y. Tsuji, Land Administrator
SUBJECT: Draft Environmental Impact Statement – Kaloko Makai
LOCATION: Kaloko and Kohanaiki, N. Kona, Hawaii; TMK: (3) 7-3-009:017, 019, port., 025, 026, 028, 062 (port.) and 063
APPLICANT: Wilson Okamoto Corporation on behalf of SCD – TSA Kaloko Makai, LLC

Transmitted for your review and comments on the above referenced document. We would appreciate your comments on this document. Please submit any comments by September 16, 2011.

If no response is received by this date, we will assume your agency has no comments. If you have any questions about this request, please contact Darlene Nakamura at 587-0417. Thank you.

Attachments

(X) We have no objections.
( ) We have no comments.
( ) Comments are attached.

Signed: [signature]
Date: September 21, 2011

cc: Central Files

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

WILLIAM J. AILA, JR.
CHAIRPERSON

WILLIAM D. BALFOUR, JR.
SUMNER ERDMAN
LORETTA J. FUDDY, A.C.S.W., M.P.H.
NEAL S. FUJIWARA
DONNA FAY K. KIYOSAKI, P.E.
LAWRENCE H. MIIKE, M.D., J.D.

WILLIAM M. TAM
DEPUTY DIRECTOR

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT
P.O. BOX 621
HONOLULU, HAWAII 96809

September 21, 2011

REF: Kaloko & Kohanaiki DEIS

TO: Russell Tsuji, Administrator
Land Division

FROM: William M. Tam, Deputy Director [signature]
Commission on Water Resource Management

SUBJECT: Draft Environmental Impact Statement - Kaloko Makai, Kaloko and Kohanaiki, N. Kona, Hawaii

FILE NO.:
TMK NO.: (3) 7-3-009:017, 019, port., 025, 026, 028, 062 (port.) and 063

Thank you for the opportunity to review the subject document. The Commission on Water Resource Management (CWRM) is the agency responsible for administering the State Water Code (Code). Under the Code, all waters of the State are held in trust for the benefit of the citizens of the State, therefore, all water use is subject to legally protected water rights. CWRM strongly promotes the efficient use of Hawaii's water resources through conservation measures and appropriate resource management. For more information, please refer to the State Water Code, Chapter 174C, Hawaii Revised Statutes, and Hawaii Administrative Rules, Chapters 13-167 to 13-171. These documents are available via the Internet at http://www.hawaii.gov/dlnr/cwrm.

Our comments related to water resources are checked off below.

☒ 1. We recommend coordination with the county to incorporate this project into the county's Water Use and Development Plan. Please contact the respective Planning Department and/or Department of Water Supply for further information.

☐ 2. We recommend coordination with the Engineering Division of the State Department of Land and Natural Resources to incorporate this project into the State Water Projects Plan.

☒ 3. We recommend coordination with the Hawaii Department of Agriculture (HDOA) to incorporate the reclassification of agricultural zoned land and the redistribution of agricultural resources into the State's Agricultural Water Use and Development Plan (AWUDP). Please contact the HDOA for more information.

☒ 4. We recommend that water efficient fixtures be installed and water efficient practices implemented throughout the development to reduce the increased demand on the area's freshwater resources. Reducing the water usage of a home or building may earn credit towards Leadership in Energy and Environmental Design (LEED) certification. More information on LEED certification is available at http://www.usgbc.org/leed. A listing of fixtures certified by the EPA as having high water efficiency can be found at http://www.epa.gov/watersense/pp/index.htm.

☒ 5. We recommend the use of best management practices (BMP) for stormwater management to minimize the impact of the project to the existing area's hydrology while maintaining on-site infiltration and preventing polluted runoff from storm events. Stormwater management BMPs may earn credit toward LEED certification. More information on stormwater BMPs can be found at http://hawaii.gov/dbedt/czm/initiative/lid.php.

☒ 6. We recommend the use of alternative water sources, wherever practicable.

☐ 7. There may be the potential for ground or surface water degradation/contamination and recommend that approvals for this project be conditioned upon a review by the State Department of Health and the developer's acceptance of any resulting requirements related to water quality.

Permits required by CWRM:
Additional information and forms are available at http://hawaii.gov/dlnr/cwrm/resources_permits.htm.

☐ 8. The proposed water supply source for the project is located in a designated water management area, and a Water Use Permit is required prior to use of water.

☒ 9. A Well Construction Permit(s) is (are) required any well construction work begins.

☒ 10. A Pump Installation Permit(s) is (are) required before ground water is developed as a source of supply for the project.

☐ 11. There is (are) well(s) located on or adjacent to this project. If wells are not planned to be used and will be affected by any new construction, they must be properly abandoned and sealed. A permit for well abandonment must be obtained.

☐ 12. Ground water withdrawals from this project may affect streamflows, which may require an instream flow standard amendment.

☐ 13. A Stream Channel Alteration Permit(s) is (are) required before any alteration(s) can be made to the bed and/or banks of a stream channel.

☐ 14. A Stream Diversion Works Permit(s) is (are) required before any stream diversion works is (are) constructed or altered.

☐ 15. A Petition to Amend the Interim Instream Flow Standard is required for any new or expanded diversion(s) of surface water.

☐ 16. The planned source of water for this project has not been identified in this report. Therefore, we cannot determine what permits or petitions are required from our office, or whether there are potential impacts to water resources.

☒ OTHER:
The DEIS correctly notes the location of the project in the Keauhou Aquifer System Area (ASA), which is part of the Hualalai Aquifer Sector Area. The Keauhou ASA has an estimated sustainable yield of 38 million gallons per day (mgd). A 2011 study by the U.S. Geological Survey estimated, ground water recharge in the Keauhou ASA may be as much as 77% greater than recharge estimates used to compute the sustainable yield in the 2008 WRPP (86 mgd vs. 152 mgd). This translates to an increase in the sustainable yield estimate from the currently adopted 38 mgd to 67 mgd (using the Robust Analytical Model). In addition, the Commission used a conservative adjustment factor translating recharge to SY, which assumed the lower basal water levels, but high- level water also occurs in the aquifer.

USGS analyzed the effects of future urbanization on Keauhou ASA recharge using Hawaii County zoning maps and the Land Use and Pattern Allocation Guide. Because the areas of the urban parcels are very small compared to the overall areas of the aquifer systems, little change in recharge occurs as a result of simulated future urbanization on an aquifer-system basis. USGS also analyzed the effects of climate change on recharge using published rainfall information (Timm and Diaz, 2009). Recharge estimates for climate change scenarios ranged from 123 mgd to 241 mgd, all higher than the recharge estimate used to estimate the current 38 mgd sustainable yield.

Not withstanding these aggregate figures, the local water flows in Keauhoa are complex and not understood yet. The National Park Service's concern that upgradient wells will adversely impact fresh water flows to Kaloko-Honokohau Park remains an important issue.

The DEIS contains a very good summary of what is known about the hydrogeologic conditions in the ASA. However there is a great deal of uncertainty regarding the communication between the high-level water and the basal aquifers, strangely some fresh water has been found at depth below seawater. The USGS, in cooperation with the National Park Service, will be constructing another numerical ground water model for the Kona area. This will aid in our understanding of the hydrogeology in the region. The Commission staff is participating in a Water Professionals group, made up of hydrologists and water resource engineers from the USGS, National Park Service, County Department of Water Supply, and the private sector, to develop a more robust ground water monitoring network for the region.

The Commission requires well construction and pump installation permits for the proposed potable water source development. To date the Commission has only received one application for one exploratory well (Well No. 4160-03). The preferred alternative is to develop 3 to 4 wells tapping the fresh water under the seawater below the brackish lens. Should wells be developed in the basal or high-level portions of the Keauhou ASA the cumulative impacts of pumping on the nearshore environment must be addressed. CWRM may require monitor wells to be installed as a condition of any well construction and/or pump installation permits. Pump test results should provide an indication of the potential impacts on the resource and other existing legal uses.

DEIS Page 3-19 contains an old definition of sustainable yield. The new legal definition under HRS §174C-2 is "Sustainable yield' means the maximum rate at which water may be withdrawn from a water source without impairing the utility or quality of the water source as determined by the commission.".

DEIS Page 4-106 estimates the potable water demand at buildout to be 3 mgd. General irrigation needs are proposed to be met with R-1 water from onsite wastewater treatment plant. However, Table 4-24 summarizes both the potable and non-potable needs for the project and shows total 3.177 mgd (average demand). Amend the table to breakdown the potable and non-potable needs for the project.

Some of the duties used to calculate water demand in Table 4-24 appear to be higher than the Domestic Consumption Guidelines in the County Water System Standards (e.g., parks, commercial). There appears to be an error in the calculation for Parks in Phase 1. The duties for Parks in Phase 1 and 3 are different. This should be clarified.

The Department of Health has jurisdiction over water quality issues associated with the disposal of stormwater through drywells and the disposal of brine through injection wells.

If there are any questions, please contact Lenore Ohye at 587-0216.

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

WILLIAM J. AILA, JR.
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

2011 AUG 25 P 1: 15

RECEIVED
LAND DIVISION
HILO, HAWAII

August 23, 2011

MEMORANDUM

TO: **DLNR Agencies:**
__Div. of Aquatic Resources
X Div. of Boating & Ocean Recreation
X Engineering Division
X Div. of Forestry & Wildlife
X Div. of State Parks
X Commission on Water Resource Management
X Office of Conservation & Coastal Lands
X Land Division – Hawaii District
__Historic Preservation

RECEIVED
2011 SEP -8 A 11: 32
DEPT. OF LAND & NATURAL RESOURCES
STATE OF HAWAII

FROM: Russell Y. Tsuji, Land Administrator
SUBJECT: Draft Environmental Impact Statement – Kaloko Makai
LOCATION: Kaloko and Kohanaiki, N. Kona, Hawaii; TMK: (3) 7-3-009:017, 019, port., 025, 026, 028, 062 (port.) and 063
APPLICANT: Wilson Okamoto Corporation on behalf of SCD – TSA Kaloko Makai, LLC

Transmitted for your review and comments on the above referenced document. We would appreciate your comments on this document. Please submit any comments by September 16, 2011.

If no response is received by this date, we will assume your agency has no comments. If you have any questions about this request, please contact Darlene Nakamura at 587-0417. Thank you.

Attachments

( ) We have no objections.
(✓) We have no comments.
( ) Comments are attached.

Signed: [signature]
Date: 9-6-11

cc: Central Files

WILSON OKAMOTO CORPORATION
ENGINEERS | PLANNERS | CONSULTANTS
1907 South Beretania Street
Artesian Plaza, Suite 400
Honolulu, Hawaii, 96826 USA
Phone: 808-946-2277
FAX: 808-946-2253
www.wilsonokamoto.com

7469-01
July 25, 2013

Mr. Russell Y. Tsuji, Administrator
Land Division
Department of Land and Natural Resources
State of Hawaii
P.O. Box 621
Honolulu, HI 96809

Subject: Draft Environmental Impact Statement (DEIS)
Kaloko Makai
Kaloko and Kohanaiki, North Kona, Hawaii
Tax Map Key: (3) 7-3-09: 017, 025, 026, and 028

Dear Mr. Tsuji:

Thank you for your letter dated September 22, 2011. The Petitioner is preparing a Second DEIS to address changes in the proposed project that will be reassessed, as needed, in the forthcoming document. You will be notified of its availability for review and comment pursuant to Chapter 343, Hawaii Revised Statutes (HRS) and Title 11, Chapter 200 Hawaii Administrative Rules (Department of Health).

With regard to your comments on the subject DEIS, we offer the following responses in the respective order of your comments:

Engineering Division

We acknowledge that your previous comments dated September 29, 2010 still apply which has been reflected in the DEIS.

Division of State Parks

We acknowledge the Division has no comments to offer at this time.

Commission on Water Resource Management (September 21, 2011; REF: Kaloko & Kohanaiki DEIS)

1. *We recommend coordination with the county to incorporate this project into the county's Water Use and Development Plan. Please contact the respective Planning Department and/or Department of Water Supply for further information.*

   Response: The Petitioner has had numerous discussions with the County Water Department and will continue these discussions as the project moves forward. Additionally, the Petitioner has obtained DWS's acceptance to ultimately tie into their system, provided that adequate water source requirements for the project can be met.

The DEIS was also distributed to the County Planning Department and Department of Water Supply.

3. *We recommend coordination with the Hawaii Department of Agriculture (HDOA) to incorporate the reclassification of agricultural zoned land and the redistribution of agricultural resources into the State's Agricultural Water Use and Development Plan (AWUDP). Please contact the HDOA for more information.*

   Response: Although a portion of the property is within the Agricultural land use district, there is currently no agricultural use on the property. Thus, the redistribution of agricultural resources into the State's Agricultural Water Use and Development Plan (AWUDP) is not needed. A copy of the DEIS was also sent to HDOA.

4. *We recommend that water efficient fixtures be installed and water efficient practices implemented throughout the development to reduce the increased demand on the area's freshwater resources. Reducing the water usage of a home or building may earn credit towards Leadership in Energy and Environmental Design (LEED) certification. More information on LEED certification is available at http://www.usgbc.org/leed.Alisting of fixtures certified by the EPA as having high water efficiency can be found at http://www.epa.gov/watersense/pp/index.htm.*

   Response: A Sustainability Plan will be included in the forthcoming Second DEIS, which includes a discussion of priority guidelines and principles to promote sustainability within the project.

   The Sustainability Plan identifies a number of measures that may be implemented to facilitate end-user conservation, including water restrictions during drier periods, public education and more efficient landscaping practices.

   Efficient fixtures and appliances will reduce indoor water use. The water distribution system will be maintained to prevent water loss and homeowners and businesses will be encouraged to maintain fixtures to prevent leaks. Landscaping will emphasize climate-adapted native and other appropriate plants suitable for coastal locations. Best management practices will be designed and implemented to minimize infiltration and runoff from daily operations.

   Water-efficient fixtures such as high efficiency toilets, flow limiters for faucets, flow control valves, and water efficient showerheads reduce water and sewer costs, reduce demand on water supplies and treatment facilities, and reduce heating energy consumption and associated greenhouse gas emissions.

5. *We recommend the use of best management practices (BMP) for stormwater management to minimize the impact of the project to the existing area's hydrology while maintaining on-site infiltration and preventing polluted runoff from storm events. Stormwater management BMPs may earn credit toward LEED certification. More information on stormwater BMPs can be found at http://hawaii.gov/dbedUczm/initiative/lid.php.*

   Response: As stated in the DEIS and forthcoming Second DEIS, the Petitioner will comply with the County of Hawaii's grading ordinance requirements and will obtain a National Pollutant Discharge Elimination System (NPDES) permit from the State Department of Health (DOH) for storm water discharges related to construction activities, which will require (structural and non-structural) Best Management Practices (BMPs), such as minimizing soil exposure and erosion control measures such as silt fences and sediment basins, to minimize off-site impacts.

6. *We recommend the use of alternative water sources, wherever practicable.*

   Response: Alternative water sources, will be used wherever practicable.

   The on-site WWTP facility will treat the wastewater to provide recycled (R-1) water for general irrigation within Kaloko Makai and thus lessen demand for potable water for irrigation needs. This reuse of treated wastewater is consistent with the Kona CDP which has an implementing "Action" designating the area below Ane Keohokālole as a reclaimed wastewater zone (Action TRAN–3.3a: Designates the reclaimed wastewater zone (Wastewater Re-use Area) on Figure 4-10c Official Public Facilities and Services Map.)

9. *A Well Construction Permit(s) is (are) required any well construction work begins.*

   Response: The Petitioner acknowledges that Well Construction Permits are required before any well construction work begins.

10. *A Pump Installation Permit(s) is (are) required before ground water is developed as a source of supply for the project.*

    Response: The Petitioner acknowledges that Pump Installation Permits are required before ground water is developed as a source of supply for the project.

Other

The DEIS correctly notes the location of the project in the Keauhou Aquifer System Area (ASA), which is part of the Hualalai Aquifer Sector Area. The Keauhou ASA has an estimated sustainable yield of 38 million gallons per day (mgd). A 2011 study by the U.S. Geological Survey estimated, ground water recharge in the Keauhou ASA may be as much as 77% greater than recharge estimates used to compute the

sustainable yield in the 2008 WRPP (86 mgd vs. 152 mgd). This translates to an increase in the sustainable yield estimate from the currently adopted 38 mgd to 67 mgd (using the Robust Analytical Model). In addition, the Commission used a conservative adjustment factor translating recharge to SY, which assumed the lower basal water levels, but high- level water also occurs in the aquifer.

Response: The updated information on sustainable yield is acknowledged and appreciated. The substantially greater recharge than the amount on which the Commission's 38 million gallon per day (mgd) sustainable yield is based, coupled with the fact that virtually all of the greater recharge computed by the USGS occurs over high level rather than basal groundwater, are promising facts for the future water supply for the Kailua-Kona area.

USGS analyzed the effects of future urbanization on Keauhou ASA recharge using Hawaii County zoning maps and the Land Use and Pattern Allocation Guide. Because the areas of the urban parcels are very small compared to the overall areas of the aquifer systems, little change in recharge occurs as a result of simulated future urbanization on an aquifer-system basis. USGS also analyzed the effects of climate change on recharge using published rainfall information (Timm and Diaz, 2009). Recharge estimates for climate change scenarios ranged from 123 mgd to 241 mgd, all higher than the recharge estimate used to estimate the current 38 mgd sustainable yield.

Notwithstanding these aggregate figures, the local water flows in Keauhou are complex and not understood yet. The National Park Service's concern that upgradient wells will adversely impact fresh water flows to Kaloko Honokohau Park remains an important issue.

Response: The water supply alternatives being evaluated for the project have been specifically limited to those which can be affirmatively demonstrated to not impact the basal groundwater flowing through Kaloko-Honokohau National Historic Park. These include high level groundwater that flows far beneath the basal lens rather than though it and desalting of saline groundwater extracted from below the basal lens. A test well will be constructed and tested to determine if the first of these alternatives is feasible. This testing will include extensive monitoring to demonstrate the lack of an impact on the basal lens.

The DEIS contains a very good summary of what is known about the hydrogeologic conditions in the ASA. However there is a great deal of uncertainty regarding the communication between the high-level water and the basal aquifers, strangely some fresh water has been found at depth below seawater. The USGS, in cooperation with the National Park Service, will be constructing another numerical ground water model for the Kona area. This will aid in our understanding of the hydrogeology in the region. The Commission staff is participating in a Water Professionals group, made up of hydrgeologists and water resource engineers from the USGS, National Park

Service, County Department of Water Supply, and the private sector, to develop a more robust ground water monitoring network for the region.

Response: Our consultant on water supply development, Tom Nance, is an active participant in the Water Professionals group and has made several presentations at group meetings. We expect that the test well that will be drilled at the upper end of the project site under his direction will add to the knowledge of the relationship between high level and basal groundwater in the area.

The Commission requires well construction and pump installation permits for the proposed potable water source development. To date the Commission has only received one application for one exploratory well (Well No. 416003). The preferred alternative is to develop 3 to 4 wells tapping the fresh water under the seawater below the brackish lens. Should wells be developed in the basal or high-level portions of the Keauhou ASA the cumulative impacts of pumping on the nearshore environment must be addressed. CWRM may require monitor wells to be installed as a condition of any well construction and/or pump installation permits. Pump test results should provide an indication of the potential impacts on the resource and other existing legal uses.

Response: Monitoring of the on-site test well to be drilled (state no. 4160-03) will include effects on the basal lens as measured in a sounding tube isolated from the fresh water below and in existing well 4160-02 which is down gradient of the test well. These test results will be shared with the Water Professionals group as well as submitted to the Commission on Water Resource Management.

DEIS Page 3-19 contains an old definition of sustainable yield. The new legal definition under HRS §174C-2 is "Sustainable yield' means the maximum rate at which water may be withdrawn from a water source without impairing the utility or quality of the water source as determined by the commission.",.

Response: Section 3.5 Groundwater has been revised in forthcoming Second DEIS.

DEIS Page 4-106 estimates the potable water demand at buildout to be 3 mgd. General irrigation needs are proposed to be met with R-1 water from onsite wastewater treatment plant. However, Table 4-24 summarizes both the potable and non-potable needs for the project and shows total 3.177 mgd (average demand). Amend the table to breakdown the potable and non-potable needs for the project.

Response: Table 4-24 will be revised in the forthcoming Second DEIS

Some of the duties used to calculate water demand in Table 4-24 appear to be higher than the Domestic Consumption Guidelines in the County Water System Standards

(e.g., parks, commercial). There appears to be an error in the calculation for Parks in Phase 1. The duties for Parks in Phase 1 and 3 are different. This should be clarified.

Response: Computation revised to updated land use plan.

The Department of Health has jurisdiction over water quality issues associated with the disposal of stormwater through drywells and the disposal of brine through injection wells.

Response: The Petitioner acknowledges that the Department of Health has jurisdiction over water quality issues associated with the disposal of stormwater through drywells and the disposal of brine through injection wells. The Petitioner will continue to consult with them on these issues.

Land Division, Hawaii District

We acknowledge the Division has no comments to offer at this time.

Your letter, along with this response, will be reproduced and included in the forthcoming Second DEIS. We appreciate your participation in the EIS review process.

Sincerely,

Earl Matsukawa, AICP
Project Manager

cc: Mr. Jay Nakamura, Stanford Carr Development
Mr. Daniel Orodenker, State Land Use Commission

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

WILLIAM J. AILA, JR.
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

GUY H. KAULUKUKUI
FIRST DEPUTY

WILLIAM M. TAM
DEPUTY DIRECTOR - WATER

AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
BUREAU OF CONVEYANCES
COMMISSION ON WATER RESOURCE MANAGEMENT
CONSERVATION AND COASTAL LANDS
CONSERVATION AND RESOURCES ENFORCEMENT
ENGINEERING
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
KAHOOLAWE ISLAND RESERVE COMMISSION
LAND
STATE PARKS

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF FORESTRY AND WILDLIFE
1151 PUNCHBOWL STREET, ROOM 325
HONOLULU, HAWAII 96813

Mr. Earl Matsukawa
Wilson Okamoto Corporation
1907 South Beretania Street
Artesian Plaza, Suite 400
Honolulu, Hawaii 96826

Subject: Comments on the Kaloko Makai, Draft Environmental Impact Statement, Hawaii

Dear Mr. Matsukawa:

Thank you for the opportunity to comment on the Draft Environmental Impact Statement (DEIS) for the Kaloko Makai Development. The Department of Land and Natural Resources, Division of Forestry and Wildlife's (DOFAW) respectfully provide the following comments on the July 2011, DEIS for the Kaloko Makai Development.

General Comments:

1. With regard to impacts to T&E species, the DEIS seeks to support a FONSI based on the draft HCP provided. However, the draft HCP has not been approved, no ITL has been issued, and compliance with HRS 195D has not been met. Since there is no guarantee that the draft HCP will be approved or implemented it is not appropriate that it provide the basis of the FONSI with regard to impacts to T&E species.

2. We understand that Ho'okuleana intends to secure an ITL and approved HCP for this project and note that pursuant to HRS 195D, the board must provide notice of the draft HCP in the OEQC bulletin for public review. We note that that has not yet occurred and that in order to obtain an ITL the draft HCP would need to be noticed in the OEQC bulletin at a later date.

3. We note that in order to issue an ITL, the board must determine compliance with HRS 343. Since the draft HCP may be revised prior to approval we caution that the subject DEIS may be out of date and may not include review of actions that may be incorporated into the HCP as part of the review and development process prior to approval of the HCP.

4. The draft HCP will be posted at the Office of Environmental Quality Control (OEQC) for public review once the draft is approved by DOFAW. The DEIS and the draft HCP are not on the same timeframe and therefore we suggest the applicant should wait before citing mitigation from the draft HCP. Because the draft HCP is not approved, it maybe subject to multiple changes and thus, a supplement to this DEIS may be needed.

Comments associated with the DEIS:

1. page 1-10: "The HCP has been initiated to reduce threats to the Kaloko Makai populations of these five species and maintain their ecosystem." The HCP has not yet been initiated to address the impacts to endangered plants. A draft HCP has been submitted to DOFAW, however, it has not been approved by BLNR.

2. The surveys are not adequate. We recommend that the applicant conduct botanical and wildlife surveys throughout the project area: (3) 7 - 3 - 009: 017, 025, 026, 028 and 063 Off - Site Potable Well Field: (3) 7 - 3 - 009: portion of 019 and portion of 062. The surveys provided in the appendices are out-dated, haven't covered the entire project area, or were conducted during the time of year least likely to detect the presence of endangered plants and wildlife.
   - The surveys should be conducted during the wet season in December 2011.
   - The invertebrate surveys conducted by Steve Montgomery in 2008 do not include the entire project area or off-site areas listed in the TMK above. The surveys are out dated and therefore new surveys are strongly recommended.
   - Botanical surveys conducted by Art Whistler in September of 2006 are out of date and were conducted during the dry season when the likelihood of detecting endangered plants and *Manduca blackburni* larval host plants and adult nectar plants is low. Furthermore, Art Whistler noted in his report that "during the present survey, only about 24 plants of *Pleomele hawaiiensis* were observed, but since counting individuals was not part of the project, this should not be judged to be indicative of a decline in the number of individuals currently there". All surveys should be designed to collect data of the number of individuals of endangered species found within the project site and right of way, including roadside. The objective of the surveys should be to identify and map the number of individual endangered plants that will be impacted by the project. Mr. Whistler's survey did not identify/specify where the endangered plants were on the project site.
   - Art Whistler's survey in 2006 does not substantiate the number of each endangered plant to be impacted by the project. It is not clear how the applicant has determined the number of species of *Nothocestrum breviflorum*, *Pleomele hawaiiensis*, and *Bidens micrantha* subsp. *ctenophylla* subject to take during project construction?
   - Each botanical and wildlife survey should provide maps of current distribution of endangered flora or fauna found in the project area. A map of the project area with clear markings of project area boundaries, a legend, GPS points of endangered species found, as well as survey tracks should be depicted on each map and presented to our agency.

- During botanical surveys, any populations of *Nicotiana glauca* (Tobacco tree, a food source for larva of the endangered *Manduca blackburni* will be GPS and represented on a map to be presented to our agency.
- Conduct bat surveys in forested areas where trees are taller than 15 feet and provide maps of these areas. If there are trees taller than 15 feet in the project area, please draft minimization and avoidance measures to avoid clearing vegetation 15 feet or taller during the bat pupping season from June 1 through September 15.

3. The HCP and DEIS include conservation measures (the outplanting of 5 species) that are the responsibility of FHWA. These measures were developed between the Service and FHWA during a Section 7 consultation for Ane Keohokalole Highway. We recommend the applicant not use management actions that will be implemented by FHWA to offset impacts to listed species due to their own (Kaloko Makai) development.

4. Art Whistler's survey in 2006, identifies *Capparis sandwichiana* and *Ipomoea indica*, within the project area. These two species are nectar plants for the endangered *Manduca blackburni*. DOFAW recommends the applicant conduct new invertebrate surveys during the wet season in December 2011 to identify *Manduca* and its adult and larval hosts plants.

5. The HCP and DEIS state "After construction, Kaloko Makai will develop a 25-ft buffer between the existing aiea tree and any structure." We recommend this be increased to 50-ft. No development would occur until successful outplanting of aiea has occurred.

6. On page 3-52, the DEIS states "Kaloko Makai will use best efforts to collect genetic material, propagate and plant hala pepe so that 6-individuals survive in the Kaloko Makai Dryland Forest Preserve. The 6 new individuals represent a 3-for-1 replacement of the 2 hala pepe outside of the Dryland Forest Preserve which will be removed and transplanted..." The intent of the 3:1 ratio used by the ESRC is 3 populations created for any 1 destroyed, not 3 for every 1 individual. DOFAW recommends the applicant collect and grow propagules from the existing plants before construction impacts and outplant these propagules, to meet the State requirement for a net recovery benefit, as opposed to transplanting the existing plants. It is unlikely that these plants, if transplanted, will survive.

7. On page 3-58, the DEIS states "Rana Biological Consulting Inc.'s 2011 study resulted in findings consistent with the location of the site, the habitat present on it, as well as the findings of the previous study summarized above." This 2011 survey only covers an off-site area of 3.5 acres to develop a potable water well and does not represent the entire 1,139 acres slated for development. DOFAW recommends the removal of this sentence or clarification of the survey area for the 2011 survey.

8. The HCP and DEIS state "After construction, Kaloko Makai will develop a 25-ft buffer between the existing aiea tree and any structure." DOFAW recommend this be increased to 50-ft. We also suggest collecting seeds from this species and propagating for further outplanting.

9. The HCP (not mentioned in the DEIS) proposes to transplant approximately 12-17 kookoolau (*Bidens micratha* ssp. *ctenophylla*) from within the area to be developed to the Kaloko Makai Dryland Forest Preserve. We recommend you collect and grow propagules from the existing plants before construction impacts and outplant these propagules, to meet the State requirement for a net recovery benefit, as opposed to transplanting the existing plants. It is unlikely that these plants, if transplanted, will survive.

10. Under Section 2.4 Conservation needs in the action area for *Bidens micratha* ssp. *ctenophylla*, *Nothocestrum breviflorum*, and *Pleomele hawaiiensis* , DOFAW recommends these species remain in place until the applicant collects propagules for storage, propagation, outplanting purposes, in order to meet the HRS 195D requirement for net recovery benefit. A Threatened and Endangered Plant Collectors Permit from the State is required before any species mentioned above are collected for storage, propagation, and outplanting. Using plants already in the Preserve as a seed source for outplanting may not qualify to meet net benefit for the species impacted outside of the Preserve. Plants that are outside of the Preserve, that are likely to be impacted by the project are the plants that should be propagated and outplanted to achieve a net benefit, however, you may augment the site with other wild population sources only after there is genetic representation of the species subject to take.

11. The HCP and DEIS state " These 150 acres will be set aside and preserved as a dryland forest preserve thus ensuring the continuation of this dryland forest ecosystem." The DOFAW suggests the final HCP and EIS describe the process that will be used to set the area aside and conserve it in perpetuity.

12. In the HCP and DEIS, the developer commits to controlling weeds in a 15-foot buffer around extant and outplanted listed and candidate plants. DOFAW recommends that weeds be controlled in the entire dryland forest preserve and along all roadsides within the development. Per the HCP, DOFAW recommends long-term control of weeds in the preserve for the entire duration of your permit.

Additional comments on the DHCP, Appendix F in the DEIS:

1. The draft HCP in the DEIS does not reflect any of DOFAW's comments and recommendation sent to the applicant in their April 2011 draft HCP. The DHCP in Appendix F of the DEIS is inconsistent with the current draft DOFAW is working with in coordination with the Applicant.

2. Federal Highways (FHWA) project has their own take issues associated with the constructing of the Ane Keohokālole Highway and are addressing their take by creating a preserve. This was addressed through a Section 7 consultation with the USFWS. The take associated with the Kaloko Makai project is separate from the FHWA's take and therefore, the applicant is responsible for meeting the State's requirement for the net recovery benefit of the species to be impacted.

3. The applicant is required under the State's 195D to provide assurance of funding for all mitigation, avoidance, and monitoring activities associated with impacts from the project. FHWA is not responsible for the applicant's impacts from the Kaloko Makai development.

4. Page 8 of the draft HCP states "HCP will be considered a success if-The number of plants that are propagated, planted and survive in the Preserve exceed the number of plants taken (representing a net gain for the species), management measures make meaningful contributions toward addressing the major threats that habitat of the taken species face.." The State's endangered species law HRS 195D has a rigorous process for establishing and substantiating a net recovery benefit for endangered plants taken as a result of a projects activities. The applicant must demonstrate net benefit by creating, at a minimum, 3 wild populations of each species taken and achieve a population that is reproducing and self-sustaining. This biologically sound approach is supported by DOFAW, USFWS and the ESRC and recommended to the applicant to achieve a net benefit. In regards to making meaningful contributions, DOFAW needs the applicant to define these contributions in collaboration with DOFAW and USFWS to assess whether the measures are appropriate for the species involved.

5. Page 10-Proposed mitigation measure 1, 2, 3, and 4. DOFAW has not approved these mitigation measures and has informed the Applicant that these measures do not meet the HRS 195D requirements for net benefit. Furthermore, the applicant states that there will be take of ma'oloa and uhiuhi but does not identify how many of each species will be taken and also how their take will be mitigated for. Please identify mitigation measures for the two above mentioned species. Please provide the botanical surveys that document locations for individuals being taken from the project activities.

6. Page 12- Buffering Each Plant-We also recommend collecting seeds from all three species before construction/impacts and propagating for further outplanting to meet the State requirement for a net recovery benefit.

7. Page 57 Section3.3 states " two *Pleomele hawaiiensis* found outside of the Kaloko Makai dryland forest reserve will be removed and transplanted to Kaloko Makai dryland forest reserve before construction activities begin." DOFAW recommends the applicant collect seeds and/or cuttings from these two plants, store, and propagate healthy plants before construction activities begin. The same applies to the population of *Bidens micratha* ssp. *ctenophylla*. Note that DOFAW is recommending the applicant conduct new botanical surveys during the wet season in 2011 to identify and map the exact number of *Bidens micratha* ssp. *ctenophylla*, *Nothocestrum breviflorum*, and *Pleomele hawaiiensis* subject to take.

8. Page 59-63. These management actions meet the Section 7 criteria but are not designed to meet the requirements of 195D, net recovery benefit for the species subject to take. Section 7 requires avoidance and minimization measures, a State HCP requires avoidance, minimization, and mitigation measures to achieve net recovery benefit, long-term invasive species management, long-term monitoring of outplants, and assurance of funding to insure the HCP obligations are met. This section has not been approved by BLNR. DOFAW recommends a meeting with the applicant to discuss the requirements under this section.

9. Page 64-65 Monitoring Plan: This plan has not been reviewed by DOFAW. The monitoring plan should be designed to monitor the success of mitigation for the three species subject to take under the HCP. Appendix F in the DEIS states " all listed species populations within the Kaloko Makai Dryland Forest Preserve will be monitored by Kaloko Makai contractors." The populations that need to be monitored are outplants from seed source coming from individuals subject to take outside of the Preserve. These are the plants that the applicant is required to substantiate a net recovery benefit and not for the plants that are currently in the Preserve.

10. Page 67 Section 5.0 summary table- DOFAW recommend the applicant fund collection, storage, propagation, outplanting activities for those species impacted outside of the Preserve. Genetic material collected by FHWA comes from a seed source inside of the Preserve. FHWA collection does not include the genetic material for those individuals impacted by the Kaloko Makai Development. The goal of the HCP is to create populations that genetically represent those species taken by the development. HRS 195D-21 (b)2D states "Identify those measures or actions to be undertaken to protect, maintain, restore, or enhance the ecosystems, natural communities, or habitat types within the plan area; a schedule for implementation of the measures or actions; and an adequate funding source to ensure that the actions or measures, including monitoring, are undertaken in accordance with the schedule;" DOFAW recommends budgeting for the State do conduct compliance monitoring.

11. Please provide DOFAW with a current Fire Management Plan and a Weed Management Plan for the project area. DOFAW has not reviewed any of the above plans inserted into this DEIS.

In April 2011, DOFAW submitted additional comments and recommendations to the consultant, Ho'okuleana, LLC , that have not been addressed in the draft HCP submitted as Appendix F in this DEIS. The HCP is a separate action from the DEIS, needing approval of DOFAW, ESRC, and BLNR in order to be granted an incidental take license. The acceptance of this DEIS, in no way, indicates the acceptance of the HCP by DOFAW, ESRC, and BLNR. DOFAW recommends the DHCP not be analyzed under this DEIS.

DOFAW looks forward to meeting with you to develop a final DEIS that results in the appropriate actions in restoring and protecting the ecological and biological integrity of the Kaloko Makai Dryland Forest Preserve. Please feel free to contact Sandee Hufana, Habitat Conservation Plan Coordinator at 808-587-4148 or via email at Sandee.K.Hufana@hawaii.gov., with any questions or concerns.

Sincerely,

for Paul J. Conry, Administrator

WILSON OKAMOTO CORPORATION
ENGINEERS | PLANNERS | CONSULTANTS
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7469-01
July 25, 2013

Mr. Roger Imoto, Administrator
Division of Forestry and Wildlife
Department of Land and Natural Resources
State of Hawaii
1151 Punchbowl Street, Room 325
Honolulu, Hawai'i 96813

Subject: Draft Environmental Impact Statement (DEIS)
Kaloko Makai
Kaloko and Kohanaiki, North Kona, Hawaii
Tax Map Key: (3) 7-3-09: 017, 025, 026, and 028

Dear Mr. Imoto:

Thank you for your letter dated September 21, 2011. The Petitioner is preparing a Second DEIS to address changes in the proposed project that will be reassessed, as needed, in the forthcoming document. You will be notified of its availability for review and comment pursuant to Chapter 343, Hawaii Revised Statutes (HRS) and Title 11, Chapter 200 Hawaii Administrative Rules (Department of Health).

With regard to your comments on the subject DEIS, we offer the following in response to your comments:

General Comments:

1. *With regard to impacts to T&E species, the DEIS seeks to support a FONSI based on the draft HCP provided. However, the draft HCP has not been approved, no ITL has been issued, and compliance with HRS 195D has not been met. Since there is no guarantee that the draft HCP will be approved or implemented it is not appropriate that it provide the basis of the FONSI with regard to impacts to T&E species.*

   Response: Based on comments during the DEIS process and further evaluation of the project layout, under the development proposal described in the Second DEIS, none of the listed endangered plants situated outside of the dryland forest preserve will be "taken" in the development and construction of the Kaloko Makai project. Furthermore, it is anticipated that the project will be developed in such a manner as to avoid any "take" of Bidens micrantha ssp. Ctenophylla, which is currently proposed for listing as an endangered species. The Petitioner will incorporate avoidance measures to the extent possible. Because no incidental take license will be needed. Petitioner no longer

anticipates entering in a Habitat Conservation Plan (HCP) as previously suggested in the DEIS.

As suggested by the U.S. Fish and Wildlife Service (USFWS), the Petitioner is proposing to implement a 50-foot buffer between one 'aiea plant and any buildings at the project. In addition, the Petitioner proposes to utilize a similar buffer around the two hala pepe plants.

The Petitioner reaffirms its prior statements that, in connection with the development of the Kaloko Makai project, it would set aside 150-acres of dryland forest for preservation purposes. This set aside will offsite direct impacts to listed species as a result of the development of the Kaloko Makai project. Within this preserve, a variety of species will have continued protection and their habitats set aside in perpetuity, enhancing their prospects for survival.

2. *We understand that Hookuleana intends to secure an ITL and approved HCP for this project and note that pursuant to HRS 195D, the board must provide notice of the draft HCP in the OEQC bulletin for public review. We note that that has not yet occurred and that in order to obtain an ITL the draft HCP would need to be noticed in the OEQC bulletin at a later date.*

   Response: See Response No. 1.

3. *We note that in order to issue an ITL, the board must determine compliance with HRS 343. Since the draft HCP may be revised prior to approval we caution that the subject DEIS may be out of date and may not include review of actions that may be incorporated into the HCP as part of the review and development process prior to approval of the HCP.*

   Response: See Response No. 1. Furthermore, we note that the issuance of a incidental take license (ITL) is not a trigger requiring compliance with Chapter 343, Hawaii Revised Statutes.

4. *The draft HCP will be posted at the Office of Environmental Quality Control (OEQC) for public review once the draft is approved by DOFAW. The DEIS and the draft HCP are not on the same timeframe and therefore we suggest the applicant should wait before citing mitigation from the draft HCP. Because the draft HCP is not approved, it may be subject to multiple changes and thus, a supplement to this DEIS may be needed.*

   Response: See Response No. 1.

Comments associated with the DEIS

1. *page 1-10: "The HCP has been initiated to reduce threats to the Kaloko Makai populations of these five species and maintain their ecosystem." The HCP has not yet been initiated to address the impacts to endangered plants. A draft HCP has been submitted to DOFAW, however, it has not been approved by BLNR.*

   Response: See Response No. 1.

2. *The surveys are not adequate. We recommend that the applicant conduct botanical and wildlife surveys throughout the project area: (3) 7 - 3 - 009: 017, 025,026,028 and 063 Off - Site Potable Well Field: (3) 7 - 3 - 009: portion of 019 and portion of 062. The surveys provided in the appendices are out-dated, haven't covered the entire project area, or were conducted during the time of year least likely to detect the presence of endangered plants and wildlife.*
   - *The surveys should be conducted during the wet season in December 2011.*
   - *The invertebrate surveys conducted by Steve Montgomery in 2008 do not include the entire project area or off-site areas listed in the TMK above. The surveys are out dated and therefore new surveys are strongly recommended.*
   - *Botanical surveys conducted by Art Whistler in September of 2006 are out of date and were conducted during the dry season when the likelihood of detecting endangered plants and Manduca blackburni larval host plants and adult nectar plants is low. Furthermore, Art Whistler noted in his report that "during the present survey, only about 24 plants of Pleomele hawaiiensis were observed, but since counting individuals was not part of the project, this should not be judged to be indicative of a decline in the number of individuals currently there". All surveys should be designed to collect data of the number of individuals of endangered species found within the project site and right of way, including roadside. The objective of the surveys should be to identify and map the number of individual endangered plants that will be impacted by the project. Mr. Whistler's survey did not identify/specify where the endangered plants were on the project site.*
   - *Art Whistler's survey in 2006 does not substantiate the number of each endangered plant to be impacted by the project. It is not clear how the applicant has determined the number of species of Nothocestrum breviflorum, Pleomele hawaiiensis, and Bidens micrantha subsp. ctenophylla subject to take during project construction?*
   - *Each botanical and wildlife survey should provide maps of current distribution of endangered flora or fauna found in the project area. A map of the project area with clear markings of project area boundaries, a legend, GPS points of endangered species found, as well as survey tracks should be depicted on each map and presented to our agency.*

- *During botanical surveys, any populations of Nicotiana glauca (Tobacco tree, a food source for larva of the endangered Manduca blackburni will be GPS and represented on a map to be presented to our agency.*
- *Conduct bat surveys in forested areas where trees are taller than 15 feet and provide maps of these areas. If there are trees taller than 15 feet in the project area, please draft minimization and avoidance measures to avoid clearing vegetation 15 feet or taller during the bat pupping season from June 1 through September 15.*

Response: A botanical survey was prepared by Isle Botanical in 2006 of the Kaloko Makai project site. An avian and terrestrial mammalian survey was prepared by RANA Productions, Inc. in 2006 of the project site. Additionally, Steve Montgomery conducted an invertebrate study for Kaloko Makai project site in 2008.

Reggie David conducted a follow-up biological and botanical survey in December 2011/January 2012. This study is included in the forthcoming Second DEIS.

The off-site potable well site (7 - 3 - 009: portion of 019 and portion of 062) has been omitted from the forthcoming Second DEIS as an alternative for water; therefore, a botanical and wildlife survey of that site is not needed.

The combined area of the botanical surveys encompasses the entire project site addressed by the Second DEIS.

Since the occurrence of potential host plants in any particular location will likely change overtime, a survey of planned construction sites during the wet season preceding construction will be conducted. If any potential host plants are found, your office will be contacted to determine an appropriate course of action.

Hawaii Forest Industry Association (HFIA) contracted Kukui Planning Company (with guidance from USFWS) to do a rare plant survey of approximately 155 acres Kaloko Makai Dryland Forest Preserve. The survey was completed in January 2012 and a summary will be included in the forthcoming Second DEIS.

During the 2006 survey for the project, RANA observed one Hawaiian hoary bat flying down-slope. Hawaiian hoary bats are regularly seen mauka of the project site and also makai of the project site in the Kaloko-Honokōhau National Historic Park and above Honokōhau boat harbor on a seasonal basis.

The Petitioner will incorporate recommended protocols to address the Hawaiian hoary bat.

3. *The HCP and DEIS include conservation measures (the outplanting of 5 species) that are the responsibility of FHWA. These measures were developed between the Service and FHWA during a Section 7 consultation for Ane Keohokalole Highway. We recommend the applicant not use management actions that will be implemented by FHWA to offset impacts to listed species due to their own (Kaloko Makai) development.*

   Response: See Response No. 1.

4. *Art Whistler's survey in 2006, identifies Capparis sandwichiana and Ipomoea indica, within the project area. These two species are nectar plants for the endangered Manduca blackburni. DOFAW recommends the applicant conduct new invertebrate surveys during the wet season in December 2011 to identify Manduca and its adult and larval hosts plants.*

   Response: Since the occurrence of potential host plants in any particular location will likely change overtime, a survey of planned construction sites during the wet season preceding construction will be conducted. If any potential host plants are found, your office will be contacted to determine an appropriate course of action.

   Steve Montgomery conducted an invertebrate study for Kaloko Makai project in November 2008 and the *Manduca blackburni* was not found.

5. *The HCP and DEIS state "After construction, Kaloko Makai will develop a 25-ft buffer between the existing aiea tree and any structure." We recommend this be increased to 50-ft. No development would occur until successful outplanting of aiea has occurred.*

   Response: As stated above, the Petitioner will incorporate avoidance measures to the extent possible, thereby eliminating the need to obtain an incidental take license and enter into a HCP. Nevertheless, your comments regarding the proposed size of the buffer around of 'aiea tree have been taken under consideration, and Petitioner intends to incorporate a 50-foot buffer around the one 'aiea tree and any structure within the project. In addition, Petitioner intends to incorporate a similar buffer around the two hala pepe and any structure within the project. The plants will be incorporated into landscaping within the 50-foot buffer.

6. *On page 3-52, the DEIS states "Kaloko Makai will use best efforts to collect genetic material, propagate and plant hala pepe so that 6-individuals survive in the Kaloko Makai Dryland Forest Preserve. The 6 new individuals represent a 3 for- 1 replacement of the 2 hala pepe outside of the Dryland Forest Preserve which will be removed and transplanted ... " The intent of the 3:1 ratio used by the ESRC is 3 populations created for any 1 destroyed, not 3 for every 1 individual. DOFAW recommends the applicant collect and grow propagules from the existing plants before construction impacts and outplant these propagules, to meet the State requirement for a net recovery benefit, as opposed to transplanting the existing plants. It is unlikely that these plants, if transplanted, will survive.*

   Response: See Response No. 1.

7. *On page 3-58, the DEIS states "Rana Biological Consulting Inc.'s 2011 study resulted in findings consistent with the location of the site, the habitat present on it, as well as the findings of the previous study summarized above." This 2011 survey only covers an off-site area of 3.5 acres to develop a potable water well and does not represent the entire 1,139 acres slated for development. DOFAW recommends the removal of this sentence or clarification of the survey area for the 2011 survey.*

   Response: Rana Biological Consulting conducted field work for the 1,139 acres in 2006. This section will be revised in the Second DEIS to reference the 2006 study. Additionally, Rana conducted work for the potable off-site well field site in 2011. However, the potable off-site well field has since been omitted from the project.

8. *The HCP and DEIS state "After construction, Kaloko Makai will develop a 25-ft buffer between the existing aiea tree and any structure." DOFAW recommend this be increased to 50-ft. We also suggest collecting seeds from this species and propagating for further outplanting.*

   Response: See Response No. 1 and 5.

9. *The HCP (not mentioned in the DEIS) proposes to transplant approximately 12-17 kookoolau (Bidens micratha ssp. ctenophylla) from within the area to be developed to the Kaloko Makai Dryland Forest Preserve. We recommend you collect and grow propagules from the existing plants before construction impacts and outplant these propagules, to meet the State requirement for a net recovery benefit, as opposed to transplanting the existing plants. It is unlikely that these plants, if transplanted, will survive.*

   Response: See Response No. 1.

10. *Under Section 2.4 Conservation needs in the action area for Bidens micrantha ssp. ctenophylla, Nothocestrum breviflorum, and Pleomele hawaiiensis, DOFAW recommends these species remain in place until the applicant collects propagules for storage, propagation, outplanting purposes, in order to meet the HRS 1950 requirement for net recovery benefit. A Threatened and Endangered Plant Collectors Permit from the State is required before any species mentioned above are collected for storage, propagation, and outplanting. Using plants already in the Preserve as a seed source for outplanting may not qualify to meet net benefit for the species impacted outside of the Preserve. Plants that are outside of the Preserve, that are likely to be impacted by the project are the plants that should be propagated and outplanted to achieve a net benefit, however, you may augment the site with other wild population sources only after there is genetic representation of the species subject to take.*

    Response: See Response No. 1.

    The Petitioner is not proposing an establishment of any new populations.

11. *The HCP and DEIS state "These 150 acres will be set aside and preserved as a dryland forest preserve thus ensuring the continuation of this dryland forest ecosystem." DOFAW suggests the final HCP and EIS describe the process that will be used to set the area aside and conserve it in perpetuity.*

    Response: The Petitioner proposes to preserve the 150-acre dryland forest in perpetuity.

    If the Petitioner is successful before the LUC, it will seek to subdivide the preserve into a single tax map (TMK) parcel through the applicable County processes. Kaloko Makai is also considering incorporating a restrictive covenant or condition into the property deed which confirms that the eventual TMK parcel which will encompass the preserve shall remain undeveloped (except for associated management-related needs) and that appropriate access shall be provided in perpetuity.

12. *In the HCP and DEIS, the developer commits to controlling weeds in a 15-foot buffer around extant and outplanted listed and candidate plants. DOFAW recommends that weeds be controlled in the entire dryland forest preserve and along all roadsides within the development. Per the HCP, DOFAW recommends long-term control of weeds in the preserve for the entire duration of your permit.*

Response: See Response No. 1.

Additional comments on the DHCP, Appendix F in the DEIS:

1. *The draft HCP in the DEIS does not reflect any of DOFAW's comments and recommendation sent to the applicant in their April 2011 draft HCP. The DHCP in Appendix F of the DEIS is inconsistent with the current draft DOFAW is working with in coordination with the Applicant.*

   Response: See Response No. 1.

2. *Federal Highways (FHWA) project has their own take issues associated with the constructing of the Ane Keohokalole Highway and are addressing their take by creating a preserve. This was addressed through a Section 7 consultation with the USFWS. The take associated with the Kaloko Makai project is separate from the FHWA's take and therefore, the applicant is responsible for meeting the State's requirement for the net recovery benefit of the species to be impacted.*

   Response: See Response No. 1.

3. *The applicant is required under the State's 195D to provide assurance of funding for all mitigation, avoidance, and monitoring activities associated with impacts from the project. FHWA is not responsible for the applicant's impacts from the Kaloko Makai development.*

   Response: See Response No. 1.

4. *Page 8 of the draft HCP states "HCP will be considered a success if-The number of plants that are propagated, planted and survive in the Preserve exceed the number of plants taken (representing a net gain for the species), management measures make meaningful contributions toward addressing the major threats that habitat of the taken species face.." The State's endangered species law HRS 1950 has a rigorous process for establishing and substantiating a net recovery benefit for endangered plants taken as a result of a projects activities. The applicant must demonstrate net benefit by creating, at a minimum, 3 wild populations of each species taken and achieve a population that is reproducing and self-sustaining. This biologically sound approach is supported by DOFAW, USFWS and the ESRC and recommended to the applicant to achieve a net benefit. In regards to making meaningful contributions, DOFAW needs the applicant to define these contributions in collaboration with DOFAW and USFWS to assess whether the measures are appropriate for the species involved.*

   Response: See Response No. 1.

5. *Page 10-Proposed mitigation measure 1,2,3, and 4. DOFAW has not approved these mitigation measures and has informed the Applicant that these measures do not meet the HRS 195D requirements for net benefit. Furthermore, the applicant states that there will be take of maoloa and uhiuhi but does not identify how many of each species will be taken and also how their take will be mitigated for. Please identify mitigation measures for the two above mentioned species. Please provide the botanical surveys that document locations for individuals being taken from the project activities.*

   Response: See Response No. 1.

6. *Page 12- Buffering Each Plant-We also recommend collecting seeds from all three species before construction/impacts and propagating for further outplanting to meet the State requirement for a net recovery benefit.*

   Response: See Response No. 1.

7. *Page 57 Section 3.3 states "two Pleomele hawaiiensis found outside of the Kaloko Makai dryland forest reserve will be removed and transplanted to Kaloko Makai dryland forest reserve before construction activities begin." DOFAW recommends the applicant collect seeds and/or cuttings from these two plants, store, and propagate healthy plants before construction activities begin. The same applies to the population of Bidens micratha ssp. ctenophylla. Note that DOFAW is recommending the applicant conduct new botanical surveys during the wet season in 2011 to identify and map the exact number of Bidens micrantha ssp. ctenophylla, Nothocestrum breviflorum, and Pleomele hawaiiensis subject to take.*

   Response: See Response No. 1.

8. *Page 59-63. These management actions meet the Section 7 criteria but are not designed to meet the requirements of 195D, net recovery benefit for the species subject to take. Section 7 requires avoidance and minimization measures, a State HCP requires avoidance, minimization, and mitigation measures to achieve net recovery benefit, long-term invasive species management, long-term monitoring of outplants, and assurance of funding to insure the HCP obligations are met. This section has not been approved by BLNR. DOFAW recommends a meeting with the applicant to discuss the requirements under this section.*

   Response: See Response No. 1.

9. *Page 64-65 Monitoring Plan: This plan has not been reviewed by DOFAW. The monitoring plan should be designed to monitor the success of mitigation for the three species subject to take under the HCP. Appendix F in the DEIS states" all listed species populations within the Kaloko Makai Dryland Forest Preserve will be monitored by Kaloko Makai contractors." The populations that need to be monitored are outplants from seed source coming from individuals subject to take outside of the Preserve. These are the plants that the applicant is required to substantiate a net recovery benefit and not for the plants that are currently in the Preserve.*

   Response: See Response No. 1.

10. *Page 67 Section 5.0 summary table- DOFAW recommend the applicant fund collection, storage, propagation, outplanting activities for those species impacted outside of the Preserve. Genetic material collected by FHWA comes from a seed source inside of the Preserve. FHWA collection does not include the genetic material for those individuals impacted by the Kaloko Makai Development. The goal of the HCP is to create populations that genetically represent those species taken by the development. HRS 195D-21 (b)2D states "Identify those measures or actions to be undertaken to protect, maintain, restore, or enhance the ecosystems, natural communities, or habitat types within the plan area; a schedule for implementation of the measures or actions; and an adequate funding source to ensure that the actions or measures, including monitoring, are undertaken in accordance with the schedule;" DOFAW recommends budgeting for the State do conduct compliance monitoring.*

    Response: See Response No. 1.

11. *Please provide DOFAW with a current Fire Management Plan and a Weed Management Plan for the project area. DOFAW has not reviewed any of the above plans inserted into this DEIS.*

    Response: See Response No. 1.

    In April 2011, DOFAW submitted additional comments and recommendations to the consultant, Ho'okuleana, LLC, that have not been addressed in the draft HCP submitted as Appendix F in this DEIS. The HCP is a separate action from the DEIS, needing approval of DOFAW, ESRC, and BLNR in order to be granted an incidental take license. The acceptance of this DEIS, in no way, indicates the acceptance of the HCP by DOFAW, ESRC, and BLNR. DOFAW recommends the DHCP not be analyzed under this DEIS.

Response: See Response No. 1.

Your letter, along with this response, will be reproduced and included in the forthcoming Draft DEIS. We appreciate your participation in the EIS review process.

Sincerely,

Earl Matsukawa, AICP
Project Manager

cc: Mr. Jay Nakamura, Stanford Carr Development
Mr. Daniel Orodenker, State Land Use Commission

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF HEALTH
P. O. BOX 3378
HONOLULU, HI 96801-3378

LORETTA J. FUDDY, A.C.S.W., M.P.H.
DIRECTOR OF HEALTH

In reply, please refer to:
File:
SDWB

September 30, 2011

Mr. Orlando Dan Davidson
Executive Officer
State Land Use Commission
Department of Business,
Economic Development & Tourism
P.O. Box 2359
Honolulu, Hawaii 96804

OCT 04 2011

Dear Mr. Davidson:

SUBJECT: DRAFT ENVIRONMENTAL IMPACT STATEMENT (DEIS) REVIEW
KALOKO MAKAI, NORTH KONA, ISLAND OF HAWAII

We would like to acknowledge receipt of the Draft Environmental Impact Statement (DEIS) dated July 2011, and express our appreciation for the opportunity to comment on the proposed project.

In the DEIS it is stated that for the alternative water sources considered for the project, facilities constructed for water supply and distribution may be dedicated to the Hawaii Department of Water Supply (DWS). We would like to emphasize that the determination as to whether the drinking water infrastructure is owned and operated as a private water system or as an extension to the existing County water system will have a profound impact on how the water system regulations will be applied to the project.

As a private water system, the new well sources and the associated infrastructure may qualify as a new public water system. Federal and state regulations define a public water system as a system that serves 25 or more individuals at least 60 days per year or has at least 15 service connections. All public water system owners and operators are required to comply with Hawaii Administrative Rules (HAR), Title 11, Chapter 20, "Rules Relating to Potable Water Systems."

It is recommended that requirements contained in the HAR, Ch. 11-20-29 relating to the need for Department of Health (DOH) approval for any new drinking water sources; HAR, Ch. 11-20-29.5

for capacity demonstration and evaluation; and HAR, Ch. 11-20-30 for modifications to a public water system (in the event that the water system is dedicated as a modification to a system owned by the Hawaii DWS be added to "Permits and Approvals" under section 1.1 Profile (page 1-3) and section 1.7.4 Required Permits and Approvals (page 1-15) in the DEIS (see table below).

Permit/Approval	Agency	Status
New water source approval - review and approval of new well sources by the DOH per HAR Ch. 11-20-29	DOH	Pending final selection of water source alternative. If new well sources are developed, plans and an engineering report are required to be submitted to the DOH for review and approval.
Capacity demonstration and evaluation - review and approval per HAR Ch. 11-20-29.5	DOH	Pending final selection of water source alternative. The need for capacity demonstration dependent on whether new well sources and associated infrastructure will be classified as a new public water system (PWS) or a modification to an existing privately owned PWS or PWS owned and operated by the Hawaii DWS.
Modifications to a public water system - review and approval of plans per HAR Ch. 11-20-30	DOH	Pending final selection of water source alternative. Applicable if water system is classified as a modification to a privately owned PWS.

Other Project Specific Water System Requirements:

- Systems that utilize technologies such as RO (Reverse Osmosis) may be subject to a pilot testing program at the discretion of the Safe Drinking Water Branch.

Other General Water System Requirements:

- All public water systems must be operated by certified distribution system and water treatment plant operators as defined by HAR Chapter 11-25 titled "Rules Pertaining to Certification of Public Water System Operators."

- All projects which propose the use of dual water systems or the use of a non-potable water system in proximity to an existing potable water system to meet irrigation or other needs must be carefully designed and operated to prevent the cross-connection of these systems and prevent the possibility of backflow of water from the non-potable system to the potable system. The two systems must be clearly labeled and physically separated by air gaps or reduced pressure principle backflow prevention devices to avoid contaminating the potable water supply. In addition backflow devices must be tested periodically (annually) to assure their proper operation. Further, all non-potable spigots and irrigated areas should be clearly labeled with warning signs to prevent the inadvertent consumption on non-potable water. Compliance with HAR Chapter 11-21 titled "Cross-Connection and Backflow Control" is also required.

- All projects which propose the establishment of a potentially contaminating activity (as identified in the Hawai`i Source Water Assessment Plan) within the source water protection area of an existing source of water for a public water supply should address this potential and activities that will be implemented to prevent or reduce the potential for contamination of the drinking water source.

Underground Injection Control (UIC):

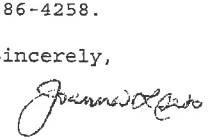
- Injection wells used for the subsurface disposal of wastewater, sewage effluent, or surface runoff are subject to environmental regulation and permitting under HAR Chapter 11-23, titled "Underground Injection Control." The DOH's approval must be first obtained before any injection well construction commences. A UIC permit must be issued before any injection well operation occurs.

- Authorization to use an injection well is granted when a UIC permit is issued to the injection well facility. The UIC permit contains discharge and operation limitations, monitoring and reporting requirements, and other facility management and operational conditions. A complete UIC permit application form is needed to apply for a UIC permit.

- A UIC permit can have a valid duration of up to five (5) years. Permit renewal is needed to keep an expiring permit valid for another term.

If there are any questions, please call Craig Watanabe at 586-4258.

Sincerely,



JOANNA L. SETO, P.E., CHIEF
Safe Drinking Water Branch
Environmental Management Division

CW:cb

c: SCD - TSA Kaloko Makai, LLC
1100 Alakea Street, 27th Floor
Honolulu, Hawaii 96813
Attention: Mr. Peter Phillips

Wilson Okamoto Corporation ✓
1907 South Beretania Street, Suite 400
Honolulu, Hawaii 96826
Attention: Mr. Earl Matsukawa, AICP

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7469-01
July 25, 2013

Ms. Joanna L. Seto, P.E., Chief
Safe Drinking Water Branch
Department of Health
State of Hawaii
P.O. Box 3378
Honolulu, HI 96801-3378

Subject: Draft Environmental Impact Statement (DEIS)
Kaloko Makai
Kaloko and Kohanaiki, North Kona, Hawaii
Tax Map Key: (3) 7-3-09: 017, 025, 026, and 028

Dear Ms. Seto:

Thank you for your letter dated September 30, 2011. The Petitioner is preparing a Second DEIS to address changes in the proposed project that will be reassessed, as needed, in the forthcoming document. You will be notified of its availability for review and comment pursuant to Chapter 343, Hawaii Revised Statutes (HRS) and Title 11, Chapter 200 Hawaii Administrative Rules (Department of Health).

With regard to your comments on the subject DEIS, we offer the following responses in the respective order of your comments:

In the DEIS it is stated that for the alternative water sources considered for the project, facilities constructed for water supply and distribution may be dedicated to the Hawaii Department of Water Supply (DWS). We would like to emphasize that the determination as to whether the drinking water infrastructure is owned and operated as a private water system or as an extension to the existing County water system will have a profound impact on how the water system regulations will be applied to the project.

Response: The Petitioner acknowledges that the determination as to whether the drinking water infrastructure is owned and operated as a private water system or as an extension to the existing County water system will have a profound impact on how the water system regulations will be applied to the project. The Petitioner will continue to work with the County Department of Water Supply effectuate a mutually acceptable solution

As a private water system, the new well sources and the associated infrastructure may qualify as a new public water system. Federal and state regulations define a public water system as a system that serves 25 or more individuals at least 60 days per year

or has at least 15 service connections. All public water system owners and operators are required to comply with Hawaii Administrative Rules (HAR), Title 11, Chapter 20, "Rules Relating to Potable Water Systems."

Response: The Petitioner acknowledges and will comply with Hawaii Administrative Rules (HAR), Title 11, Chapter 20, "Rules Relating to Potable Water Systems."

It is recommended that requirements contained in the HAR, Ch. 11-20-29 relating to the need for Department of Health (DOH) approval for any new drinking water sources; HAR, Ch. 11-20-29.5 for capacity demonstration and evaluation; and HAR, Ch. 11-20-30 for modifications to a public water system (in the event that the water system is dedicated as a modification to a system owned by the Hawaii DWS be added to "Permits and Approvals" under section 1.1 Profile (page 1-3) and section 1.7.4 Required Permits and Approvals (page 1-15) in the DEIS

Response: The Petitioner acknowledges and will comply with applicable requirements contained in the HAR, Ch. 11-20-29 relating to the need for Department of Health (DOH) approval of any new drinking water sources; HAR, Ch. 11-20-29.5 for capacity demonstration and evaluation; and, HAR, Ch. 11-20-30 for modifications to a public water system.

The Second DEIS has been updated to include these requirements to "Permits and Approvals" under section 1.1 Profile (page 1-3) and section 1.7.4 Required Permits and Approvals (page 1-15).

<u>Other Project Specific Water System Requirements:</u>
Systems that utilize technologies such as RO (Reverse Osmosis) may be subject to a pilot testing program at the discretion of the Safe Drinking Water Branch.

Response: The Petitioner acknowledges that systems utilizing technologies such as RO (Reverse Osmosis) may be subject to a pilot testing program at the discretion of the Safe Drinking Water Branch.

<u>Other General Water System Requirements:</u>
All public water systems must be operated by certified distribution system and water treatment plant operators as defined by HAR Chapter 11-25 titled "Rules Pertaining to Certification of Public Water System Operators."

Response: The Petitioner acknowledges that all public water systems must be operated by certified distribution system and water treatment plant operators as

defined by HAR Chapter 11-25 titled "Rules Pertaining to Certification of Public Water System Operators."

All projects which propose the use of dual water systems or the use of a non-potable water system in proximity to an existing potable water system to meet irrigation or other needs must be carefully designed and operated to prevent the cross-connection of these systems and prevent the possibility of backflow of water from the non-potable system to the potable system. The two systems must be clearly labeled and physically separated by air gaps or reduced pressure principle backflow prevention devices to avoid contaminating the potable water supply. In addition backflow devices must be tested periodically (annually) to assure their proper operation. Further, all non-potable spigots and irrigated areas should be clearly labeled with warning signs to prevent the inadvertent consumption on non-potable water. Compliance with HAR Chapter 11-21 titled "Cross-Connection and Backflow Control" is also required.

Response: The Petitioner acknowledges that compliance with HAR Chapter 11-21 titled "Cross-Connection and Backflow Control" is required.

All projects which propose the establishment of a potentially contaminating activity (as identified in the Hawai'i Source Water Assessment Plan) within the source water protection area of an existing source of water for a public water supply should address this potential and activities that will be implemented to prevent or reduce the potential for contamination of the drinking water source.

Response: The forthcoming Second DEIS has been updated to address activities that will be implemented to prevent or reduce the potential for contamination of the drinking water source.

Underground Injection Control (UIC):
Injection wells used for the subsurface disposal of wastewater, sewage effluent, or surface runoff are subject to environmental regulation and permitting under HAR Chapter 11-23, titled "Underground Injection Control." The DOH's approval must be first obtained before any injection well construction commences. A UIC permit must be issued before any injection well operation occurs.

Response: The Petitioner acknowledges that injection wells used for the subsurface disposal of wastewater, sewage effluent, or surface runoff are subject to environmental regulation and permitting under HAR Chapter 11-23, titled "Underground Injection Control" and that the DOH's approval must be first obtained before any injection well construction commences and an UIC permit must be issued before any injection well operation occurs.

Authorization to use an injection well is granted when a UIC permit is issued to the injection well facility. The UIC permit contains discharge and operation limitations, monitoring and reporting requirements, and other facility management and operational conditions. A complete UIC permit application form is needed to apply for a UIC permit.

Response: The Petitioner acknowledges that authorization to use an injection well is granted when a UIC permit is issued to the injection well facility and that a complete UIC permit application form is needed to apply for a UIC permit.

A UIC permit can have a valid duration of up to five (5) years. Permit renewal is needed to keep an expiring permit valid for another term.

Response: The Petitioner acknowledges that a UIC permit can have a valid duration of up to five (5) years and that permit renewal is needed to keep an expiring permit valid for another term.

Your letter, along with this response, will be reproduced and included in the forthcoming Second DEIS. We appreciate your participation in the EIS review process.

Sincerely,

Earl Matsukawa, AICP
Project Manager

cc: Mr. Jay Nakamura, Stanford Carr Development
Mr. Daniel Orodenker, State Land Use Commission

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

LORETTA J. FUDDY, A.C.S.W., M.P.H.
DIRECTOR OF HEALTH

STATE OF HAWAII
DEPARTMENT OF HEALTH
P. O. BOX 3378
HONOLULU, HI 96801-3378

In reply, please refer to:
File:

LUD-3 7 3 009 017-ID746
Draft EIS Kaloko Makai

August 22, 2011

EM

Mr. Earl Matsukawa, AICP
Project Manager
Wilson Okamoto Corporation
1907 South Beretania Street
Artesian Plaza Suite 400
Honolulu, Hawaii 96826

Dear Mr. Matsukawa:

Subject: Draft Environmental Impact Statement (DEIS), Kaloko Makai
Kaloko and Kohanaiki, North Kona, Island of Hawaii 1,138.866 acres
TMK (3) 7-3-009: 017, 019 (portion), 025, 026, 028. 062 (portion) and 063

Thank you for the opportunity to review the subject project which requests comments on the Draft Environmental Impact Statement for the Kaloko Makai Development Project. We have the following comments to offer.

Our recommendation is to have the subject development connect to the County sewer system. However, if it is determined that a County sewer system is not available, a wastewater treatment plant (WWTP) shall be provided for the project. The WWTP shall comply with applicable provisions of Hawaii Administrative Rules (HAR), chapter 11-62, "Wastewater Systems. Please be informed that if wastewater sludge is treated for land application purposes, the WWTP and composting facility will require an Individual Permit for operation.

All wastewater plans must conform to applicable provisions of HAR, chapter 11-62. We do reserve the right to review the detailed plans for conformance to the applicable rules. Should you have any questions, please contact the Planning & Design Section of the Wastewater Branch at 586-4294 or fax to 586-4300.

Sincerely,

MARSHALL LUM, P.E., ACTING CHIEF
Wastewater Branch

LM:cle

c: DOH's Environmental Planning Office (EPO 11-153)
Mr. Dane Hiromasa, DOH-WWB Kona Staff
Mr. Orlando Dan Davidson, DBEDT
Mr. Peter Phillips, SCD-TSA Kaloko Makai, LLC

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www.wilsonokamoto.com

7469-01
July 25, 2013

Ms. Sina Pruder, Chief
Wastewater Branch
Department of Health
State of Hawaii
P.O. Box 3378
Honolulu, HI 96801-3378

Subject: Draft Environmental Impact Statement (DEIS)
Kaloko Makai
Kaloko and Kohanaiki, North Kona, Hawaii
Tax Map Key: (3) 7-3-09: 017, 025, 026, and 028

Dear Ms. Pruder:

Thank you for your letter dated August 22, 2011 (LUD-3 7 3 009 017-ID746). The Petitioner is preparing a Second DEIS to address changes in the proposed project that will be reassessed, as needed, in the forthcoming document. You will be notified of its availability for review and comment pursuant to Chapter 343, Hawaii Revised Statutes (HRS) and Title 11, Chapter 200 Hawaii Administrative Rules (Department of Health).

With regard to your comments on the subject DEIS, we offer the following responses in the respective order of your comments:

Our recommendation is to have the subject development connect to the County sewer system. However, if it is determined that a County sewer system is not available, a wastewater treatment plant (WWTP) shall be provided for the project. The WWTP shall comply with applicable provisions of Hawaii Administrative Rules (HAR), chapter 11-62, "Wastewater Systems. Please be informed that if wastewater sludge is treated for land application purposes, the WWTP and composting facility will require an Individual Permit for operation.

Response: Based on discussions with the County of Hawaii Department of Environmental Management, the Kealakehe facility is not available to receive wastewater from Kaloko Makai. Therefore, the Petitioner proposes a private on-site wastewater treatment plant to process wastewater for the project.

All wastewater plans must conform to applicable provisions of HAR, chapter 11-62. We do reserve the right to review the detailed plans for conformance to the applicable rules.

Response: The proposed Kaloko Makai wastewater treatment facility will comply with applicable provisions of Hawaii Administrative Rules (HAR), Chapter 11-62, "Wastewater Systems".

Your letter, along with this response, will be reproduced and included in the forthcoming Second DEIS. We appreciate your participation in the EIS review process.

Sincerely,

Earl Matsukawa, AICP
Project Manager

cc: Mr. Jay Nakamura, Stanford Carr Development
Mr. Daniel Orodenker, State Land Use Commission

COPY

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

LORETTA J. FUDDY, A.C.S.W., M.P.H.
DIRECTOR OF HEALTH

STATE OF HAWAII
DEPARTMENT OF HEALTH
P.O. Box 3378
HONOLULU, HAWAII 96801-3378

In reply, please refer to:
File:
11-634A CAB

September 20, 2011

Mr. Orlando Dan Davidson
Executive Officer
State Land Use Commission
Department of Business, Economic Development
& Tourism
P.O. Box 2359
Honolulu, Hawaii 96804

RECEIVED
SEP 25 2011
WILSON OKAMOTO CORPORATION

EM
TF

Dear Mr. Davidson:

SUBJECT: Draft Environmental Impact Statement
Kaloko Makai Project
Kaloko and Kohanaiki, North Kona, Island of Hawaii
Ref: 7469-01

All projects should address potential dust, emissions, and odor nuisance concerns. Activities must comply with the provisions of Hawaii Administrative Rules, §11-60.1-33 on Fugitive Dust. In addition, for cases involving mixed land use, we strongly recommend that buffer zones be established, wherever possible, in order to alleviate potential dust and odor nuisance problems.

We encourage the contractor to implement a dust control plan, which does not require approval by the Department of Health, to comply with the fugitive dust regulations.

Additional dust control measures that may complement those that are being proposed include, but are not limited to, the following:

a) Planning the different phases of construction, focusing on minimizing the amount of dust-generating materials and activities, centralizing on-site vehicular traffic routes, and locating potential dust-generating equipment in areas of the least impact;
b) Providing an adequate water source at the site prior to start-up of construction activities;
c) Landscaping and providing rapid covering of bare areas, including slopes, starting from the initial grading phase;
d) Minimizing dust from shoulders and access roads;
e) Providing adequate dust control measures during weekends, after hours, and prior to daily start-up of construction activities; and
f) Controlling dust from debris being hauled away from the project site. Also, controlling dust from daily operations of material being processed, stockpiled, and hauled to and from the facility.

If you have any questions, please contact Mr. Barry Ching of the Clean Air Branch at 586-4200.

Sincerely,

Wilfred K. Nagamine

WILFRED K. NAGAMINE
Manager, Clean Air Branch

BC:rg

c: Peter Phillips, SCD - TSA Kaloko Makai, LLC
✓ Earl Matsukawa, AICP, Wilson Okamoto Corporation

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7469-01
July 25, 2013

Mr. Wilfred K. Nagamine, Manager
Clean Air Branch
Department of Health
State of Hawaii
P.O. Box 3378
Honolulu, HI 96801-3378

Subject: Draft Environmental Impact Statement (DEIS)
Kaloko Makai
Kaloko and Kohanaiki, North Kona, Hawaii
Tax Map Key: (3) 7-3-09: 017, 025, 026, and 028

Dear Mr. Nagamine:

Thank you for your letter dated September 20, 2011 (11-634A CAB). The Petitioner is preparing a Second DEIS to address changes in the proposed project that will be reassessed, as needed, in the forthcoming document. You will be notified of its availability for review and comment pursuant to Chapter 343, Hawaii Revised Statutes (HRS) and Title 11, Chapter 200 Hawaii Administrative Rules (Department of Health).

With regard to your comments on the subject DEIS, we offer the following responses in the respective order of your comments:

All projects should address potential dust, emissions, and odor nuisance concerns. Activities must comply with the provisions of Hawaii Administrative Rules, §11-60.1-33 on Fugitive Dust. In addition, for cases involving mixed land use, we strongly recommend that buffer zones be established, wherever possible, in order to alleviate potential dust and odor nuisance problems.

Response: The Petitioner will comply with the provisions of Hawaii Administrative Rules, §11-60.1-33 on Fugitive Dust.

We encourage the contractor to implement a dust control plan, which does not require approval by the Department of Health, to comply with the fugitive dust regulations. Additional dust control measures that may complement those that are being proposed include, but are not limited to, the following:

a) Planning the different phases of construction, focusing on minimizing the amount of dust generating materials and activities, centralizing on-site vehicular traffic routes, and locating potential dust-generating equipment in areas of the least impact;
b) Providing an adequate water source at the site prior to start-up of construction activities;

c) Landscaping and providing rapid covering of bare areas, including slopes, starting from the initial grading phase;
d) Minimizing dust from shoulders and access roads;
e) Providing adequate dust control measures during weekends, after hours, and prior to daily startup of construction activities; and
f) Controlling dust from debris being hauled away from the project site. Also, controlling dust from daily operations of material being processed, stockpiled, and hauled to and from the facility.

Response: As discussed in the DEIS and in the forthcoming Second DEIS, the construction contractor(s) is responsible for complying with the State DOH regulations that prohibit visible dust emissions at property boundaries. Compliance with State regulations will require adequate measures to control airborne dust by methods such as water spraying and sprinkling of loose or exposed soil or ground surface areas and dust-generating equipment, and the use of wind screens in sensitive areas during construction. No significant impacts on air quality are anticipated with appropriate mitigation during the construction phase and no violations of federal and state air quality standards are anticipated in the long-term.

A dust/particulate matter control plan will be implemented throughout the entire construction phase. All construction and construction related activities will comply with the provision set forth in Chapter 11-60.1-33 of the HAR on fugitive dust. Measures to be utilized include:

- Planning construction in phases to minimize the amount of dust-generating materials and activities, refining on-site vehicular traffic routes, and situating potential dust-generating equipment in areas of minimal impact.
- Watering active work areas and any temporary unpaved work roads on a consistent, daily basis.
- Landscaping and accelerated covering of barren areas, including slopes, commencing from the outset of the grading phase.
- Controlling dust from debris and materials being hauled off-site.
- Using wind screens and/or minimizing the area of disturbance as possible at any given time.
- Preventing trucks from tracking dirt and sediment onto paved roadways by routine road washing and tire cleaning.
- Monitoring dust at the project site boundary throughout construction as a method of evaluating the efficiency of the dust/particulate matter control program, and subsequently modifying and updating the program as deemed necessary.

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Your letter, along with this response, will be reproduced and included in the forthcoming Second DEIS. We appreciate your participation in the EIS review process.

Sincerely,

Earl Matsukawa, AICP
Project Manager

cc: Mr. Jay Nakamura, Stanford Carr Development
Mr. Daniel Orodenker, State Land Use Commission

NEIL ABERCROMBIE
GOVERNOR

KATHRYN S. MATAYOSHI
SUPERINTENDENT

STATE OF HAWAI'I
DEPARTMENT OF EDUCATION
P.O. BOX 2360
HONOLULU, HAWAI'I 96804

OFFICE OF THE SUPERINTENDENT

RECEIVED
SEP 12 2011
WILSON OKAMOTO CORPORATION

September 9, 2011

TO: Mr. Orlando Dan Davidson, Executive Officer
State Land Use Commission
Department of Business, Economic Development & Tourism

FROM: Kathryn S. Matayoshi, Superintendent
Department of Education

SUBJECT: Draft Environmental Impact Statement for Kaloko Makai
Kaloko and Kohanaiki, North Kona, Hawaii,
TMKs (3) 7-3-009:017, 019 (por.), 025, 026, 028, 062 (por.), and 063

The Department of Education (DOE) has reviewed the Draft Environmental Impact Statement (EIS) for the Kaloko Makai project proposed for North Kona, Hawaii.

The DOE anticipates an impact on its facilities as a result of the Kaloko Makai project. The DOE notes three school sites within the EIS: an elementary school in Phase I, a middle school in Phase II, and an elementary school in Phase III.

The Kaloko Makai project is within the present boundaries of the West Hawaii School Impact Fee District which was adopted by the Board of Education (BOE) on April 15, 2010. The project is expected to provide contributions based on the per-unit rate established for the district. The developer should enter into a written agreement with the DOE with the details of the proposed school sites.

Thank you for the opportunity to provide comments. If you have any questions, please call Jeremy Kwock of the Facilities Development Branch at 377-8301.

KSM:JK:jmb

c: Peter Phillips, SCD-TSA Kaloko Makai, LLC
Earl Matsukawa, AICP, Wilson Okamoto Corporation
Randolph G. Moore, Assistant Superintendent, OSFSS

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7469-01
July 25, 2013

Ms. Kathryn Matayoshi, Superintendent
Department of Education
State of Hawaii
P.O. Box 2360
Honolulu, HI 96804

Subject: Draft Environmental Impact Statement (DEIS)
Kaloko Makai
Kaloko and Kohanaiki, North Kona, Hawaii
Tax Map Key: (3) 7-3-09: 017, 025, 026, and 028

Dear Ms. Matayoshi:

Thank you for your letter dated September 9, 2011. The Petitioner is preparing a Second DEIS to address changes in the proposed project that will be reassessed, as needed, in the forthcoming document. You will be notified of its availability for review and comment pursuant to Chapter 343, Hawaii Revised Statutes (HRS) and Title 11, Chapter 200 Hawaii Administrative Rules (Department of Health).

With regard to your comments on the subject DEIS, we offer the following responses in the order of your comments:

The DOE anticipates an impact on its facilities as a result of the Kaloko Makai project. The DOE notes three school sites within the EIS: an elementary school in Phase I, a middle school in Phase II, and an elementary school in Phase III.

The Kaloko Makai project is within the present boundaries of the West Hawaii School Impact Fee District which was adopted by the Board of Education (BOE) on April 15, 2010. The project is expected to provide contributions based on the per-unit rate established for the district. The developer should enter into a written agreement with the DOE with the details of the proposed school sites.

Response: The Petitioner has had numerous discussions and meetings with DOE staff regarding the Kaloko Makai development and its impacts on DOE facilities in West Hawaii. Kaloko Makai will continue to work with the DOE on equitable contributions based on the per-unit rate established for the district, as well as a written agreement on the details of the proposed school sites.

Please note that the Middle School is now planned in Phase I rather then in Phase II, based on prior discussions with the DOE. This change is noted in the forthcoming Second DEIS.

Your letter, along with this response, will be reproduced and included in the forthcoming Second DEIS. We appreciate your participation in the EIS review process.

Sincerely,

Earl Matsukawa, AICP
Project Manager

cc: Mr. Jay Nakamura, Stanford Carr Development
Mr. Daniel Orodenker, State Land Use Commission

NEIL ABERCROMBIE
GOVERNOR

GLENN M. OKIMOTO
DIRECTOR

Deputy Directors
JADE T. BUTAY
FORD N. FUCHIGAMI
RANDY GRUNE
JADINE URASAKI

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

IN REPLY REFER TO:
DIR 1005
STP 8.0545

September 20, 2011

TO: Orlando Dan Davidson, Executive Officer
State Land Use Commission
Department of Business, Economic Development & Tourism

FROM: Glenn M. Okimoto, Ph.D.
Director of Transportation

SUBJECT: KALOKO MAKAI – DRAFT ENVIRONMENTAL IMPACT STATEMENT (DEIS)

Thank you for requesting the State Department of Transportation's (DOT) review of the subject project. DOT previously commented during the environmental assessment/environmental impact statement preparation notice for the subject project in its letters STP 8.0302 dated December 8, 2010 and STP 8.0269 dated October 26, 2010 (see Appendix S of the DEIS).

DOT met with the petitioner on August 17, 2011, and was informed a supplemental DEIS is forthcoming that will include several changes to the development. Therefore, DOT is only providing a limited technical review until the supplemental DEIS is submitted for review.

DOT offers the following comments on the subject DEIS dated July 2011 and the traffic impact study (TIS) dated July 22, 2011, which supplement DOT's prior comments that are still valid and applicable.

1. The trip generation calculation is quite cumbersome to review. Table 3 of the TIS provides trip generation calculations of individual parcels for each Traffic Analysis Zone (TAZ) of each phase. It is requested that trip generation tables include a summary table that presents the project trip generation by the Institute of Transportation Engineers (ITE) land uses for each phase.

2. The trip distribution figures do not include any incoming trips to the project. It would be reasonable to assume that a development of this size would include a distribution for both incoming and outgoing trips.

3. The analysis for the existing traffic conditions states that the Queen Kaahumanu Highway will be widened to four lanes before year 2015, and is similarly restated in the future year conditions as well. However, it is unclear whether or not the widening was incorporated into the calculations.

4. Table 14 and 15 of the TIS which provides the 2025 and 2035 Level of Service (LOS) analysis respectively must be revised to include projected intersection LOS calculations for a "Without Project" scenario for comparative analysis purposes.

5. The figures in the TIS are of poor quality and difficult to read, and very hard to accurately tell where the lanes start and stop. Clarity, sharpness and color rendition are needed. Many of the proposed lane geometry for the intersections do not match the proposed "lane traffic" shown on Hina Lani Street. The transportation portion of the DEIS includes several of the same figures in color, which makes it clearer and easier to understand. The figures in the TIS should be revised accordingly.

6. The recommended improvements section within the TIS does not provide any description of the improvements needed, other than referring to Figures 27 to 29. There are more details of the recommended improvements in the DEIS that should be reflected in the TIS, because the TIS is the document which is suppose to provide all recommended mitigation to address project impacts in addition to an analysis supporting such recommendations.

7. The 2015 recommendation within the TIS for the grade-separated interchange at the intersection of Queen Kaahumanu Highway and Hina Lani Street should indicate that Hina Lani Street will be realigned as stated in the DEIS document for consistency between the two documents. In addition, Figure 28 in the TIS only shows a "Future Interchange" graphic symbol at the current Queen Kaahumanu Highway and Hina Lani Street intersection. The symbol needs to be clarified, as it may infer that the interchange will be located at the current intersection location, when in fact it is proposed to be constructed further to the north. Also, neither document, the DEIS or TIS, provides any information on the necessary improvements to the internal roadway network to allow for the construction and connection of the proposed grade-separated interchange.

8. The TIS shall be revised to respond to comments 1 through 7 above and all previous comments, and to include the supplemental changes, and shall be submitted with the Supplemental DEIS.

9. Equipment and material storage and staging areas shall comply with the National Pollution Discharge and Elimination System (NPDES) permit requirements and Best Management Practices (BMP) measures shall be installed.

10. No stormwater runoff will be allowed onto State Highway facilities.

11. If the area under the future interchange at the Queen Kaahumanu Highway in the vicinity of Hina Lani Street is reclassified to Urban District, the petitioner should be required to dedicate the land necessary for the future interchange, including setback areas to DOT based on existing Conservation District prices.

12. Any agreement addressing the required traffic mitigation improvements, including fair share contribution for regional transportation improvements, on State highway facilities should be coordinated and prepared between the petitioner and the DOT Highways Division.

13. The petitioner's traffic consultant will need to continue discussions and coordination with DOT Highways Division to ensure that all traffic impacts are adequately addressed and properly mitigated.

DOT appreciates the opportunity to provide these limited technical comments and looks forward to receive the petitioner's supplemental DEIS for our further review and comments. If there are any questions, including the need to meet with DOT Highways Division staff, please contact Mr. David Shimokawa of the DOT Statewide Transportation Planning office at telephone number (808) 831-7976.

c: Peter Phillips, SCD-TSA Kaloko Makai, LLC
Wilson Okamoto Corporation

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7469-01
July 25, 2013

Dr. Glenn T. Okimoto, Director
Department of Transportation
State of Hawaii
869 Punchbowl Street
Honolulu, HI 96813-5097

Subject: Draft Environmental Impact Statement (DEIS)
Kaloko Makai
Kaloko and Kohanaiki, North Kona, Hawaii
Tax Map Key: (3) 7-3-09: 017, 025, 026, and 028

Dear Dr. Okimoto

Thank you for your letter dated September 20, 2011 (DIR 1005; STP 8.0545). The Petitioner is preparing a Second DEIS to address changes in the proposed project that will be reassessed, as needed, in the forthcoming document. You will be notified of its availability for review and comment pursuant to Chapter 343, Hawaii Revised Statutes (HRS) and Title 11, Chapter 200 Hawaii Administrative Rules (Department of Health).

With regard to your comments on the subject DEIS, we offer the following responses in the respective order of your comments:

DOT met with the petitioner on August 17, 2011, and was informed a supplemental DEIS is forthcoming that will include several changes to the development. Therefore, DOT is only providing a limited technical review until the supplemental DEIS is submitted for review.

Response: The Petitioner appreciates the opportunity to continue discussions with DOT and acknowledges DOT will be reviewing the forthcoming Second DEIS.

DOT offers the following comments on the subject DEIS dated July 2011 and the traffic impact study (TIS) dated July 22, 2011, which supplement DOT's prior comments that are still valid and applicable.

1. *The trip generation calculation is quite cumbersome to review. Table 3 of the TIS provides trip generation calculations of individual parcels for each Traffic Analysis Zone (TAZ) of each phase. It is requested that trip generation tables include a summary table that presents the project trip generation by the Institute of Transportation Engineers (ITE) land uses for each phase.*

Response: The TIS has been revised and will be included in the forthcoming Second DEIS. The trip generation rates will be summarized in a table by project land use categories.

2. *The trip distribution figures do not include any incoming trips to the project. It would be reasonable to assume that a development of this size would include a distribution for both incoming and outgoing trips*

   Response: The trip distribution shown on the figures is for entering and exiting trips. The figures in the Second DEIS will clarify this.

3. *The analysis for the existing traffic conditions states that the Queen Kaahumanu Highway will be widened to four lanes before year 2015, and is similarly restated in the future year conditions as well. However, it is unclear whether or not the widening was incorporated into the calculations.*

   Response: The widening of Queen Kaahumanu Highway and the construction of Ane Keohokalole Highway were taken into account as part of the analysis.

4. *Table 14 and 15 of the TIS which provides the 2025 and 2035 Level of Service (LOS) analysis respectively must be revised to include projected intersection LOS calculations for a "Without Project" scenario for comparative analysis purposes.*

   Response: Tables showing "With" and "Without Project" for each phase of the project will be included in the revised TIS, that will be appended to the forthcoming Second DEIS.

5. *The figures in the TIS are of poor quality and difficult to read, and very hard to accurately tell where the lanes start and stop. Clarity, sharpness and color rendition are needed. Many of the proposed lane geometry for the intersections do not match the proposed "lane traffic" shown on Hina Lani Street. The transportation portion of the DEIS includes several of the same figures in color, which makes it clearer and easier to understand. The figures in the TIS should be revised accordingly.*

   Response: All of the subconsultant studies in the DEIS have been half-sized and are reproduced in black and white to reduce the volume and cost of the printed document. A PDF of the revised TIS report, in color, will be provided to you. PDF version for OEQC publication will also be in color.

6. *The recommended improvements section within the TIS does not provide any description of the improvements needed, other than referring to Figures 27 to 29. There are more details of the recommended improvements in the DEIS that should be reflected in the TIS, because the TIS is the document which is suppose to provide all recommended mitigation to address project impacts in addition to an analysis supporting such recommendations.*

   Response: The TIS has been revised to describe the improvements needed and will be appended to the forthcoming Second DEIS.

7. *The 2015 recommendation within the TIS for the grade-separated interchange at the intersection of Queen Kaahumanu Highway and Hina Lani Street should indicate that Hina Lani Street will be realigned as stated in the DEIS document for consistency between the two documents. In addition, Figure 28 in the TIS only shows a "Future Interchange" graphic symbol at the current Queen Kaahumanu Highway and Hina Lani Street intersection. The symbol needs to be clarified, as it may infer that the interchange will be located at the current intersection location, when in fact it is proposed to be constructed further to the north. Also, neither document, the DEIS or TIS, provides any information on the necessary improvements to the internal roadway network to allow for the construction and connection of the proposed grade-separated interchange.*

   Response: The TIS has been revised to depict the grade-separated interchange north of the existing intersection of Queen Kaahumanu Highway and Hina Lani Street. The internal roadways have been conceptually laid out to accommodate the anticipated realignment of Hina Lani Street.

8. *The TIS shall be revised to respond to comments 1 through 7 above and all previous comments, and to include the supplemental changes, and shall be submitted with the Supplemental DEIS.*

   Response: Comments 1 through 7, if appropriate, have been incorporated in the revised TIS, which will be appended to the forthcoming Second DEIS.

9. *Equipment and material storage and staging areas shall comply with the National Pollution Discharge and Elimination System (NPDES) permit requirements and Best Management Practices (BMP) measures shall be installed.*

   Response: The Petitioner acknowledges that all equipment and material storage and staging areas shall comply with the National Pollution Discharge and Elimination System (NPDES) permit requirements and that Best Management Practices (BMP) measures shall be installed.

10. No stormwater runoff will be allowed onto State Highway facilities.

Response: The Petitioner acknowledges that no stormwater runoff will be allowed onto State Highway facilities. The project will comply with the National Pollution Discharge and Elimination System (NPDES) permit requirements and as stated in the forthcoming Second DEIS, Best Management Practices (BMP) measures will be installed and implemented.

11. If the area under the future interchange at the Queen Kaahumanu Highway in the vicinity of Hina Lani Street is reclassified to Urban District, the petitioner should be required to dedicate the land necessary for the future interchange, including setback areas to DOT based on existing Conservation District prices.

Response: As stated in the forthcoming Second DEIS, if and when DOT requires the land for the interchange, arrangements can be made for the land at that time.

Please note that a discussion of the interchange will be included in the forthcoming Second DEIS. It states that the Kaloko Makai plan designates 75 acres of light industrial or business park land uses in the Special District located at its makai end fronting Queen Kaahumanu Highway. Of this total, approximately 25 acres have been identified by the State Department of Transportation (DOT) for a future highway interchange at the entrance to the Project. Thus, industrial/business activity on those lands will be interim uses and only 50 gross acres (approximately 40 net usable acres after allowing for circulation and infrastructure) are considered long-term light industrial land uses.

12. Any agreement addressing the required traffic mitigation improvements, including fair share contribution for regional transportation improvements, on State highway facilities should be coordinated and prepared between the petitioner and the DOT Highways Division.

Response: The Petitioner acknowledges that any agreement addressing the required traffic mitigation improvements, including fair share contribution for regional transportation improvements, on State highway facilities should be coordinated and prepared between the petitioner and the DOT Highways Division.

13. The petitioner's traffic consultant will need to continue discussions and coordination with DOT Highways Division to ensure that all traffic impacts are adequately addressed and properly mitigated.

Response: The Petitioner will continue discussions and coordination with DOT Highways Division to ensure that all traffic impacts are adequately addressed and properly mitigated.

Your letter, along with this response, will be reproduced and included in the forthcoming Second DEIS. We appreciate your participation in the environmental review process.

Sincerely,

Earl Matsukawa, AICP
Project Manager

cc: Mr. Jay Nakamura, Stanford Carr Development
Mr. Daniel Orodenker, State Land Use Commission

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EM

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COPY

October 5, 2011

Orlando Dan Davidson, Executive Officer
State Land Use Commission
c/o Department of Business, Economic Development & Tourism
P.O. Box 2359
Honolulu, Hawai'i 96804

RE: Draft Environmental Impact Statement
Kaloko Makai Development Project
Kaloko and Kohanaiki, North Kona, Hawai'i Island

Aloha e Executive Officer Davidson,

The Office of Hawaiian Affairs (OHA) is in receipt of an August 3, 2011 request for comments on a draft environmental impact statement (DEIS) prepared pursuant to Chapter 343, Hawaii Revised Statutes (HRS) to support the Kaloko Makai Project (the project) proposed by SCD-TSA Kaloko Makai, LLC (the applicant) in North Kona on the Island Of Hawai'i.

We appreciate that in response to several requests,[1] the applicant graciously extended the DEIS comment period an additional fifteen (15) days. This allowed for additional review of the extensive technical documents which support the potential impacts and proposed mitigation measures in the DEIS. We offer the following comments:

Background

The final environmental impact statement (FEIS) for this project will be a primary support document for a petition to the State Land Use Commission (LUC) requesting a State Land Use District Boundary Amendment (DBA) for the reclassification of 224.430 acres from the Conservation District to the Urban District and 724.436 acres from the Agricultural District to the Urban District. The FEIS may also serve to support a broad range of additional State of Hawai'i (State) and/or County of Hawai'i (County) permits or approvals which are required to facilitate the project. The LUC is the accepting authority for the final environmental impact statement for this project.

[1] By letter dated August 26, 2011 OHA requested a thirty (30) day extension of the DEIS comment period. By letter dated August 5, 2011 the National Park Service requested a sixty (60) day extension of the DEIS comment period.

The total project area is 1,139 acres that are currently vacant and undeveloped. This total is inclusive of the 948.866 acre LUC petition area. An additional eighteen acres of land may be utilized for the development of up to four (4) off-site wells, and construction of a reservoir and transmission system to provide the potable water the project requires.

At full build out, the project is envisioned to consist of 5,000 single and multi-family units, up to 1.1 million square feet of commercial-lease area, seventy-five (75) acres of light industrial uses, a 120-room lodge and business center, parks and open spaces (including a 150 acre forest preserve), archaeological and cultural preserves, three school sites and associated infrastructure. The applicant will provide forty (40) acres of land for the possible development of a regional hospital and an additional ten (10) acres for a new Kona Judiciary Complex.

County of Hawai'i General Plan and Kona Community Development Plan

OHA recognizes that the project is generally consistent with the broad land use polices of the County General Plan (GP) and the more specific elements and guiding principles of the Kona Community Development Plan (CDP)[2] which translates the GP into implementation actions relative to land use. The GP designates the project area for "urban expansion" and "conservation". The project area is within the "Urban Area" described in the CDP which directs future growth along proposed transit routes and the designation of ten "Neighborhood Village Transit Orientated Developments" (TOD).[3] This project is one of these designated TOD.

State Land Use Commission Decision Making Criteria and Standards

Chapter 205, HRS establishes the general responsibilities of the LUC in determining the appropriate uses of land in the State and the specific decision making criteria for DBA proceedings. The general standards for determining the boundaries of the Urban District established by Chapter §15-15-18, Hawaii Administrative Rules (HAR) will applicable to the forthcoming DBA. We are confident the LUC will be mindful of your public trust responsibilities as you consider acceptance of the environmental impact statement and subsequently, the DBA petition. An obvious interest of OHA in this matter is to ensure the LUC and all other government agencies fulfill your additional constitutional and statutory responsibilities to the Hawaiian people and our families which have been confirmed by judicial opinion.

As we have already mentioned, OHA recognizes that the GP and CDP designate the project area for urban development and the regional development of the "Urban Area" described in the CDP is already well underway. With this in mind, OHA has no fundamental objections to seeing the petition requesting the DBA and reclassification moving forward through the applicable proceedings, but we do advocate that the LUC afford full consideration to applicable concerns that could be expressed during these proceedings. The issue that is clearly looming is whether our resources can not only withstand the direct affects of this specific project, but also the cumulative affects of full development of the Urban Area described in the Kona CDP.

[2] The Kona CDP was adopted as Ordinance 08 131 by the Council of the County of Hawai'i on September 25, 2008, making it the first community development plan enacted on Hawai'i Island.
[3] Kona CDP, pages 4-39 to 4-44 and Figure 4-7.

OHA views the core intent of the Chapter 343, HRS process as preparing a final document which will guide the informed decision making of government agencies who consider the approvals that facilitate the development of a given action. In this specific case, the LUC as the Chapter 343, HRS "accepting authority" will be the first of many agencies to consider an approval that is necessary to facilitate this project. The applicant and their consultants have the inherent responsibility to acknowledge and identify what the true direct, indirect, secondary and cumulative affects of this project on our environment and resources will be, so that efforts to develop appropriate mitigation can begin as early as possible.

We must also be mindful that full build-out of the project will occur in three phases and will not be completed until a generation from now, in the year 2040.[4] In April 2010, the Hawai'i Supreme Court issued a ruling that overturned two lower court decisions by requiring that the impacts and mitigation measures of an environmental impact statement accepted for a project in 1985 be updated by a supplemental environmental impact statement to ensure that as the project moved forward a generation later, the concerns of the surrounding community were adequately addressed.[5]

Water

As an opening comment on water, OHA offers the practical and profound wisdom of the traditional saying *ola i ka wai a ka 'ōpua*[6]- there is life in the water from the 'ōpua clouds of Kona. After our need for clean air to breath, clean drinking water is a resource essential to the survival of life. The struggle over access to and the use of water, and the debate over how our actions result in direct, secondary and cumulative affects on this precious resource which extend across our State have already arrived in Kona. We are fast approaching a point where collaborative efforts between all stakeholders to develop a framework to comprehensively manage this resource will become necessary to ensure it is available for current and future generations.[7]

The project overlies the Keauhou Groundwater Aquifer System Area (ASYA), within the Hualalai Aquifer Sector Area (ASEA). The County of Hawai'i has already acknowledged that "*the development of the County General Plan land use maximum density within the Hualalai ASEA cannot be sustained by conventional water resources, even if agricultural demands are not included*".[8] The discovery of "high-level groundwater" circa 1992 provides strong indications that the Keauhou ASYA sustainable yield may be substantially greater than the 1990 State Commission on Water Resource Management estimate.[9]

[4] DEIS, page 2-59.
[5] See *Unite Here! Local 5 v. City and County of Honolulu*, 123 Haw. 150, 231 P.3d 423 (2010).
[6] See Pukui, Mary Kawena. *'Ōlelo No'eau Hawaii Proverbs & Poetical Sayings*. Bishop Museum Press. 1983. #2482. (Pukui).
[7] Pursuant to Chapter §174C-41, Hawaii Revised Statutes, a principle tool available to the State of Hawai'i Commission on Water Resource Management to implement a management framework to control groundwater use and withdrawals is to designate a Water Management Area (WMA). There are currently no designated WMA on the Island of Hawai'i.
[8] See Fukunaga & Associates, Inc. *Hawai'i County Water Use and Development Plan*. August 2010 Final Report (WUDP 2010). Page 809-43.
[9] See http://hawaii.gov/dlnr/cwrm/mapsillustrations/gwhu_hawaii.pdf. The Commission on Water Resource Management sustainable yield estimate for the Keauhou ASYA is 38 mgd.

The factors which affect the availability, discharge and overall quality of groundwater in Kona are complex and extend beyond the basic application of hydrology. Our understanding of the nature and extent of the geological feature which confines high-level groundwater and its relationship to the traditional "basal lens" which defines the basic hydrologic cycle of groundwater is largely conjecture at that this time[10]. Since its initial discovery in North Kona circa 1990, high-level groundwater has been rapidly developed and advanced studies to accompany additional development of this resource have been recommended.[11]

As specific elements of the Kona CDP are implemented and the development of the designated Urban Area of North Kona continues, the direct, secondary and cumulative affects on the quality of groundwater must be considered. The management framework which will guide the use and withdrawal of groundwater must also require that best management practices (BMP) be implemented, employed and monitored to ensure the quality of this resource is protected.

OHA has historically advocated for the protection of Native Hawaiian water rights, because in addition to sustaining life, this resource is essential to the perpetuation of our traditional and customary practices. On September 14, 2011, the OHA-Board of Trustees extended the specific focus of our advocacy on water to North Kona and the Keauhou ASYA by unanimously supporting a resolution that:

> *strongly encourages all stakeholders interested in the sustainability of the Keauhou Aquifer to actively work to protect the traditional and customary practices of Native Hawaiians in the area that are dependent on abundant clean groundwater*[12]

With this in mind, we respectfully offer the following comments on the potential this project has to impact groundwater resources and advocate that the LUC consider not only the direct impacts of this project, but also cumulative and secondary impacts within the broader context of full build-out of the land use elements described in the Kona CDP. To a certain extent, OHA views these comments on groundwater as being applicable to any forthcoming development action within the Urban Area designated by the Kona CDP.

Potable Water

The project's full build-out potable water demand is estimated to be between 3.2 mgd (average demand) and 4.8 mgd (maximum demand).[13] The applicant is considering six (6) alternatives to provide for this potable water demand:

1. Development of three (3) to four (4) mid-level (1,000 foot elevation) off-site wells (preferred alternative);
2. Utilization of four (4) to five (5) high-elevation (1,700 to 2,000 feet) off-site wells which would draw high-level groundwater;

[10] See Belt Collins Hawai'i, Ltd. *Keopu Well, Reservoir and Water Transmission Lines Final Environmental Assessment*. Prepared for the Hawai'i Housing Finance and Development Corporation. March 2010. Page 21
[11] WUDP 2010, pages 809-43 and -44.
[12] The full resolution is enclosed with this letter and was unanimously supported after consideration and discussion at a duly noticed meeting of the OHA-Board of Trustees on September 14, 2011.
[13] DEIS page 2-48 and Table 4-24

3. Development of three (3) to four (4) on-site wells (700 foot elevation);
4. Obtaining water commitments conferred into the Department of Water Supply system through existing water agreements;
5. Connection to the Department of Water Supply potable water system; and
6. A combination of all alternatives.[14]

In brief, all of these alternatives involve connecting to the County of Hawai'i-Department of Water Supply (DWS) North Kona Service Area System (SAS). The basic elements of these alternatives include: only the applicant completing necessary improvements[15] to the SAS (so that it has the capacity to support the project); the applicant working collaboratively or negotiating with other developers/landowners to complete improvements to the SAS; or the applicant negotiating to obtain existing water entitlements from the current SAS. The applicant believes that "*none of the alternatives draw water from basal groundwater underlying the project site*".[16]

Alternative 1 (the preferred alternative) seems to be the most viable in terms of the basic issue of accessing a groundwater source. Success in accessing this groundwater source will then lead into an extensive discussion on the impacts drawing the significant amount of water this project requires from the Keauhou ASYA would cause. The applicant attempts to avoid immediate discussion on this issue by suggesting that the wells developed under Alternative 1 will draw potable water from a "*groundwater phenomenon...freshwater hundreds of feet below the brackish basal lens*".[17]

It is our understanding that there is only limited information and data[18] relative to the availability, extent, characteristics and quality of this potential groundwater "phenomenon" available at this time and whether it is "disconnected" from the hydrologic cycle of the Keauhou ASYA as the applicant seems to suggest is unsubstantiated.

While the applicant "expects" that water drawn from the wells developed under the preferred alternative will meet DOH quality standards, it appears they have developed a contingency plan in the event it does not- desalinization through reverse osmosis (RO).[19] What is alarming to OHA is that the construction of a desalinization facility (facility) is not proposed until Phase 3 of the project[20] which is anticipated to begin in 2032 and completed by 2040.[21] If this is the case, should the preferred alternative be employed drawing groundwater that requires desalinization, how will this be done to provide for potable water demands if construction of the facility is proposed in the last phase of the project?

[14] DEIS, pages 4-108 to -123.
[15] "Improvements" are generally defined as a source well, storage and/or supply reservoirs and transmission lines which constitute a system that is then dedicated to the DWS pursuant to an executed agreement.
[16] DEIS, page 3-26.
[17] DEIS, pages 3-15 and 4-109.
[18] DEIS, pages 3-15 to -16 and Figure 3-6 references an interpretive analysis of the drilling of the Ke'opu Monitor Well (State Well No. 3858-01) by the State of Hawai'i Commission on Water Resource Management in 2001 to monitor the basal lens as the evidence of this groundwater source.
[19] DEIS, pages 2-48 to -49 and 4-110.
[20] DEIS, Figure 2-14.
[21] DEIS, page 2-59.

If the requirement for desalinization does become a reality, the instant DEIS is clearly deficient both in terms of supporting any State or County approvals necessary for the actual construction of the facility but also in identifying and mitigating the short and long term impacts the RO process will have on groundwater resources.

A product of RO is saline concentrate which will be disposed of by underground injection wells.[22] The applicant concludes that since this saline concentrate will be injected at depths of equal density, the RO process has no impacts on the basal lens and the saline concentrate is simply "*discharged into the ocean offshore at a substantial depth and distance from the shoreline*".[23] This is another assertion which is unsubstantiated.

The Department of Land and Natural Resources-Division of Aquatic Resources (DAR) has identified the near shore marine waters and coral reef ecosystems along the coastline approximately 1 mile for the project boundary as an area with substantial submarine groundwater discharge.[24] DAR views this project as a coastal development with "*substantial potential to impact marine water quality and coastal ecosystems*"[25] by increasing nutrient and contaminant concentrations in groundwater discharge. It is unclear whether DAR's analysis included consideration of the applicant's proposal to dispose of saline concentrate through underground injection wells.

A fundamental principle which must be acknowledged and addressed in the event the preferred alternative is employed is that there could be impacts to an already anomalous basal lens. The extent of these impacts is unknown at this time. In the event desalinization is required, overall impacts to the quality of the Keauhou ASYA could be magnified through an additional increase in discharged groundwater salinity. It is possible that these magnified impacts will adversely affect the near shore marine resources necessary to perpetuate the traditional and customary practices of the Native Hawaiian people. While accessing groundwater is viable under this alternative, the uncertainties relative to the elements of this alternative must be addressed before it becomes a reality.[26]

Alternative 2 would utilize off-site wells drawing high-level groundwater. Only one of the well sites required for this alternative is identified at this time. Pursuant to an agreement with the DWS, TSG Kula Nei, L.P. and Springbrook Investments, L.P (TSG/SI) will be completing SAS improvements (anticipated to have a maximum daily production capacity of 1.0 mgd) in exchange for entitlements needed to support the 120,000 gpd potable water needs of the "Kula

[22] DEIS, page 4-110.
[23] Ibid.
[24] See DEIS, Appendix S. October 22, 2010 letter from Robert T. Nishimoto, DAR Program Manager to Earl Matsukawa, Wilson Okamoto Corporation. (DAR letter)
[25] Ibid.
[26] The WUDP 2010, page 809-45 offers a general recognition that desalinization is a viable alternative to providing potable water but does not discuss how to address the impacts of full-scale development of this alternative. OHA is aware that the Shores at Kohanaiki Project and the proposed O'oma Beachside Village Project, situated to the immediate northwest of this project are may already be utilizing and are proposing a large-scale desalinization facility respectively. Thus, the cumulative affects of multiple large-scale desalinization facilities must be considered.

Nei Project".[27] The actual timeframe for TSG/SI to complete these SAS improvements is unclear.

Based on the average and maximum daily potable water demands this project will require, it is clear that even an agreement with the DWS which would confer all of the remaining water commitments from the TSG/SI system to the applicant, a significant amount of potable water will still be required.[28] The locations of the additional well sites and systems, and the timeframe for developing them are unknown. OHA views the viability of this alternative as an uncertainty at this time.[29]

Alternative 3 is a variation of Alternative 1 and proposes the same elements to access a groundwater source, including desalinization. The wells developed under this alternative would be situated on-site. The comments and concerns we have already expressed relative to Alternative 1 are applicable to this alternative. Other than a general description of the elevation at which the wells would be sited, the DEIS does not depict their exact location or distribution in project plans. This is an issue specific to this alternative which should be clarified.

Alternative 4 would involve the applicant negotiating for the "transfer" of existing water entitlements from the SAS. The only specific negotiations described in the DEIS are with Lanihau Properties, LLC who will convert Palani Well No.1 to a production well, construct a 1 mg reservoir and install a 12-inch water transmission line to connect to an existing 16-inch DWS water main.[30] This production well will draw high-level groundwater at maximum pumping capacity of 1.6 mgd.[31]

Completion of this specific system is anticipated sometime in 2011. Pursuant to a well development agreement (agreement) executed between the Board of Water Supply, Lanihau Properties, LLC, West Hawai'i Business Park, LLC and Palani Ranch, Inc this system would be dedicated to the DWS and support the SAS.[32] Lanihau Properties, LLC is entitled to eight-five (85) percent of the maximum pumping capacity of the well, which will be allocated for the development of their properties.

The applicant seeks to negotiate with the DWS and Lanihau Properties, LLC for the "transfer" of their water entitlements to support this project. The success of these negotiations however, seem to be dependent on Lanihau Properties, LLC scaling down or abandoning the planned developments of their lands. Based on the information available to us at this time, OHA sees the viability of this alternative as another uncertainty.

[27] See Belt Collins Hawai'i, Ltd. *Kula Nei Project Final Environmental Impact Statement Volumes 1-3*. Prepared for the Shopoff Group. September 2007. Page 2-13.
[28] DEIS, Table 4-24 estimates the average daily demand of Phase 1 of the project alone at 1.361 mgd.
[29] DEIS, page 2-59 anticipates Phase 1 of the project beginning in 2012.
[30] See County of Hawai'i-Department of Water Supply. *Palani Well No. 1 (State Well No. 4158-03) Final Environmental Assessment*. October 2009. Pages 1-1 to -8.
[31] Ibid.
[32] Ibid, Appendix 4.

Alternative 5 would simply connect to the SAS to obtain the potable water the project requires. The DWS has already informed the applicant that the SAS cannot support this project.[33] Unless the DWS has changed their position, OHA does not view Alternative 5 as a realistic option.

Alternative 6 would employ a combination of all five alternatives under consideration. The applicant believes that this alternative will result in "*no additional environmental or ecological impacts*".[34] OHA agrees that if a combination of all alternatives were employed there would be no additional impacts, but the actual extent of the direct, cumulative and secondary impacts of each alternative currently under consideration have not been identified at this time.

Wastewater

The Kona CDP mandates the expansion of the Kealakehe Wastewater Treatment Plant (KWTP) and the development of a new wastewater treatment plant that to the extent possible, will utilize a "natural treatment system" (new WTP) to accommodate projected wastewater volume from the Urban Area.[35] The applicant acknowledges that the timeframe for completing the KWTP expansion and the development of a new WTP are unknown.[36] Thus, the discussion that the applicant will collaborate with the County on the KWTP expansion or the development of a new WTP is moot when considering the project's timeframes. The County-Department of Environmental Management has already informed the applicant that the current capacity of the KWTP cannot accommodate this project.[37]

OHA views the development of an on-site private wastewater treatment plant (project WTP) to accommodate the average wastewater flow of 2.2 mgd and design peak wastewater flow of approximately 12.2 mgd that this project will generate[38] as a necessity. We do seek an explanation on what accounts for the difference between average and design peak wastewater flow, as the 10 mgd difference is a significant amount of wastewater.[39]

We applaud the applicant for proposing to utilize technologies at the project WTP that will provide recycled (R-1) water for general irrigation within the project in accordance with DOH requirements.[40] We are immediately alarmed however, at the applicants acknowledgment that in the first phase of the project "*there will likely not be enough R-1 water to irrigate the parks and schools that are slated for construction*".[41] We request clarification on how this issue will be addressed and question whether it means the project's potable water demands are actually

[33] DEIS, Appendix S. October 25, 2010 letter from Milton Pavao, DWS Manager to the Wilson Okamoto Corporation.
[34] DEIS, page 4-123.
[35] See Kona CDP, page 4-111 Policy PUB-4.5, 4.5a and 4.5b.
[36] DEIS, pages 2-50 and 4-124.
[37] DEIS, page 4-126.
[38] DEIS, page 4-124.
[39] See DEIS, Appendix R. Wilson Okamoto Corporation. *Draft Preliminary Engineering Report Kaloko Makai*. July 2011. Appendices, which provide the "design peak flow" 12.230 mgd estimate, but do not specify how this estimate is generated.
[40] See Chapter 11-62, Hawaii Administrative Rules.
[41] DEIS, page 4-132.

higher than current estimates.[42] Furthermore, the applicant is aware that the DOH restricts the use of R-1 water above the underground injection control (UIC) line and thus, R-1 water will only be used for irrigation in the portion of the project below the UIC line.[43] OHA requests clarification whether this is a second issue which may result in an increase in potable water demand estimates.

It is unclear whether the project WTP will be equipped with specific technologies to accommodate waste from the light industrial and commercial elements of the project and in the event the regional hospital facility is built, medical waste.[44] This is an issue that should be addressed.

At full build-out of the project, R-1 water availability may exceed irrigation demands during periods of extended wet weather and the project WTP will employ percolation basins to dispose of excess R-1 water. The applicant has concluded that this use of percolation basins will not adversely affect overall groundwater quality, or more specifically the resources of Kaloko-Honokohau National Historical Park.[45] We question this conclusion, as the geology (extremely porous 'a'a lava) of Kona which accommodates the disposal of significant volumes of water in relatively small percolation basins also implies that there is very little natural filtration of contaminants and nutrients before this water quickly reaches the basal lens and enters near shore marine waters.

The U.S. Environmental Protection Agency (EPA) and U.S. Department of Commerce-National Oceanic and Atmospheric Administration (NOAA) have jointly published guidance on the types of management measures designers of onsite disposal systems (OSDS), such as a WTP should consider.[46] One of the core objectives of this guidance is to ensure OSDS "*are not installed in areas where soil absorption systems will not provide adequate treatment of effluents containing solids, phosphorus, pathogens, nitrogen, and nonconventional pollutants prior to entry into surface waters and ground water (e.g., highly permeable soils, areas with shallow water tables or confining layers, or poorly drained soils)*".[47] This guidance also specifically recommends consideration of factors such as soil type, soil depth, rate of sea level rise, depth to water table and topography to ensure the discharge of pollutants into groundwater is reduced to the extent practicable.

DAR has already informed the applicant that they view this project as a coastal development with "*substantial potential to impact marine water quality and coastal ecosystems*".[48] The introduction of nutrients and containments into groundwater and near shore

[42] DEIS, page 4-129 proposes that "*supplemental potable water will be added to the R-1 storage tank as needed to ensure that the irrigation demands of users can be met*".
[43] DEIS, Figure 4-14.
[44] DEIS, page 2-39 describes that even without the regional hospital, the project WTP could receive medical waste from the physicians' clinic and urgent care facility proposed in Phase 1.
[45] DEIS, page 4-130.
[46] See *Coastal Nonpoint Pollution Control Program: Program Development and Approval Guidance*. Published jointly by the EPA and NOAA under the authority of Section 6217 of the Coastal Zone Act Reauthorization Amendments. Chapter 4, Section (V). (EPA and NOAA guidance).
[47] Ibid.
[48] DAR letter.

marine waters either through excess effluent disposal or percolation of R-1 water irrigation within the project must be thoroughly evaluated so that appropriate mitigation can be developed.

OHA advocates that in addition to designing project WTP elements pursuant to State DOH standards, EPA and NOAA guidance must be considered. Furthermore, the applicant should be required to proactively develop a groundwater monitoring plan in coordination with all stakeholders as the data obtained will directly contribute to short and long term efforts to protect overall groundwater quality in Kona.

Drainage

Again, the same geology of Kona which allows for rainfall, and storm and irrigation waters to quickly percolate also implies that there is very little natural filtration of contaminants and nutrients before this water quickly reaches the basal lens and enters near shore marine waters.

A system of catch basins, drain lines and drywells will dispose of storm and irrigation waters which do not percolate naturally in natural or landscaped areas.[49] The project area will be particularly vulnerable to storm waters during initial mass grading, stockpiling and excavation prior to the development of drainage infrastructure. We will rely on assurances that the applicant will adhere to all DOH and County requirements during initial project development. The construction and post-construction best management practices which will be employed[50] are critical in contributing to the protection of overall groundwater quality and near shore marine resources.

The EPA and NOAA have also jointly published guidance on the three basic mechanisms employed to treat urban runoff- infiltration, filtration and detention. This guidance notes that standard infiltration systems may not be appropriate where groundwater requires protection and that certain restrictions may also apply to using infiltration systems located above "sole source drinking water aquifers".[51]

A pollution prevention plan (PPP) will be developed and we offer our general support that mitigation of "*contaminated surface water can be achieved through the development of a PPP designed to address all pollutants associated with the development...to prevent any release into the environment, including the groundwater.*"[52] This is an important recognition and we appreciate the applicant's commitment that "*no grading activity will take place*" until the PPP has been prepared.[53] OHA advocates that this PPP be developed pursuant to DOH standards and in consultation with all stakeholders. Consideration should also be afforded to EPA and NOAA guidance that results in the development of infiltration, filtration and detention mechanisms that employ the best available science and technology to provide protection for groundwater and near shore marine resources.

[49] DEIS, page 4-133.
[50] DEIS, page 3-44.
[51] See EPA and NOAA guidance. Chapter 4, Section II (A and B).
[52] DEIS, pages 3-26 to -27.
[53] Ibid.

Water Conservation

The applicant's consideration of incorporating State-Office of Environmental Quality Control and U.S. Green Building Council- Leadership in Energy and Environmental Design guidelines relative to water conservation into project design concepts and utilizing native plant species adapted to the project area in project landscaping design is appropriate and appreciated.[54]

Given the issues relative to the water demands of this project facing the applicant, their commitment to strategies "*to reduce consumption, conserve resources and minimize water use*" is also appropriate.[55] It is surprising that the applicant is only "considering" specific measures to facilitate end-user water conservation such as: water restrictions during extended dry weather periods, education and efficient landscaping practices.[56] OHA sees these types of specific measures as a necessity and we advocate the applicant commit to them.

Conclusion on Water

The applicant has clearly exerted considerable effort to avoid drawing groundwater from the traditional basal lens of the Keauhou ASYA. To a certain extent, these efforts appear to be a laudable attempt to recognize the need for developing alternatives to provide potable water and reduce the pressure on our precious and limited groundwater resources. More specifically however, these efforts seem to be directed at the National Park Service (NPS) who has consistently expressed concerns relative to overall groundwater quality and discharge, and how the fishponds wetlands, anchialine ponds and approximately 627 acres of near shore marine waters within the Kaloko-Honokohau National Historical Park[57] are or will be affected by this project and the overall development of Kona CDP elements.[58]

Unfortunately, OHA views the end result of these efforts as ambiguity and uncertainty within the DEIS that contradicts the core intent of the Chapter 343, HRS process- informed decision making. We do not see how any reviewer of the DEIS, including the LUC or any other government agency can comprehensively assess the true impacts of the alternatives under consideration to develop potable water. OHA must establish the position that the applicant's ability to provide for the potable water needs of this project and adequately mitigate the impacts of the project on overall groundwater quality are both clearly unresolved issues at this time.[59]

OHA offers a second traditional saying as our closing comment on water for your consideration: *Kekaha wai'ole o na Kona*- waterless Kekaha of the Kona District.[60] While we will not offer any attempt to understand any hidden meanings of this saying, we can only hope

[54] DEIS, page 2-60.
[55] DEIS, page 4-106.
[56] Ibid.
[57] Kaloko-Honokohau National Historical Park is encompassed by Honokohau Settlement National Historical Landmark
[58] DEIS, pages 3-60 to -75.
[59] DEIS, page 4-108 provides the applicant's own acknowledgment that it must "*undertake additional research to assess the potential impacts and appropriate mitigation measures of the selected systems*" developed under the selected alternative.
[60] Pukui. #1716.

that its literal translation does not foreshadow the future of Kona.[61] It is the inherent responsibility of all interested parties and stakeholders to collaboratively work to see that it is not.

The immediate issue relative to water which is facing the LUC and all other government agencies is how you will fulfill your responsibilities to ensure the availability, and protect the quality of a public trust resource which is also essential to the perpetuation of a broad range of traditional and customary practices of the Native Hawaiian people.

Native Dryland Forest Preserve

Approximately 265-acres, constituting one of the largest remaining native dryland forest (dryland forest) areas in the Hawaiian Islands have been identified in Kaloko Ahupua'a. Of this total, approximately 150-acres are situated within the project area and the applicant is proposing to establish the Kaloko Makai Dryland Forest Preserve (preserve). OHA offers our support for the general concept of establishing the preserve and we applaud the applicant for this proposal.

A variety of "common" native tree species (trees) are situated within the project area, outside of the boundaries of the preserve. These trees may be impacted during land clearing to facilitate the project and the applicant proposes to coordinate as appropriate to harvest them prior to the initiation of project activities so their wood can be used to perpetuate certain traditional and customary practices.[62] OHA also applauds the applicant for this proposal.

Habitat Conservation Plan

The U.S. Fish and Wildlife Service (FWS) has identified four (4) native plant species listed as "endangered" (listed species) as defined by the Endangered Species Act (ESA)[63] and a single native plant species identified as a "candidate" for listing as endangered[64] (candidate) within the project area. Any species listed under the ESA is automatically afforded protections pursuant to State law.[65]

Two of the listed species and the candidate occur outside of the boundaries of the preserve and preparation of a habitat conservation plan (HCP) is required to support the issuance of a license by the State Board of Land and Natural Resources to allow for the "take"[66] of the listed species resulting from project development. The applicant has prepared a draft HCP.[67] OHA has no objections to the immediate and short term management actions relative to the listed and candidate species which area described in the HCP.

[61] Kekaha is a geographic region of Kona inclusive of the project area which is generally described as extending along the coast from Honokohau north to Kapalaoa.
[62] DEIS, page 4-56.
[63] See 16 U.S.C 1522(6). The four ESA listed species are: 'aiea, hala pepe, ma'oloa and uhiuhi.
[64] See 50 CFR §424.02(b). The ESA candidate is ko'oko'olau.
[65] See Chapter §195D-4, Hawaii Revised Statutes.
[66] Ibid at (g).
[67] See DEIS, Appendix F. Hookuleana, LLC. *Kaloko Makai Dryland Forest Preserve Draft Habitat Conservation Plan*. July 2011. (HCP)

Nexus between the HCP and the Ane Keohokalole Mid-Level Highway Project

The HCP repeatedly mentions the Ane Keohokalole Mid-Level Highway Project (mid-level road)[68] and specifically references on-going ESA-Section 7 consultation between the FWS, the U.S. Department of Transportation-Federal Highways Administration (FHWA) and the County due to the affects of the mid-level road on listed or candidate species. In the final environment assessment (FEA) for the mid-level road the FHWA concluded that construction will *"not likely adversely affect any listed species known from the Island of Hawai'i"*.[69] The FWS concurred with the FHWA's conclusion.[70]

The applicant emphasizes that no FHWA funding will support the project and suggests that the preserve will be "*best served by Kaloko Makai and FHWA working cooperatively to complement each other's management actions rather than to duplicate activities*".[71] While this may be true, a review of the management actions described in the HCP make it clear that the FHWA has a significant responsibility in the initial implementation and short term (three-year) management before the applicant's management responsibilities significantly increase.[72] The ability of a reviewer of the DEIS to clearly understand the nexus between the HCP and the mid-level road (nexus) is critical in determining whether the overall goals of the HCP are feasible. OHA feels that the instant DEIS does not adequately describe the origin of this nexus and the FHWA's conclusion in the mid-level road FEA causes additional uncertainty. We request clarification on this issue.

Traditional and Customary Practices relative to Native Species within the Project Area

A participant in the interviews conducted to support the project's cultural impact assessment (CIA)[73] specifically referenced the practical use of the ESA candidate, ko'oko'olau within the preserve:

> *...the ko'oko'olau plant is in the project area. The only place you'll find the plant. If they develop it, please get the seeds, and use it as part of landscaping when doing it. The plant is used for tea, better than Lipton and Earl Grey. You have to watch for this plant, because this is the only area that has it and collect the seeds...*[74]

[68] The Ane Keohokalole Mid-Level Highway Project (project) has been completed by the County of Hawai'i with funding support from the U.S. Department of Transportation-Federal Highways Administration and provides a regional roadway and utility corridor extending three miles from Palani Road in the south to Hina Lani Street in the north.
[69] See *Final Environmental Assessment for the Ane Keohokalole Mid-Level Highway Project*. September 2009. Page 5-17.
[70] Ibid, Appendix I. August 24, 2009 letter from Loyal Mehroff, FWS Field Supervisor to Pat Phung, FHWA.
[71] HCP, page 5.
[72] Ibid, pages 35-47 and 57-73.
[73] DEIS, Appendix L. Monahan, Magat, Groza and Hammatt. *Cultural Impact Assessment for a 1,150-Acre Parcel within portions of Kohanaiki and Kaloko Ahupua'a, North Kona District, Hawai'i Island.* Cultural Surveys Hawai'i, Inc. Prepared for Stanford Carr Development, LLC. May 2008. (CIA)
[74] Ibid, pages 60-61.

This statement may indicate that Native Hawaiians are actively accessing the project area to exercise traditional and customary gathering rights. The ko'oko'olau[75] within the project area are found outside of the preserve and "will be removed".[76] The HCP proposes actions within the preserve to mitigate the loss of this native plant due to development of the project, but it does not address the specific issue of it being actively gathered.[77]

The limited distribution of ko'oko'olau outside of the project combined with the possibility that access to the lands they are situated on is restricted,[78] means this project may directly affect the traditional and customary practices of the Native Hawaiian people, as we will no longer be able to gather this specific resource.

General Comments on Dryland Forests

In traditional and early-historic times, a dryland forest was a source of valuable resources ranging from food and medicine to raw material for a variety of uses.[79] Sadly, published reports describe that approximately 90% of the dryland forests in the State of Hawai'i have been lost due to the impacts of modern development, wildfire, and introduced animal and plant species.[80]

On the Island of Hawai'i, on-going restoration efforts at two specific locations outside of this project provide strong indications that our dryland forests can get on the road to recovery. In Ka'upulehu, the members of the North Kona Dry Forest Working Group (DFWG) are patiently developing techniques which have been proven successful in an initial 6-acre pilot project and are now being applied in a larger 70-acre project.[81] In Kealakehe, the State Department of Hawaiian Home Lands (DHHL) has implemented a plan to establish and manage dryland forest preserves at the "Villages at La'i'Ōpua" that contain both listed and candidate species.[82]

The Kaloko dryland forest has been long recognized as being in good condition due to certain natural factors (rugged lava) which have acted as a deterrent to usual threats such as fire and introduced animal and plant species.[83] In addition to ESA listed and candidate native plant species, botanical surveys identified at least twenty-four additional native tree, shrub and plant species (native species) within the project area.[84] With the exception of pili, all of these additional native species are present within the dryland forest and the boundaries of the preserve.[85]

[75] See Abbott, Isabella Aiona. *Lā'au Hawai'i Traditional Hawaiian Uses of Plants*. Bishop Museum Press. 1992. (Abbott). Table 3 and page 102. Ko'oko'olau is identified as a plant commonly used in traditional Hawaiian medicine as a general tonic and specific remedies for throat and stomach troubles and for severe asthma.
[76] HCP, page 47.
[77] Ibid.
[78] Ibid, page 45.
[79] See Abbott and Krauss, Beatrice H. *Plants in the Hawaiian Culture*. University of Hawai'i Press. 1993.
[80] See http://www.hawaiiforest.org/reports/dryland.html.
[81] Ibid.
[82] See Leonard Bisel Associates, LLC and Geometrician Associates. *La'i'ōpua Plant Mitigation and Preserve Restoration Plan*. Prepared for the State of Hawai'i Department of Hawaiian Home Lands. January 2008.
[83] HCP, page 32.
[84] DEIS, Appendix E. Isle Botanica. Botanical Survey of Kaloko Properties. Prepared for the Wilson Okamoto Corporation. December 2006. Table 1
[85] Ibid, page 6.

Comprehensive Management of the Preserve

The preserve is identified as an unresolved issue in the relatively narrow sense of the HCP being dependent upon the applicant receiving all necessary entitlements, permits and funding.[86] OHA views the importance of the preserve in a context which extends beyond the HCP and sees the comprehensive management of the preserve as a resource for current and future generations as an unresolved issue. We do not want to see the preserve only recognized for its botanical value and become inaccessible to our community. The variety of native species within the preserve may not be immediately available for use in the perpetuation of traditional and customary practices, but a management objective of the preserve should be that they all eventually one day will be.

When considering that at full build-out, two elementary and a middle school (schools) may be developed within the project area, there is a possibility that the preserve could be incorporated into the educational curriculum of the schools as a "living classroom". The educational potential of the preserve extends to all generations as project residents and those from neighboring communities could have the opportunity to actually see native species within a natural ecosystem and understand their uses in perpetuating traditional and customary practices. Programs that collaborate with the on-going efforts at Ka'upulehu and Kealakehe could be considered.

Archaeological studies have identified at least two trail segments (trails) which extend through the preserve.[87] We encourage the applicant to fully explore the possibility of whether these trails can be used for community access through the preserve. This could promote both educational and recreational opportunities within the preserve, and also foster pedestrian connectivity to other areas within the project and surrounding areas to which the project area is traditionally and culturally connected to.

If the applicant's petition to the LUC is successful and the DBA granted, the applicant will seek to subdivide the preserve into a single tax map key (TMK) parcel through the applicable County processes.[88] OHA requests that the applicant consider incorporating a restrictive covenant or condition into the property deed which confirms that the eventual TMK parcel which will encompass the preserve shall remain undeveloped and that appropriate access shall be provided in perpetuity.

Conclusion on the Dryland Forest

Overall, OHA reaffirms our support and appreciation for the applicant's proposal to establish the preserve and we look forward to seeing it achieve its full potential as it will day stand as a priceless kīpuka once the urban development elements of the Kona CDP are completed. We encourage the applicant to work with all appropriate parties to develop a comprehensive plan to guide the management of and appropriate access to the preserve into the future.

[86] DEIS, page 8-9.
[87] DEIS, Figure 4-3.
[88] HCP, page 55.

The immediate unresolved issue that must be addressed is the affect this project will have on traditional and customary gathering rights with the removal of the ko'oko'olau. It is unknown at this time whether other native plant species within the project area or preserve are actively being gathered and utilized.[89]

Chapter 6E, Hawaii Revised Statutes

The applicant has prepared an archaeological inventory survey (AIS) and submitted it to the State Department of Land and Natural Resources-State Historic Preservation (SHPD) for review. At this juncture, the SHPD has provided no comments on the AIS. The applicant views this as an unresolved issue.[90] OHA agrees that this is definitely an unresolved issue, but in a much broader sense that extends beyond the submission of the AIS to the SHPD for review and comment.

Pursuant to Chapter §6E-42(a)[91], HRS, prior to an approval any agency or officer of the State must provide the SHPD an opportunity for review and comment on the effect a project will have on historic properties[92]. This is a critical point, as we view the first "approval" relative to this project as the LUC's acceptance of the environmental impact statement. If the LUC is depending on the SHPD to determine an adequate level of effort to identify historic properties within the project area, appropriate significance assessments for identified historic properties and warranted mitigation measures via the Chapter 6E, HRS process (process), then this process should be completed before the LUC accepts the environmental impact statement.

The vast majority of the historic properties identified and documented in the AIS are resources of potential cultural and religious significance to the Native Hawaiian people. This emphasizes that an assessment of the potential impacts this project will have on these resources, and the relative traditional and customary practices or religious beliefs of the Native Hawaiian people is dependant on the LUC reviewing documents which are the product of the completed process. Consideration must also be afforded to a myriad of existing archaeological and ethnographic studies related to the project area to place it within a larger traditional and cultural landscape.

OHA is concerned that issues relative to the project AIS and overall compliance with Chapter 6E, HRS and implementing Hawaii Administrative Rules (HAR) will remain unresolved as the Chapter 343, HRS moves forward towards completion. If this concern becomes a reality, OHA does not see how the LUC, or any government agency can fulfill your constitutional or

[89] See CIA, page 57. A second CIA participant references the medicinal uses of native species found within the project area, but it is unclear whether these uses are active.
[90] DEIS, page 8-9.
[91] Chapter §6E-42(a) requires that: *before any agency or officer of the State or its political subdivisions approves any project involving a permit, license, certificate, land use change, subdivision, or other entitlement for use, which may affect historic property, aviation artifacts, or a burial site, the agency or office shall advise the department and prior to any approval allow the department an opportunity for review and comment on the effect of the proposed project on historic properties, aviation artifacts, or burial sites, consistent with Section 6E-43, including those listed in the Hawai'i register of historic places.*
[92] Chapter §6E-2 defines a "historic property" as: *any building, structure, object, district, area, or site, including heiau and underwater site, which is over fifty years old.*

statutory responsibilities to the Native Hawaiian people, as simply relying on the submittal of the AIS to the SHPD for review and comment fails to do so.

Request for Clarification on the Seven Volumes which Comprise the AIS

The project AIS is comprised of seven volumes.[93] Five volumes constitute the archaeological inventory surveys (surveys) of the tax map key (TMK) parcels which encompass the project area.[94] A sixth volume has been prepared to summarize the findings of the surveys.[95] The seventh volume is an archaeological assessment (assessment) of a portion of the eighteen (18) acre site which may be utilized for the development of off-site wells to provide for the project's potable water needs.[96]

Five (5) TMK parcels encompass the project area, but only four (4) surveys have been prepared. It appears the survey which was prepared for TMK parcel (3) 7-3-009:028 includes the immediately adjacent 46.869-acre TMK parcel (3) 7-3-009:063. Please clarify whether our understanding of this issue is correct, as it will account for all 5 TMK parcels listed in the DEIS.

The assessment identified no historic properties within an approximately 3.44 acre area south of Hina Lani Street.[97] It appears that the remaining acreage north of Hina Lani Street which may be utilized for the development of off-site wells was subject to an archaeological survey separate (separate survey) from the project AIS. This separate survey identified 89 sites distributed on multiple tax map key parcels. Seven of these sites were subject to a preservation plan approved by the SHPD. Four of these preserve sites are on the tax map key parcel north of Hina Lani Street where the off-site wells will be developed, but their locations are not depicted or described in the DEIS. OHA also requests clarification on this issue.

Significance Criteria

State law defines the five criteria (criteria) used in assessing the significance of historic properties.[98] The first four criteria mirror those used at the federal level in assessing National Register of Historic Places:

> Criterion "A'- *associated with events that have made an important contribution to the broad patterns of our history;*
>
> Criterion "B"- *associated with the lives of persons important in our past;*
>
> Criterion "C"- *embody the distinctive characteristics of a type, period, or method of construction or represent the work of a master, or possess high artistic value;*

[93] DEIS, page 4-1.
[94] DEIS, Figure 2-2.
[95] DEIS, Appendix J. *Summary Report of Archaeological Inventory Survey for Kaloko Makai.* Cultural Surveys Hawai'i, Inc. May 2008. (Summary Report).
[96] DEIS, Appendix K. Wilkinson, Mitchell and Hammatt. *Draft Archaeological Assessment Report For The Proposed Kaloko Heights Well Site Project, Kaloko Ahupua'a, North Kona District, Hawai'i Island.* Cultural Surveys Hawai'i, Inc. July 2011. Prepared for Stanford Carr Development.
[97] Ibid, page 6 and Figure 1.
[98] See Chapter §13-284-6, HAR.

> Criterion "D"- *has yielded, or is likely to yield, information important for research on prehistory or history.*

The fifth criterion is the key exception found in State law:

> Criteria "E"- has *an important value to the native Hawaiian people or to another ethnic group of the state due to associations with cultural practices once carried out, or still carried out, at the property or due to traditional beliefs, events or oral accounts- these associations being important to the group's history and cultural identity.*

This definition is extremely broad. When considering the dominant role religious beliefs had in shaping traditional Hawaiian society and guiding the daily activities of all classes of people,[99] in a very general sense, any historic property associated with the native Hawaiian people has religious or cultural significance.

The pattern and practice of archaeology in Hawai'i which OHA sees today is that contracted consultants are determining what significance an identified site has to the Native Hawaiian people from an archaeological perspective. The project AIS identified a total of 341 historic properties (sites) comprised of 658 features.[100] The vast majority of these sites are assigned a "pre-contact age"[101] and associated with the native Hawaiian people. We are disappointed to see that the applicant's archaeological contractor has assessed so many of these sites as significant only under criteria "D".

OHA's position is that any site identified in an AIS that is associated with the native Hawaiian people is automatically "significant" under Criterion "E". While this position will not result in OHA advocating for the preservation of every site assigned cultural or religious significance to the Hawaiian people, it is the foundation of our advocacy that it is the Native Hawaiian people who have the responsibility to determine the significance of the tangible reminders of ka 'ike o ka po'e kahiko (the knowledge of the ancestors).[102]

Proposed Mitigation

Of the 341 total sites identified in the project area, the applicant is proposing that seventy-two (72) be preserved, eighty (80) be subject to data recovery and "no further work" for one hundred eight-nine (189).[103] At this time, OHA has been unable to comprehensively review the descriptions or contextual information to provide specific comments on the proposed mitigation for every identified site at this time. We do offer general comments on the proposed mitigation to emphasize our position that the unresolved status of the Chapter 6E, HRS process inhibits the ability to assess the impacts of this project on the resources, and the traditional and customary practices of the Native Hawaiian people.

[99] See Kamakau, Samuel Manaiakalani. Ka Po'e Kahiko The People of Old. Bishop Museum Press. Honolulu. 1991. Page 11. *There were two kinds of kanawai observed by the Hawaiian people from the very ancient days: the kanawai akua, or gods' laws; and the kanawai kapu ali'i, or sacred chiefly laws.*
[100] Summary Report, page 50.
[101] Ibid, Tables 3-7.
[102] Chapter §13- 284-6(c) requires consultation with Native Hawaiian Organizations and/or individuals for criterion "E" sites prior to the submission of an AIS to the SHPD.
[103] Summary Report, Table 11.

Thirty (30) of the sites proposed for preservation are burials.[104] Pursuant to State law, the Hawai'i Island Burial Council (HIBC) has the statutory authority to render a determination of preservation in place or relocation for these burials and make recommendations to the SHPD on short and long-term mitigation measures.[105] The HIBC considers the views of recognized lineal and cultural descendants in determining burial treatment.[106] The DEIS and project AIS contains no discussion on the status of consultation with lineal and/or cultural descendants and the impact this project will have on traditional and customary practices and beliefs associated with these specific burials is completely unknown at this time.

The data recovery of eighty (80) sites will be conducted pursuant to a plan developed in accordance with State law.[107] This plan will identify a research objective which will be addressed through the data recovery effort. The applicant has proposed six (6) possible data recovery research objectives (objectives).[108] OHA views all of these proposed objectives as having a possible impact on the traditional beliefs of the Native Hawaiian people, but OHA and other parties will not be able to provide substantive comments until an objective is selected, a plan developed and the results of data recovery published in a report.

OHA appreciates the applicant's acknowledgement of community concerns relative to an extensive network of traditional and historic trails which extend throughout the project area.[109] The mauka-makai Kohanaiki Trail, which historically extended continuously from the Kohanaiki Homesteads (mauka of the project) to the coastal lands now managed by the NPS is of specific concern. It is important to note, that the significance and practical use of these trails are not from the distant past, as there members of our community with us today who utilized these trails in their lifetimes.[110] The NPS and Department of Land and Natural Resources- Na Ala Hele Program have expressed a specific interest in ensuring that mauka-makai trails extending through the project area maintain connectivity to surrounding areas which have a traditional or cultural connection. While certain mitigation measures relative to trails have been proposed,[111] it is unknown whether they are adequate in addressing community concerns or will be approved by regulatory agencies.

Request for Additional Information Relative to Site 20720

It is our understanding that a 1996 archaeological study, which included the project area identified eight possible burial sites.[112] The project AIS conducted testing of these possible burial sites. This testing resulted in five sites being confirmed as "non-burial" and two sites as "probable burial". The eighth site (Site 20720) was "*determined to have been destroyed*".[113]

[104] Ibid, page 56.
[105] See Chapter §6E-43 and 43.5, HRS and Chapter §13-300-33, -36 and -38, HAR.
[106] See Chapter §13-300-33(b)(2), HAR.
[107] See Chapter 13-278, HAR.
[108] Summary Report, pages 70-71.
[109] DEIS, pages 4-51-57.
[110] See Maly, Kepa and Onaona Maly. *He Wahi Mo'olelo 'Ohana No Kaloko Me Honokōhau Ma Kekaha O Nā Kona- A Collection Of Family Traditions Describing Customs, Practices and Beliefs of the Families and Lands of Kaloko and Honokōhau, North Kona, Island of Hawai'i.* Kumu Pono Associates. 2002. Prepared for the National Park Service.
[111] DEIS, page 4-56 and -57
[112] DEIS, page 4-35.
[113] Ibid.

OHA requests additional information on the circumstances which led to the destruction of Site 20720, as this is a matter which may require an investigation into possible violations of Chapter 6E, HRS.

Site 26452

Site 26452 is described as a lava tube which is accessed through an opening within the project area, but extends outside of the project area where at least eight (8) confirmed burials have been identified.[114] OHA recognizes that the applicant cannot propose mitigation for portion of the lava tube outside of the project area. We do hope that the applicant and neighboring landowner will collaborate to propose mitigation measures for the site that are consistent. OHA will also be seeking assurances from the SHPD that the owner of the parcel under which the lava tube extends and the burials are situated has been formally notified of their presence.

Conclusion on Chapter 6E, Hawaii Revised Statutes

OHA views the unresolved issues relative to the Chapter 6E, HRS as inhibiting LUC's and all other government agencies ability to adequately assess the impacts this project will have on the resources, and traditional and customary practices and beliefs of the Native Hawaiian people. The submittal of the project AIS to the SHPD for review does little to resolve this issue. OHA advocates that the Chapter 6E, HRS process be completed before the LUC takes any action on the environmental impact statement so that the consultation effort which leads to final mitigation measures being approved can be considered by decision makers.

Cultural Impact Assessment

In 2000, the Hawai'i State Legislature found that:

> [T]he 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 exercise thereof is necessary to ensure the continued existence, development, and exercise of native Hawaiian culture.[115]

The result of this finding was an amendment to the definitions of "environmental impact statement" and "significant effect" contained within §343-2, HRS to now include the terms "welfare" and "cultural practices". The preparation of a cultural impact assessment (CIA), as a technical report to support the findings and conclusions in a Chapter 343, HRS document is how an assessment of the affects of an action on the resources and exercise of the "native Hawaiian culture", along with proposed mitigation to address these affects is usually attempted to fulfill the requirements of this amendment.

[114] Summary Report, page 37.
[115] Act 50, H.B. NO. 2895, H.D. 1, 20th Leg. (2000).

With our substantial concerns relative to groundwater, dryland forest and archaeological resources (resources) which are directly related to the perpetuation of traditional and customary practices (practices) and beliefs of the Native Hawaiian people in mind, OHA respectfully concludes that the project CIA is woefully inadequate. The mitigation measures proposed as a result of the CIA,[116] while appreciated are elementary when considering the substantial and long term impacts this project could have.

Outside of the amendments to Chapter 343, HRS and a CIA, the Hawai'i Supreme Court established a specific analytical framework in order for the LUC to complete a proper analysis of the impacts of a given action on Native Hawaiian resources, beliefs and traditional and customary practices. This judicial guidance applies to all State and county agencies and requires an agency to:

> (1) Identify and scope of "valued cultural, historical, or natural resources" in the petition area, including the extent to which traditional and customary native Hawaiian rights are exercised in the petition area; (2) Extent to which those resources- including traditional and customary native Hawaiian rights- will be affected or impaired by the proposed action; and (3) Feasible action, if any, to be taken by the [agency] to reasonably protect native Hawaiian rights if they are found to exist.[117]

As we have already mentioned, the unresolved issues related to resources inhibits all agencies', including the LUC's, ability to apply this framework and complete a sufficient analysis. Considering the clear threat to resources which are essential to the perpetuation of Native Hawaiian traditional and customary practices, OHA hopes that the LUC will agree with our position and require the applicant to provide additional information in order to fulfill your affirmative duty to protect the reasonable exercise of traditional and customary rights.

Public Services and Facilities

The applicant's proposals and commitments relative to public facilities and services are all appreciated as they have the potential to positively impact the North Kona Community in general. When considering that the full build-out of the Department of Hawaiian Home Lands (DHHL) La'i 'Opua residential development in Kealakehe will concentrate a significant Native Hawaiian population in the region, these facilities and services are of elevated importance to OHA and DHHL beneficiaries.

Regional Hospital

OHA looks forward to seeing the development of a new regional hospital moving forward on the 40 acres of land within the project area the applicant has committed to provide. The need for a new regional hospital is clearly recognized as it will increase accessibility and decrease travel times for the North Kona Community. The Kona Community Hospital in Kealakekua (15 miles south) and North Hawai'i Community Hospital (35 miles north) currently

[116] DEIS, pages 4-55 to -57.
[117] See *Ka Pa'akai O Ka 'Āina v. Land Use Commission*, 94 Haw. 1,7 P.3d 1068 (2000).

service the emergency and trauma needs of this area.[118] We applaud all involved in the effort to develop this much need facility.

Kona Judiciary Complex

We also applaud the applicant for committing 10 acres of land within the project area for the possible development of the new Kona Judiciary Complex (complex). It is our understanding that the State Department of Accounting and General Services (DAGS) has commissioned a selection study to determine the most viable alternative locations (locations) for the complex. These locations will be comprehensively assessed in a forthcoming draft environmental impact statement prepared by the DAGS.

Schools

The State Department of Education (DOE) has informed the applicant that this project will have a "significant impact" on DOE facilities in West Hawai'i.[119] The project is within the West Hawai'i School Impact Fee District and thus, the applicant is subject to impact land and cash payment fee components (impact fees).[120] The applicant references a July 21, 2011 meeting with the DOE to discuss impact fees,[121] but it is unclear whether the results of this meeting ensure compliance with applicable State laws. This information should be provided in the DEIS.

Housing

We appreciate that the applicant is committed to proving 700 "affordable" units with pricing to be determined in consultation with government agencies.[122]

A "Social Impact Assessment" (SIA) was prepared as a technical report to support the DEIS.[123] Twenty-four (24) interviewees, or "stakeholders" representing a "wide spectrum of beliefs and interests" were deliberately selected to share their thoughts on: issues independent of the project affecting West Hawai'i, overall issues specific to the project and specific issues related to project elements.[124] Interestingly, the "affordable housing" criteria established by the U.S. Department of Housing and Urban Development (HUD) and how this criteria affects the community in general, and specifically Native Hawaiians was a prevailing theme during these interviews.[125]. The SIA then attempted to determine the extent of "actual inequities" in HUD and County of Hawai'i affordable housing guidelines and criteria.

[118] DEIS, Page 4-88.
[119] See DEIS, Appendix S. October 15, 2010 letter from Kathryn Matayoshi, DOE Superintendent to Earl Matsukawa, Wilson Okamoto Corporation.
[120] See Chapter §302A-1601 to 1610, HRS
[121] See DEIS, Appendix S. July 25, 2011 letter from Earl Matsukawa, Wilson Okamoto Corporation to Kathryn Matayoshi, DOE Superintendent.
[122] DEIS, page 2-20 and Table 2-2
[123] John M. Knox & Associates, Inc. *Kaloko Makai Social Impact Assessment Volumes 1-3*. May 3, 2011. DEIS, Appendix Q. (Knox, 2011).
[124] Ibid, Volume 1, pages 3-1 and 3-2.
[125] Ibid, pages 3-13 and 3-14.

The SIA analysis of the potential "inequities" in affordable housing guidelines and criteria concludes that "*all groups...face serious affordability issues in regard to housing in West Hawai'i (especially North Kona)*" and that "*Native Hawaiians (and perhaps Filipinos) are particularly challenged in West Hawai'i due to lower overall incomes that reflect differences in overall education, age, and family structure*".[126]

This conclusion seems to be ambiguously dismissed by a closing comment on this issue that:

> *the social challenges facing West Hawai'i will probably have less to do with the fairness of "affordable housing" guidelines than with the soaring prices of market housing. The social impact of the Kaloko Makai project will be positive to the extent that it succeeds in the goal of providing more affordable market housing to working families- a goal that would likely be achieved by greater densities consistent with the Kona Community Development Plan*[127]

OHA sees the conclusion and closing comment in the SIA as doing very little to address the concerns of interviewees, or comprehensively assessing any actual inequities in HUD or County of Hawai'i affordable housing criteria and guidelines that adversely affect Native Hawaiians. OHA sees the DEIS preparer's outright dismissal of concerns relative to affordable housing expressed by SIA interviewees as a "fleeting fantasy"[128] as extremely alarming. We urge caution in the approach the applicant utilized to discuss this important issue.

Conclusion

The aspects of this project ranging from housing to employment and economic benefits that are offered as "beneficial impacts"[129] must be carefully balanced against the long term vision of the Kona Community and impacts to resources that we must ensure are available for future generations.

As we have already recognized, this project area is consistent with uses described in the County general Plan and is within the Urban Area designated within the Kona Community Development Plan (CDP). Thus the years of planning which went into the CDP, seems to confirm the community's long term vision that this project would one day become a reality.

What the elements of the CDP do not specifically provide for or address however, is how the direct, secondary and cumulative affects of each project will impact our resources and this is the source of our opposition to seeing this project move forward at this time. OHA believes that our review of this DEIS provides adequate evidence that the project will result in adverse impacts to three resources (groundwater, native dryland forest species, and archaeological and burial sites) of importance to the Native Hawaiian people and to a certain extent all of Hawai'i. These adverse impacts are both extreme and unresolved and thus, the LUC and other decision

[126] Ibid, Volume 2, page 2-8.
[127] Ibid, page 2-12.
[128] DEIS, page 4-105.
[129] DEIS, page S-1.

makers are unable to fulfill their responsibilities to conduct informed decision making in accordance with constitutional and statutory mandates and judicial opinion.

We believe that these impacts and unresolved issues can be addressed, but it will take a comprehensive and collaborative effort (effort) that involves all stakeholders. We look forward to participating, as appropriate or needed to advocate for the interests of our beneficiaries in this effort. As we await a response, we will caution the applicant that unless the recommended effort is reflected and the concerns of all DEIS reviewers addressed, rather than simply responded to, we will continue to be opposed to this project.

Thank you for the opportunity to provide comments. Should you have any questions, please feel free to contact me, or have you staff contact Keola Lindsey at keolal@oha.org or 594-0244.

'O wau iho nō me ka 'oia'i'o,

Clyde W. Nāmu'o
Chief Executive Officer

CWN:kl

Enclosures (1): September 14, 2011 OHA-BOT Resolution

C: OHA-BOT
OHA West Hawai'i Community Outreach Coordinator
Kathy Billings, Kaloko-Honokohau National Historical Park Superintendent
Peter Phillips, SCD-TSA Kaloko Makai, LLC
Earl Matsukawa, Wilson Okamoto Corporation
William Aila, Department of Land and Natural Resources and Commission on Water Resource Management, Chairman

A Resolution of the Office of Hawaiian Affairs

A resolution to encourage all stakeholders interested in the sustainability of the Keauhou Aquifer to actively work to protect the traditional and customary practices of Native Hawaiians that are dependent on abundant clean groundwater

WHEREAS, there is a special spirit in the Kona area that encompasses the life that flows in the land and the water that washes upon its shores, where Native Hawaiians found a clean underground water source to sustain their settlement of the area; and

WHEREAS, the cultural and historic importance of this area to Native Hawaiians is more significant given that the area is one of the driest in the archipelago, and only through intelligent and careful adaptation were Native Hawaiians able to make it into one of the most productive and important areas for our society; and

WHEREAS, when one of the most sacred and naturally significant parts of this area, the makai portions of the Kohanaiki, Kaloko, Honokōhau, and Kealakehe ahupua'a were threatened with development in the early 1970s, Native Hawaiians in the area organized and successfully lobbied Congress to take action to protect this area; and

WHEREAS, U.S. Representative Patsy Mink succeeded in the establishment of a Commission to study the area for inclusion as a National Park, and the Commission members and staff preparing the study included such noted Native Hawaiians as 'Iolani Luahine, George Nā'ope, Herb Kawainui Kane and John D. Waihe'e III; and

WHEREAS, that study, known as the Spirit of Kaloko Honokōhau, was accepted and endorsed by Congress when it established Kaloko Honokōhau National Historical Park in 1978 for the express purpose of preserving, interpreting, and perpetuating Native Hawaiian activities and culture; and

WHEREAS, the ability of Native Hawaiians to continue traditional and customary practices throughout coastal Kona is dependent on the continued flow of fresh, clean groundwater to the sea; and

WHEREAS, since 1978, the amount of groundwater withdrawn in the Kona area has approximately doubled and is projected to increase by at least another fifty percent (50%) in the near-term, which the best available science indicates will impact the Park's resources; and

WHEREAS, development in the Kona area continues to grow with the potential for increasing sources of pollution and threats to abundant clean groundwater; and

WHEREAS, the National Park Service, as stewards of this wahi pana, have endeavored over the last ten years to protect water resources in the area through a collaborative, cooperative approach with stakeholders; and

WHEREAS, despite these efforts, the significance of abundant clean groundwater to the cultural practices, history, and interests of Native Hawaiians in the area is still not widely recognized, as evidenced by the Hawai'i County Water Use and Development Plan, which does not consider the effects of groundwater withdrawal on the traditional and customary practices of Native Hawaiians; and

WHEREAS, OHA has historically played a critical leadership role in protecting Native Hawaiian water rights through its advocacy, including through litigation in the Waiāhole, Nā Wai 'Ehā, and Waiola O Moloka'i cases, and commenting on the effects of development on Native Hawaiian water rights in this area and across the archipelago; and

– Continued –

A Resolution of the Office of Hawaiian Affairs

A resolution to encourage all stakeholders interested in the sustainability of the Keauhou Aquifer to actively work to protect the traditional and customary practices of Native Hawaiians that are dependent on abundant clean groundwater

WHEREAS, the protection and preservation of clean groundwater is essential to the perpetuation of traditional and customary practices of Native Hawaiians, and hence the perpetuation of a unique Native Hawaiian presence and culture in this significant area; and

NOW, THEREFORE, BE IT RESOLVED by the Office of Hawaiian Affairs Board of Trustees, on this 14th day of September, 2011, that it strongly encourages all stakeholders interested in the sustainability of the Keauhou Aquifer to actively work to protect the traditional and customary practices of Native Hawaiians in the area that are dependent on abundant clean groundwater; and

BE IT FURTHER RESOLVED, that a certified copy of this Resolution be transmitted to the Commission on Water Resource Management, the Hawai'i State Department of Land and Natural Resources, the Hawai'i County Department of Water Supply, the Hawai'i County Water Board, the Hawai'i County Council, and the Mayor of Hawai'i County.

Colette Y. Machado
Chairperson, Trustee, Moloka'i and Lāna'i

Boyd P. Mossman
Vice Chair, Trustee, Maui

Rowena Akana
Trustee, At-large

Robert K. Lindsey Jr.
Trustee, Hawai'i

Peter Apo
Trustee, O'ahu

Oswald K. Stender
Trustee, At-large

S. Haunani Apoliona, MSW
Trustee, At-large

John D. Waihe'e IV
Trustee, At-large

Donald B. Cataluna
Trustee, Kaua'i and Ni'ihau

Date: September 14, 2011

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7469-01
July 25, 2013

Mr. Kamanaopono Crabbe, Chief Executive Officer
Office of Hawaiian Affairs
State of Hawai'i
711 Kapi'olani Blvd., Suite 500
Honolulu Hawai'i 96813

Subject: Draft Environmental Impact Statement (DEIS)
Kaloko Makai
Kaloko and Kohanaiki, North Kona, Hawaii
Tax Map Key: (3) 7-3-09: 017, 025, 026, and 028

Dear Mr. Crabbe:

Thank you for your letter dated October 5, 2011 (HRD11/3552F). The Petitioner is preparing a Second DEIS to address changes in the proposed project that will be reassessed, as needed, in the forthcoming document. You will be notified of its availability for review and comment pursuant to Chapter 343, Hawaii Revised Statutes (HRS) and Title 11, Chapter 200 Hawaii Administrative Rules (Department of Health).

With regard to your comments on the subject DEIS, we offer the following in response to your comments:

County of Hawaii General Plan and Kona Community Development Plan
OHA recognizes that the project is generally consistent with the broad land use policies of the County General Plan (GP) and the more specific elements and guiding principles of the Kona Community Development Plan (CDP) which translates the GP into implementation actions relative to land use. The GP designates the project area for "urban expansion" and "conservation". The project area is within the "Urban Area" described in the CDP which directs future growth along proposed transit routes and the designation of ten "Neighborhood Village Transit Orientated Developments" (TOD). This project is one of these designated TOD.

Response: The Petition acknowledges that OHA recognition that the proposed project is generally consistent with the land use policies of the County General Plan (GP) and the guiding principles of the Kona Community Development Plan (CDP).

State Land Use Commission Decision Making Criteria and Standards
Chapter 205, HRS establishes the general responsibilities of the LUC in determining the appropriate uses of the land in the State and the specific decision making criteria

for DBA proceedings. The general standards for determining the boundaries of the Urban District established by Chapter 15-15-18, Hawaii Administrative Rules (HAR) will be applicable to the forthcoming DBA. We are confident that the LUC will be mindful of your public trust responsibilities as you consider acceptance of the environmental impact statement and subsequently, the DBA petition. An obvious interest of OHA in this matter is to ensure the LUC and all other government agencies fulfill your additional constitutional and statutory responsibilities to the Hawaiian people and our families which have been confirmed by judicial opinion.

Response: The Petitioner acknowledges that the general standards for determining the boundaries of the Urban District established by Chapter 15-15-18, Hawaii Administrative Rules (HAR) will be applicable to the forthcoming District Boundary Amendment (DBA). OHA's interests with regard to the proposed project's constitutional and statutory responsibilities to the Hawaiian people are of paramount importance.

As we have already mentioned, OHA recognizes that the GP and CDP designate the project area for urban development and the regional development of the "Urban Area" described in the CDP is already well underway. With this in mind, OHA has no fundamental objections to seeing the petition requesting the DBA and reclassification moving forward through the applicable proceedings, but we do advocate that the LUC afford full consideration to applicable concerns that could be expressed during these proceedings. The issue that is clearly looming is whether our resources cannot only withstand the direct affects of this specific project, but also the cumulative affects of full development of the Urban Area described in the Kona CDP.

Response: The Petitioner acknowledges that OHA has no fundamental objections to requesting the DBA.

The purpose of the EIS is to evaluate direct, secondary and cumulative affects and to provide mitigation measures to minimize impacts. The Petitioner believes the forthcoming Second DEIS provides a comprehensive assessment of the true direct, indirect, secondary and cumulative effects of the proposed project on Hawaii's resources and environment in order to ensure proper mitigation.

OHA views the core intent of the Chapter 343, HRS process as preparing a final document which will guide the informed decision making of government agencies who consider the approvals that facilitate the development of a given action. In this specific case, the LUC as the Chapter 343, HRS "accepting authority" will be the first of many agencies to consider an approval that is necessary to facilitate this project. The applicant and their consultants have the inherent responsibility to acknowledge

and identify what the true direct, indirect, secondary, and cumulative affects of this project on our environment and resources will be, so that efforts to develop appropriate mitigation can begin as early as possible.

> Response: The Petitioner acknowledges that Chapter 343 requires evaluation of direct, indirect, secondary and cumulative affects. The Petitioner believes the forthcoming Second DEIS provides a comprehensive assessment of the true direct, indirect, secondary and cumulative effects of the proposed project on Hawaii's resources and environment in order to ensure proper mitigation.

We must also be mindful that full-build-out of the project will occur in three phases and will not be completed until a generation from now, in the year 2040. In April 2010, the Hawaii Supreme court issued a ruling that overturned two lower court decisions by requiring that the impacts and mitigation measures of an environmental impact statement accepted for a project in 1985 be updated by a supplemental environmental impact statement to ensure that as the project moved forward a generation later, the concerns of the surrounding community were adequately addressed.

> Response: As referenced, the proposed project's final phase is projected to be completed in the year 2045; effectively a generation from now. The Petitioner acknowledges that the concerns of the surrounding community may change over this time-span, and will take measures to ensure that the proposed project will address those interests, in compliance with the ruling of the Hawaii Supreme court and any applicable amendment of Chapter 343, HRS or its implanting rules under Title 11, Chapter 200 HAR.

Water

As an opening comment on water, OHA offers the practical and profound wisdom of the traditional saying ola i ka wai a ka 'opua - there is life in the water from the 'opua clouds of Kona. After our need for clean air to breath, clean drinking water is a resource essential to the survival of life. The struggle over access to and the use of water, and the debate over how our actions result in direct, secondary and cumulative affects on this precious resource which extend across our State have already arrived in Kona. We are fast approaching a point where collaborative efforts between all stakeholders to develop a framework to comprehensively manage this resource will become necessary to ensure it is available for current and future generations.

The project overlies the Keauhou Groundwater Aquifer System Area (ASYA), within the Hualalai Aquifer Sector Area (ASEA). The County of Hawai'i has already acknowledged that "the development of the County General Plan land use maximum density within the Hualalai ASEA cannot be sustained by conventional water

resources, even if agricultural demands are not included. The discovery of "high-level groundwater" circa 1992 provides strong indications that the Keauhou ASYA sustainable yield may be substantially greater than the 1990 State Commission on Water Resource Management estimate.

The factors which affect the availability, discharge and overall quality of groundwater in Kona are complex and extend beyond the basic application of hydrology. Our understanding of the nature and extent of the geological feature which confines high-level groundwater and its relationship to the traditional "basal lens" which defines the basic hydrologic cycle of groundwater is largely conjecture at that this time. Since its initial discovery in North Kona circa 1990, high-level groundwater has been rapidly developed and advanced studies to accompany additional development of this resource have been recommended.

As specific elements of the Kona CDP are implemented and the development of the designated Urban Area of North Kona continues, the direct, secondary and cumulative affects on the quality of groundwater must be considered. The management framework which will guide the use and withdrawal of groundwater must also require that best management practices (BMP) be implemented, employed and monitored to ensure the quality of this resource is protected.

OHA has historically advocated for the protection of Native Hawaiian water rights, because in addition to sustaining life, this resource is essential to the perpetuation of our traditional and customary practices. On September 14, 2011, the OHA Board of Trustees extended the specific focus of our advocacy on water to North Kona and the Keauhou ASYA by unanimously supporting a resolution that: strongly encourages all stakeholders interested in the sustainability of the Keauhou Aquifer to actively work to protect the traditional and customary practices of Native Hawaiians in the area that are dependent on abundant clean groundwater.

With this in mind, we respectfully offer the following comments on the potential this project has to impact groundwater resources and advocate that the LUC consider not only the direct impacts of this project, but also cumulative and secondary impacts within the broader context of full build-out of the land use elements described in the Kona CDP. To a certain extent, OHA views these comments on groundwater as being applicable to any forthcoming development action within the Urban Area designated by the Kona CDP.

Potable Water

The project's full build-out potable water demand is estimated to be between 3.2 mgd (average demand) and 4.8 mgd (maximum demand). The applicant is considering six (6) alternatives to provide for this potable water demand:

1. *Development of three (3) to four (4) mid-level (1,000 foot elevation) off-site wells (preferred alternative);*
2. *Utilization of four (4) to five (5) high-elevation (1,700 to 2,000 feet) off-site wells which would draw high-level groundwater;*
3. *Development of three (3) to four (4) on-site wells (700 foot elevation);*
4. *Obtaining water commitments conferred into the Department of Water Supply system through existing water agreements;*
5. *Connection to the Department of Water Supply potable water system; and*
6. *A combination of all alternatives.*

In brief, all of these alternatives involve connecting to the County of Hawai'i-Department of Water Supply (DWS) North Kona Service Area System (SAS). The basic elements of these alternatives include: only the applicant completing necessary improvements to the SAS (so that it has the capacity to support the project); the applicant working collaboratively or negotiating with other developers/landowners to complete improvements to the SAS; or the applicant negotiating to obtain existing water entitlements from the current SAS. The applicant believes that "none of the alternatives draw water from basal groundwater underlying the project site".

Response: The alternatives now being considered for the project's drinking water supply have been narrowed down to those that can be affirmatively demonstrated as having no impact on the basal lens. These are limited to use of the high level groundwater drawn from strata far below the basal groundwater so as not to impact it and desalinizing saline groundwater, also drawn from below the basal lens.

An *Assessment of the Potential Impact of the Proposed Kaloko Makai Project on Water Resources* was prepared by Tom Nance Water Resource Engineering and will be included in the forthcoming Second DEIS.

Alternative 1 (the preferred alternative) seems to be the most viable in terms of the basic issue of accessing a groundwater source. Success in accessing this groundwater source will then lead into an extensive discussion on the impacts drawing the significant amount of water this project requires from the Keauhou ASYA would cause. The applicant attempts to avoid immediate discussion on this issue by suggesting that the wells developed under Alternative 1 will draw potable water from a "groundwater phenomenon...freshwater hundreds of feet below the brackish basal lens".

Response: The water supply alternative that will be implemented will be determined by results of the test well (state no. 4160-03) to be drilled at the upper end of the project site. If this alternative is implemented, there would

still be a 1:1 reduction in the amount of fresh groundwater ultimately discharged into the Makai environment. The recent USGS recharge study suggests this discharge into to Makai environment is 152 MGD less the amount of pumpage from wells. Current pumpage is about 14 MGD, a resulting decrease of 9.2% of this discharge. At full build out, the project would utilize about 2.15 MGD, a decrease of another 1.4% of the discharge into the Makai environment.

It is our understanding that there is only limited information and data relative to the availability, extent, characteristics and quality of this potential groundwater "phenomenon" available at this time and whether it is "disconnected" from the hydrologic cycle of the Keauhou ASYA as the applicant seems to suggest is unsubstantiated.

Response: The possible movement of high level groundwater far beneath the basal lens rather than moving though it was indicated by the results of two deep monitor wells (state nos. 3858-01 and 3959-01) and, at least indirectly, by the anomalously saline and cold basal groundwater in the coastal area that would otherwise before less saline, warmer, and in sufficient quantities to successfully develop irrigation quality brackish wells. The planned test well will contribute significantly to groundwater knowledge as well as provide direction on the supply alternative to pursue.

While the applicant "expects" that water drawn from the wells developed under the preferred alternative will meet DOH quality standards, it appears they have developed a contingency plan in the event it does not - desalinization through reverse osmosis (RO). What is alarming to OHA is that the construction of a desalinization facility is not proposed until Phase 3 of the project which is anticipated to being in 2032 and completed by 2040. If this is the case, should the preferred alternative be employed drawing groundwater that requires desalinization, how will this be done to provide for potable water demands if construction of the facility is proposed in the last phase of the project?

Response: If desalinization is the water supply alternative that will be pursued, it will developed at the outset of the project and supply all of its development phases.

If the requirement for desalinization does become a reality, the instant DEIS is clearly deficient both in terms of supporting any State or County approvals necessary for the actual construction of the facility but also in identifying and mitigating the short and long term impacts the RO process will have on groundwater resources.

Response: If desalinization is the option to be pursued, it will only be known after the planned deep test well (state no. 4160-03) is completed. At that time, approvals for the required wells would be sought from the Commission on Water Resource Management and approval of the desalinization for use as a drinking water supply would be sought from the Department of Health. There is no reason to believe that the approvals would be denied. However, it would be premature to pursue these approvals now.

A product of RO is saline concentrate which will be disposed of by underground injection wells. The applicant concludes that since this saline concentrate will be injected at depths of equal density, the RO process has no impacts on the basal lens and the saline concentrate is simply "discharged into the ocean offshore at a substantial depth and distance from the shoreline". This is another assertion which is unsubstantiated.

Response: By injecting the concentrate into a groundwater zone of equivalent or lesser salinity, the greater density of the concentrate will prevent its rise into the basal lens above. As such it will move toward the shoreline and ultimately discharge further offshore than the discharge of basal groundwater. It should also be pointed out that the concentrate itself, which is natural groundwater with the addition of naturally occurring salts removed from the desalting process, will not be a harmful addition to the Makai environment as it will quickly be mixed to background salinity levels.

The Department of Land and Natural Resources-Division of Aquatic Resources (DAR) has identified the near shore marine waters and coral reef ecosystems along the coastline approximately 1 mile for the project boundary as an area with substantial submarine groundwater discharge. DAR views this project as a coastal development with "substantial potential to impact marine water quality and coastal ecosystems" by increasing nutrient and contaminant concentrations in groundwater discharge. It is unclear whether DAR's analysis included consideration of the applicant's proposal to dispose of saline concentrate through underground injection wells.

Response: An *Assessment of the Potential Impact of the Proposed Kaloko Makai Project on Water Resources* and *An Assessment of Marine and Pond Environments* were prepared by Tom Nance Water Resource Engineering and Marine Research Consultants, respectively. Both reports will be included in the forthcoming Second DEIS.

The impact on groundwater prepared by Tom Nance Water Resource Engineering (2012) identified and quantified changes in the quantity of

groundwater discharge, the expected change in salinity, and the expected addition of nutrients.

This comment is addressed fully in Marine Research Consultants (2012). In brief, the projected increase in nutrient loading from groundwater is small relative to the natural nutrient fluxes reaching the ocean. In many areas of West Hawaii the overall nutrient flux is substantially greater than the projected loading at KAHO. In addition, the physical structure of the nearshore marine habitat consists of a shallow bench that is impacted by consistent wave forces which mix groundwater nutrients to background levels resulting in little or no effective increases in nutrient concentrations that could affect coral reef structure or function. This is discussed further in Marine Research Consultants report prepared for the project.

A fundamental principle which must be acknowledged and addressed in the event the preferred alternative is employed is that there could be impacts to an already anomalous basal lens. The extent of these impacts is unknown at this time. In the event desalinization is required, overall impacts to the quality of the Keauhou AYSA could be magnified through an additional increase in discharged groundwater salinity. It is possible that these magnified impacts will adversely affect the near shore marine resources necessary to perpetuate the traditional and customary practices of the Native Hawaiian people. While accessing groundwater is viable under this alternative, the uncertainties relative to the elements of this alternative must be addressed before it becomes a reality.

Response: The assessment by Tom Nance Water Resource Engineering (2012) identifies and quantifies the potential impacts to groundwater of each of the supply alternatives that are being considered. Each of the supply alternatives has been formulated to avoid impacting the basal lens. Admittedly and despite the results of the two deep monitor wells (state nos. 3858-01 and 3959-01), there is still some uncertainty regarding the relationship of high level groundwater and the basal lens in the mauka-makai corridor of the project site. The proposed test well (state no. 4160-03) is intended to eliminate that uncertainly. In the absence of those results, the TNWRE study included an assessment of the possible outcomes.

<u>Alternative 2</u> would utilize off-site wells drawing high-level groundwater. Only one of the well sites required for this alternative is identified at this time. Pursuant to an agreement with the DWS, TSG Kula Nei, L.P. and Spring-brook Investments, L.P. (TSG/SI) will be completing SAS improvements (anticipated to have a maximum daily production capacity of 1.0 mgd) in exchange for entitlements needed to support the

120,000 gpd potable water needs of the "Kula Nei Project". The actual timeframe for TSG/SI to complete these SAS improvements is unclear.

Based on the average and maximum daily potable water demands this project will require, it is clear that even an agreement with the DWS which would confer all of the remaining water commitments from the TSG/SI system to the applicant, a significant amount of potable water will still be required. The locations of the additional well sites and systems, and the timeframe for developing them are unknown. OHA views the viability of this alternative as an uncertainty at this time.

Response: The off-site potable well site alternative mauka of Kaloko Makai has been dropped.

Alternative 3 is a variation of Alternative 1 and proposes the same elements to access a groundwater source, including desalinization. The wells developed under this alternative would be situated on-site. The comments and concerns we have already expressed relative to Alternative 1 are applicable to this alternative. Other than a general description of the elevation at which the wells would be sited, the DEIS does not depict their exact location or distribution in project plans. This is an issue specific to this alternative which should be clarified.

Response: See previous response.

Alternative 4 would involve the applicant negotiating for the "transfer" of existing water entitlements from the SAS. The only specific negotiations described in the DEIS are with Lanihau Properties, LLC who will convert Palani Well No.1 to a production well, construct a 1 mg reservoir and install a 12-inch water transmission line to connect to an existing 16-inch DWS water main. This production well will draw high-level groundwater at maximum pumping capacity of 1.6 mgd.

Completion of this specific system is anticipated sometime in 2011. Pursuant to a well development agreement (agreement) executed between the Board of Water Supply, Lanihau Properties, LLC, West Hawai'i Business Park, LLC and Palani Ranch, Inc this system would be dedicated to the DWS and support the SAS. Lanihau Properties, LLC is entitled to eight-five (85) percent of the maximum pumping capacity of the well, which will be allocated for the development of their properties.

The applicant seeks to negotiate with the DWS and Lanihau Properties, LLC for the "transfer" of their water entitlements to support this project. The success of these negotiations however, seem to be dependent on Lanihau Properties, LLC scaling down or abandoning the planned developments of their lands. Based on the

information available to us at this time, OHA sees the viability of this alternative as another uncertainty.

Response: This alternative has been dropped.

Alternative 5 would simply connect to the SAS to obtain the potable water the project requires. The DWS has already informed the applicant that the SAS cannot support this project. Unless the DWS has changed their position, OHA does not view Alternative 5 as a realistic option.

Response: This alternative has been dropped.

Alternative 6 would employ a combination of all five alternatives under consideration. The applicant believes that this alternative will result in "no additional environmental or ecological impacts". OHA agrees that if a combination of all alternatives were employed there would be no additional impacts, but the actual extent of the direct, cumulative and secondary impacts of each alternative currently under consideration have not been identified at this time.

Response: This alternative has been dropped.

Wastewater

The Kona CDP mandates the expansion of the Kealakehe Wastewater Treatment Plant (KWTP) and the development of a new wastewater treatment plant that to the extent possible, will utilize a "natural treatment system" (new WTP) to accommodate projected wastewater volume from the Urban Area. The applicant acknowledges that the timeframe for completing the KWTP expansion and the development of a new WTP are unknown. Thus, the discussion that the applicant will collaborate with the County of KWTP expansion or the development of a new WTP is moot when considering the project's timeframes. The County-Department of Environmental Management has already informed the applicant that the current capacity of the KWTP cannot accommodate this project.

Response: The County Department of Environmental Management (DEM) has indicated that the Kealakehe facility is not available for Kaloko Makai, therefore an on-site WWTP is the preferred alternative. The Petitioner will continue to consult with DEM and if other alternatives arise in the process.

OHA views the development of an on-site private wastewater treatment plant (project WTP) to accommodate the average wastewater flow of 2.2 mgd and design peak wastewater flow of approximately 12.2 mgd that this project will generate as a necessity. We do seek an explanation on what accounts for the difference between

average and design peak wastewater flow, as the 10 mgd difference is a significant amount of wastewater.

Response: The design average and design peak flow is based upon local wastewater standards and common practice.

We applaud the applicant for proposing to utilize technologies at the project WTP that will provide recycled (R-1) water for general irrigation within the project in accordance with DOH requirements. We are immediately alarmed however, at the applicants acknowledgement that in the first phase of the project "there will likely not be enough R-1 water to irrigate the parks and schools that are slated for construction". We request clarification on how this issue will be addressed and question whether it means the project's potable water demands are actually higher than current estimates. Furthermore, the applicant is aware that the DOH restricts the use of R-1 water above the underground injection control (UIC) line and thus, R-1 water will only be used for irrigation in the portion of the project below the UIC line. OHA requests clarification whether this is a second issue which may result in an increase in potable water demand estimates.

Response: Initially, Phase 1 will not likely generate enough R-1 water to irrigate the parks and schools, however when the project is completed R-1 waste may exceed demand. SCD will work with other nearby landowners on the use of the possible excess R-1 water. The Petitioner confirms that, currently, R-1 water can only be applied to lands located makai of the UIC line. Most of the project site lies makai of the UIC line.

It is unclear whether the project WTP will be equipped with specific technologies to accommodate waste from the light industrial and commercial elements of the project and in the event the regional hospital facility is built, medical waste. This is an issue that should be addressed.

Response: If and when a hospital is constructed, the hospital developer and operator will work to mitigate wastes produced by development and operation of the hospital.

At full build-out of the project, R-1 water availability may exceed irrigation demands during periods of extended wet weather and the project WTP will employ percolation basis to dispose of excess R-1 water. The applicant has concluded that this use of percolation will not adversely affect overall groundwater quality, or more specifically the resources of Kaloko Honokahau National Historic Park. We question this conclusion, as the geology (extremely porous aa lava) of Kona which accommodates the disposal of significant volumes of water in relatively small percolation basis also

implies that there is very little natural filtration of contaminants and nutrients before this water quickly reaches the basal lens and enters near shore marine waters.

Response: The 2012 report by Tom Nance Water Resource Engineering specifically addresses this comment. Its resulting analysis, summarized in Table 4 of the report, quantifies the following changes to basal groundwater flowing into Kaloko-Honokohau National Historic Park: a 6.2% increase in the flowrate; a -5.1% decrease in salinity; a 5.2% increase in nitrogen; and a 2.1% increase in phosphorus.

The U.S. Environmental Protection Agency (EPA) and U.S. Department of Commerce-National Oceanic and Atmospheric Administration (NOAA) have jointly published guidance on the types of management measures designers of onsite disposal systems (OSDS), such as a WTP should consider. One of the core objectives of this guidance is to ensure OSDS "are not installed in areas where soil absorption systems will not provide adequate treatment of effluents containing solids, phosphorus, pathogens, nitrogen, and nonconventional pollutants prior to entry into surface waters and ground water (e.g., highly permeable soils, areas with shallow water tables or confining layers, or poorly drained soils)". This guidance also specifically recommends consideration of factors such as soil type, soil depth, rate of sea level rise, depth to water table and topography to ensure the discharge of pollutants into groundwater is reduced to the extent practicable.

Response: The portion of R-1 treated wastewater that will be reused for irrigation will take advantage of the natural consumption of nutrients by plant uptake and the natural nutrient removal in the unsaturated lavas for the portion of the applied R-1 effluent that moves below the plant root zone. For the fraction of the R-1 effluent that cannot be reused for irrigation on the project site, the preferred alternative is to provide that supply for other irrigation uses nearby. If and when necessary, the amount that cannot be reused for irrigation would be disposed of in onsite injection wells.

DAR has already informed the applicant that they view this project as a coastal development with "substantial potential to impact marine water quality and coastal ecosystems". The introduction of nutrients and contaminants into groundwater and near shore marine waters through excess effluent disposal or percolation of R-1 water irrigation within the project must be thoroughly evaluated so that appropriate mitigation can be developed.

Response: The impact assessment in the 2012 report by Tom Nance Water Resource Engineering, which was not available for the initial published EIS, does contain a detailed analysis of the use and disposal of R-1 effluent.

OHA advocates that in addition to designing project WTP elements pursuant to State DOH standards, EPA and NOAA guidance must be considered. Furthermore, the applicant should be required to proactively develop a groundwater monitoring plan in coordination with all stakeholders as the data obtained will directly contribute to short and long term efforts to protect overall groundwater quality in Kona.

Response: The project will develop and implement a groundwater monitoring program to detect possible changes in groundwater quality so that mitigation measures, if appropriate, can be implemented.

Drainage

Again, the same geology of Kona which allows for rainfall, and storm and irrigation waters to quickly percolate also implies that there is very little natural filtration of contaminants and nutrients before this water quickly reaches the basal lens and enters near shore marine waters.

A system of catch basins, drain lines and drywells will dispose of storm and irrigation waters which do not percolate naturally in natural or landscaped areas. The project area will be particularly vulnerable to storm waters during initial mass grading, stockpiling and excavation prior to the development of drainage infrastructure. We will rely on assurances that the applicant will adhere to all DOH and County requirements during initial project development. The construction and post-construction best management practices which will be employed are critical in contributing to the protection of overall groundwater quality and near shore marine resources.

Response: The Petitioner will adhere to all State DOH and County requirements during construction and post-construction and will implement best management practices to minimize impacts to groundwater and near shore marine resources.

The EPA and NOAA have also jointly published guidance on the three basic mechanisms employed to treat urban runoff- infiltration, filtration and detention. This guidance notes that standard infiltration systems may not be appropriate where groundwater requires protection and that certain restrictions may also apply to using infiltration systems located above "sole source drinking water aquifers".

Response: The underlying groundwater is not a sole source aquifer. Rather, it is a brackish basal aquifer that is far too salty for irrigation use. Its primary value is for the biota in the Kaloko-Honokohau National Historic Park's anchialine ponds and in the nearshore makai environment. The project's

potential impact on these uses of the groundwater is assessed in the 2012 report by Tom Nance Water Resource Engineering.

A pollution prevention plan (PPP) will be developed and we offer our general support that mitigation of "contaminated surface water can be achieved through the development of a PPP designed to address all pollutants associated with the development.... To prevent any release into the environment, including the groundwater." This is an important recognition and we appreciate the applicant's commitment that "no grading activity will take place" until the PPP has been prepared. OHA advocates that this PPP be developed pursuant to DOH standards and in consultation with all stakeholders. Consideration should also be afforded to EPA and NOAA guidance that results in the development of infiltration, filtration and detention mechanisms that employ the best available science and technology to provide protection for groundwater and near shore marine resources.

Response: The Petitioner is committed to preparing a PPP prior to construction. The PPP will be prepared in consultation with appropriate State and County agencies.

Water Conservation

The applicant's consideration of incorporating State-Office of Environmental Quality Control and U.S. Green Building Council-Leadership in Energy and Environmental Design guidelines relative to water conservation into project design concepts and utilizing native plant species adapted to the project area in project landscaping design is appropriate and appreciated.

Given the issues relative to the water demands of this project facing the applicant, their commitment to strategies "to reduce consumption, conserve resources and minimize water use" is also appropriate. It is surprising that the applicant is only "considering" specific measures to facilitate end-user water conservation such as: water restrictions during extended dry weather periods, education and efficient landscaping practices. OHA sees these types of specific measures as a necessity and we advocate the applicant commit to them.

Response: In the design and construction of Kaloko Makai, SCD – TSA Kaloko Makai, LLC will implement feasible measures to promote energy conservation and environmental stewardship, such as the standards and guidelines promulgated by the US Green Building Council, the United States Environmental Protection Agency (EPA) ENERGY STAR Program or other similar programs. Additionally, the forthcoming Second DEIS includes a Sustainability Plan.

Conclusion on Water

The applicant has clearly exerted considerable effort to avoid drawing groundwater from the traditional basal lens of the Keauhou ASYA. To a certain extent, these efforts appear to be a laudable attempt to recognize the need for developing alternatives to provide potable water and reduce the pressure on our precious and limited groundwater resources. More specifically however, these efforts seem to be directed at the National Park Service (NPS) who has consistently expressed concerns relative to overall groundwater quality and discharge, and how the fishponds wetlands, anchialine ponds and approximately 627 acres of near shore marine waters within the Kaloko-Honokohau National Historic Park are or will be affected by this project and the overall development of Kona CDP elements.

Unfortunately, OHA views the end result of these efforts as ambiguity and uncertainty within the DEIS that contradicts the core intent of the Chapter 343, HRS process-informed decision making. We do not see how any reviewer of the DEIS, including the LUC or any other government agency can comprehensively assess the true impacts of the alternatives under consideration to develop potable water. OHA must establish the position that the applicant's ability to provide for the potable water needs of the project and adequately mitigate the impacts of the project on the overall groundwater quality are both clearly unresolved issues at this time.

Response: The 2012 assessment by Tom Nance Water Resource Engineering has been added to the EIS to address the concerns you raised in this comment.

OHA offers a second traditional saying as our closing comment on water for your consideration: Kekaha wai ole o na Kona - waterless kekaha of the Kona District. While we will not offer any attempt to understand any hidden meanings of this saying, we can only hope that its literal translation does not foreshadow the future of Kona. It is the inherent responsibility of all interested parties and stakeholders to collaboratively work to see that it is not.

The immediate issue relative to water which is facing the LUC and all other government agencies is how you will fulfill your responsibilities to ensure the availability, and protect the quality of a public trust resource which is also essential to the perpetuation of a broad range of traditional and customary practices of the Native Hawaiian people.

Response: The Petitioner acknowledges you closing comment.

Native Dryland Forest Preserve

Approximately 265-acres, constituting one of the largest remaining native dryland forest (dryland forest) areas in the Hawaiian Islands have been identified in Kaloko

Ahupua'a . Of this total, approximately 150-acres are situated within the project area and the applicant is proposing to establish the Kaloko Makai Dryland Forest Preserve (preserve). OHA offers our support for the general concept of establishing the preserve and we applaud the applicant for this proposal.

A variety of "common" native tree species (trees) are situated within the project area, outside of the boundaries of the preserve. These trees may be impacted during land clearing to facilitate the project and the applicant proposes to coordinate as appropriate to harvest them prior to the initiation of project activities so their wood can be used to perpetuate certain traditional and customary practices. OHA also applauds the applicant for this proposal.

Response: The Petitioner appreciates OHA's support.

Habitat Conservation Plan

The U.S. Fish and Wildlife Service (FWS) has identified four (4) native plant species listed as "endangered" (listed species) as defined by the Endangered Species Act (ESA)63 and a single native plant species identified as a "candidate" for listing as endangered (candidate) within the project area. Any species listed under the ESA is automatically afforded protections pursuant to State law.

Two of the listed species and the candidate occur outside of the boundaries of the preserve and preparation of a habitat conservation plan (HCP) is required to support the issuance of a license by the State Board of Land and Natural Resources to allow for the "take" of the listed species resulting from project development. The applicant has prepared a draft HCP. OHA has no objections to the immediate and short term management actions relative to the listed and candidate species which area described in the HCP.

Response: The endangered species hala pepe and 'aiea that are located outside of the dryland forest will be left in place and a 50-foot buffer will be provided, therefore a HCP will not be required.

Nexus Between the HCP and the Ane Keohokalole Mid-Level Highway Project

The HCP repeatedly mentions the Ane Keohokalole Mid-Level Highway Project (midlevel road) 68 and specifically references on-going ESA-Section 7 consultation between the FWS, the U.S. Department of Transportation-Federal Highways Administration (FHWA) and the County due to the affects of the mid-level road on listed or candidate species. In the final environment assessment (FEA) for the mid-level road the FHWA concluded that construction will "not likely adversely affect any listed species known from the Island of Hawaii". The FWS concurred with the FHWA's conclusion.

The applicant emphasizes that no FHWA funding will support the project and suggests that the preserve will be "best served by Kaloko Makai and FHWA working cooperatively to complement each other's management actions rather than to duplicate activities". While this may be true, a review of the management actions described in the HCP make it clear that the FHWA has a significant responsibility in the initial implementation and short term (three-year) management before the applicant's management responsibilities significantly increase. The ability of a reviewer of the DEIS to clearly understand the nexus between the HCP and the mid-level road (nexus) is critical in determining whether the overall goals of the HCP are feasible. OHA feels that the instant DEIS does not adequately describe the origin of this nexus and the FHWA's conclusion in the mid-level road FEA causes additional uncertainty. We request clarification on this issue.

Response: The FHWA does not own the land nor are they creating a preserve. The Petitioner is owner of the land and, subject to receiving appropriate land use entitlements, will create the Preserve and the preferred alternative notes various management measures.

The Petitioner will preserve 150-acres of the Kaloko Makai Dryland Forest. A variety of endangered and candidate species will have continued protection and their habitats set aside in perpetuity, which will enhance their prospects for survival. Management of the preserve includes weed control and fire management.

The reason the Petitioner is not conducting management actions at the same time as FHWA is that, essentially, the Petitioner would be duplicating efforts for the same plants, in the same location, at the same time. This would be unnecessary and a wasteful expenditure of conservation management funds.

The reason the Petitioner is following FHWA's management actions (after their approximate three years of management of the site,) is that FHWA is required to expend their funds (set aside for the Ane Keohokālole Highway project) by 2015 and are not able to spend any funds after that deadline. The species and habitat of the Kaloko Makai Dryland Forest Preserve will be best served by the Petitioner and FHWA working cooperatively to complement each other's management actions rather than to duplicate activities.

Traditional and Customary Practices relative to Native Species within the Project Area

A participant in the interviews conducted to support the project's cultural impact assessment (CIA) specifically referenced the practical use of the ESA candidate,

ko'oko'olau within the preserve: ... the ko'oko'olau plant is in the project area. The only place you'll find the plant. If they develop it, please get the seeds, and use it as part of landscaping when doing it. The plant is used for tea, better than Lipton and Earl Grey. You have to watch for this plant, because this is the only area that has it and collect the seeds...

This statement may indicate that Native Hawaiians are actively accessing the project area to exercise traditional and customary gathering rights. The kookoolau within the project area are found outside of the preserve and "will be removed". The HCP proposes actions within the preserve to mitigate the loss of this native plant due to the development of the project, but it does not address the specific issue of it being actively gathered.

The limited distribution of kookoolau outside of the project combined with the possibility that access to the lands they are situated on is restricted, means this project may directly affect the traditional and customary practices of the Native Hawaiian people, as we will no longer be able to gather this specific resource.

Response: The Cultural Impact Assessment for this project makes reference to the medicinal use of ko'oko'olau (Bidens spp.) on pages v, vi, 60, 61, 72, 76 & 78 and recommends preservation of remaining areas of lowland forest in the project area containing several endangered and threatened native species, including ko'oko'olau.

Existing ko'oko'olau within the Preserve will be managed through creation of the 150-acre Kaloko Makai Dryland Forest Preserve. Ko'oko'olau, as well as a variety of endangered and candidate species within the Preserve, will have continued protection and their habitats set aside in perpetuity, which will enhance their prospects for survival. Management of the 150-acre Kaloko Makai Dryland Forest Preserve, includes weed control and fire management.

The Petitioner looks forward to working with OHA on the appropriate harvesting of the ko'oko'olau for traditional and customary practices of the Native Hawaiian people within the Kaloko Makai Dryland Forest Preserve.

General Comment on Dryland Forest

In traditional and early-historic times, a dryland forest was a source of valuable resources ranging from food and medicine to raw material for a variety of uses. Sadly, published reports describe that approximately 90% of the dryland forests in the State of Hawai'i have been lost due to the impacts of modern development, wildfire, and introduced animal and plant species. On the Island of Hawai'i, on-going restoration efforts at two specific locations outside of this project provide strong indications that

our dryland forests can get on the road to recovery. In Ka'upulehu, the members of the North Kona Dry Forest Working Group (DFWG) are patiently developing techniques which have been proven successful in an initial 6-acre pilot project and are now being applied in a larger 70-acre project. In Kealakehe, the State Department of Hawaiian Home Lands (DHHL) has implemented a plan to establish and manage dryland forest preserves at the "Villages at La'i'Opua" that contain both listed and candidate species.

The Kaloko dryland forest has been long recognized as being in good condition due to certain natural factors (rugged lava) which have acted as a deterrent to usual threats such as fire and introduced animal and plant species. In addition to ESA listed and candidate native plant species, botanical surveys identified at least 24 additionally native trees, shrub and plant species (native species) within the project area. With the exception of pili, all of these additional native species are present within the dryland forest and the boundaries of the preserve.

Response: Native trees, shrub and plant species (native species) within the Preserve will have continued protection and their habitats set aside in perpetuity, which will enhance their prospects for survival. Creation and management of the 150-acre Kaloko Makai Dryland Forest Preserve, includes weed control and fire management.

Comprehensive Management of the Preserve

The preserve is identified as an unresolved issue in the relatively narrow sense of the HCP being dependent upon the applicant receiving all necessary entitlements, permits and funding. OHA views the importance of the preserve in a context which extends beyond the HCP and sees the comprehensive management of the preserve as a resource for current and future generations as an unresolved issue. We do not want to see the preserve only recognized for its botanical value and become inaccessible to our community. The variety of native species within the preserve may not be immediately available for use in the perpetuation of traditional and customary practices, but a management objective of the preserve should be that they all eventually one day will be.

Response: As stated above, The Petitioner looks forward to working with OHA on the appropriate harvesting of the ko'oko'olau for traditional and customary practices of the Native Hawaiian people within the Kaloko Makai Dryland Forest Preserve.

When considering that at full build-out, two elementary and a middle school (schools) may be developed within the project area, there is a possibility that the preserve could be incorporated into the educational curriculum of the schools as a "living classroom". The educational potential of the preserve extends to all generations as

project residents and those from neighboring communities could have the opportunity to actually see native species within a natural ecosystem and understand their uses in perpetuating traditional and customary practices. Programs that collaborate with the on-going efforts at Ka'upulehu and Kealakehe could be considered.

Response: The Petitioner acknowledges and concurs with the educational potential of the preserve. The trail system within the Kaloko Makai Dryland Forest Preserve will allow it to be accessed by residents and visitors and afford opportunities to educational programs as well. Appropriate signage will also be developed to encourage public cooperation and discourage trespassing, vandalism or arson within the Kaloko Makai Dryland Forest Preserve

Archaeological studies have identified at least two trail segments (trails) which extend through the preserve. We encourage the applicant to fully explore the possibility of whether these trails can be used for community access through the preserve. This could promote both educational and recreational opportunities within the preserve, and also foster pedestrian connectivity to other areas within the project and surrounding areas to which the project area is traditionally and culturally connected to.

Response: There are two trails that start near the same point on Hina Lani; one is an old stepping stone trail that leads mauka and the other runs across the Kaloko Makai Dryland Forest.

These trails are intended to be open for public use.

In addition, the land use plan for Kaloko Makai includes a school and park at the end of one of the trails so residents within the project will be able to walk to and from school via the trail. The other trail will connect to a public street and will allow people easy access to the trail.

The nature of the Kaloko Makai Dryland Forest and the reason it appears to be in the good shape is because it is rough and inhospitable a'ā flow. Over the years, even animals such as cattle and goats did not go in this area because it is so rough.

The trail system within the Kaloko Makai Dryland Forest will allow it to be accessed by residents and visitors and afford the ability for educational programs as well. Appropriate signage will also be developed to encourage public cooperation and discourage trespassing, vandalism or arson within the Kaloko Makai Dryland Forest Preserve.

If the applicant's petition to the LUC is successful and the DBA granted, the applicant will seek to subdivide the preserve into a single tax map key (TMK) parcel through the applicable County processes. OHA requests that the applicant consider incorporating a restrictive covenant or condition into the property deed which confirms that the eventual TMK parcel which will encompass the preserve shall remain undeveloped and that appropriate access shall be provided in perpetuity.

Response: OHA's request for the incorporation of a restrictive covenant or condition into the property deed will be forwarded to the Petitioner for consideration.

Conclusion on Dryland Forest

Overall, OHA reaffirms our support and appreciation for the applicant's proposal to establish the preserve and we look forward to seeing it achieve its full potential as it will one day stand as a priceless kipuka once the urban development elements of the Kona CDP are completed. We encourage the applicant to work with all appropriate parties to develop a comprehensive plan to guide the management of and appropriate access to the preserve into the future.

The immediate unresolved issue that must be addressed is the affect this project will have on traditional and customary gathering rights with the removal of the ko'oko'olau. It is unknown at this time whether other native plant species within the project area or preserve are actively being gathered and utilized.

Response: As stated above native trees, shrub and plant species (native species) including ko'oko'olau within the Preserve will be managed through creation of the 150-acre Kaloko Makai Dryland Forest Preserve. These species will have continued protection and their habitats set aside in perpetuity which will enhance their prospects for survival. Creation and management of the 150-acre Kaloko Makai Dryland Forest Preserve, includes weed control and fire management.

Additionally, the two trail systems within the Kaloko Makai Dryland Forest will allow it to be accessed by those practicing traditional and customary gathering rights within the Kaloko Makai Dryland Forest Preserve.

Although the Cultural Impact Assessment for this project makes reference to the medicinal use of ko'oko'olau (Bidens spp.) on pages v, vi, 60, 61, 72, 76 & 78, it does not identify any other native plant species within the project area or preserve that are actively being gathered and utilized.

Chapter 6E, Hawaii Revised Statutes

The applicant has prepared an archaeological inventory survey (AIS) and submitted it to the State Department of Land and Natural Resources-State Historic Preservation (SHPD) for review. At this juncture, SHPD has provided no comments on the AIS. The applicant views this as an unresolved issue. OHA agrees that this is definitely an unresolved issue, but in a much broader sense that extends beyond the submission of the AIS to the SHPD for review and comment.

Pursuant to Chapter 6E-42(a), HRS, prior to an approval any agency or officer of the State must provide the SHPD an opportunity for review and comment on the effect a project will have on historic properties. This is a critical point, as we view the first "approval" relative to this project as the LUC's acceptance of the environmental impact statement. If the LUC is depending on the SHPD to determine an adequate level of effort to identify historic properties within the project area, appropriate significance assessments for identified historic properties and warranted mitigation measures via the Chapter 6E, HRS process (process), then this process should be completed before the LUC accepts the environmental impact statement.

Response: SHPD is a critical party in reviewing and commenting on the reports as part of the overall compliance with Chapter 6E, HRS. The Petitioner will continue to follow up with SHPD regarding their review.

The vast majority of the historic properties identified and documented in the AIS are resources of potential cultural and religious significance to the Native Hawaiian people. This emphasizes that an assessment of the potential impacts this project will have on these resources, and the relative traditional and customary practices or religious beliefs of the Native Hawaiian people is dependent on the LUC reviewing documents which are the product of the completed process. Consideration must also be afforded to a myriad of existing archaeological and ethnographic studies related to the project area to place it within a larger traditional and cultural landscape.

OHA is concerned that issues relative to the project AIS and overall compliance with Chapter 6E, HRS and implementing Hawaii Administrative Rules (HAR) will remain unresolved as the Chapter 343, HRS moves forwards towards completion. If this concern becomes a reality, OHA does not see how the LUC, or any government agency can fulfill your constitutional or statutory responsibilities to the Native Hawaiian people, as simply relying on the submittal of the AIS to the SHPD for review and comment fails to do so.

The project AIS is comprised of seven volumes. Five volumes constitute the archaeological inventory surveys (surveys) of the tax map key (TMK) parcels which encompass the project area. A sixth volume has been prepared to summarize the

findings of the surveys. The seventh volume is an archaeological assessment (assessment) of a portion of the eighteen (18) acre site which may be utilized for the development of off-site wells to provide for the project's potable water needs.

Five (5) TMK parcels encompass the project area, but only four (4) surveys have been prepared. It appears the survey which was prepared for TMK Parcel (3) 7-3-009:028 includes the immediately adjacent 46.869-acre TMK Parcel (3) 7-3-009:063. Please clarify whether our understanding of this issue is correct, as it will account for all 5 TMK parcels listed in the DEIS.

Response: All TMK parcels are included in the AIS reports. The archaeological inventory survey for the Kaloko Makai project area consists of 7 bound hard copies. AIS for 7-3-009: 017 consists of 1 volume 7-3-009: 025 consists of 2 volumes; 7-3-009: 026 consists of 3 volumes; and 7-3-009: 28 consists of 1 volume. A portion of parcel 28 was later subdivided and became parcel 63. The AIS for parcel 28 covers parcel 63. CSH also prepared an archaeological assessment for the off-site potable well field in 2011. There are a total of 8 volumes for the overall Kaloko Makai project.

The assessment identified no historic properties within an approximately 3.44 acre area south of Hina Lani Street. It appears that the remaining acreage north of Hina Lani Street which may be utilized for the development of off-site wells was subject to an archaeological survey separate (separate survey) from the project AIS. This separate survey identified 89 sites distributed on multiple tax map key parcels. Seven of these sites were subject to a preservation plan approved by SHPD. Four of these preserve sites are on the tax map key parcel north of Hina Lani Street where the off-site wells will be developed, but their locations are not depicted or described in the DEIS. OHA also requests clarification on this issue.

Response: The preferred alternative is for an on-site well site.

<u>Significance Criteria</u>
State Law defines the five criteria (criteria) used in assessing the significance of historic properties. The first four criteria mirror those used at the federal level in assessing National Register of Historic Places:
Criterion "A"- associated with events that have made an important contribution to the broad patterns of our history;
Criterion "B"- associated with the lives of persons important in our past;
Criterion "C"- embody the distinctive characteristics of a type, period, or method of construction or represent the work of a master, or possess high artistic value;
Criterion "D"- has yielded, or is likely to yield, information important for research on prehistory or history.

The fifth criterion is the key exception found in State law:
Criteria "E"- has an important value to the native Hawaiian people or to another ethnic group of the state due to associations with cultural practices once carried out, or still carried out, at the property or due to traditional beliefs, events or oral accounts- these associations being important to the group's history and cultural identity.

This definition is extremely broad. When considering the dominant role religious beliefs had in shaping traditional Hawaiian society and guiding the daily activities of all classes of people, in a very general sense, any historic property associated with the native Hawaiian peoples has religious or cultural significance.

Response: The Petitioner agrees that the "fifth criterion" "E" "associations being important to the [ethnic] group's history and cultural identity" (HAR 13-275-6(b) (5) can be interpreted as extremely broad. There has been some general agreement that burials and religious historic properties are more appropriate for significance nomination under "Criterion E" than, say, agricultural sites. Criterion E has been assigned commensurate with prevailing norms. The concurrence of the SHPD is required before significance is finalized. The SHPD is the final arbiter of significance.

The pattern and practice of archaeology in Hawaii which OHA sees today is that contracted consultants are determining what significance an identified site ahs to the Native Hawaiian people from an archaeological perspective. The project AIS identified a total of 341 historic properties (sites) comprised of 658 features. The vast majority of these sites are assigned a "pre-contact age" and associated with the Native Hawaiian people. We are disappointed to see that the applicant's archaeological contractor has assessed so many of these sites as significant only under criteria "D".

Response: Significance criteria (HAR 13-275-6 (b) are very specific. Assessment of significance was carried out with care (67 sites were designated as significant under multiple criteria). The project area was indeed rich in archaeological resources. However, because the project area is well back from the coast, was always somewhat "rural", and is relatively poorly watered there were few sites that could be associated with events or broad patterns of history (Criterion A), that could be associated with specific persons (Criterion B), or that showed distinctive characteristics or represented the work of a master (Criterion C).

OHA's position is that any site identified in an AIS that is associated with the Native Hawaiian people is automatically "significant" under Criterion "E". While this position will not result in OHA advocating for the preservation of every site assigned

cultural or religious significance to the Hawaiian people, it is the foundation of our advocacy that it is the Native Hawaiian people who have the responsibility to determine the significance of the tangible reminders of ka ike o ka poe kahiko (the knowledge of the ancestors).

Response: The Petitioner understands OHA's position that "Criterion E" should be applied to all pre-Contact, Native Hawaiian historic properties. The SHPD's acceptance of the AIS is required before significance is finalized. The SHPD is the final arbiter of significance. In the past, the SHPD has not taken the position that all pre-Contact, Native Hawaiian historic properties are significant under Criterion E.

Proposed Mitigation

Of the 341 total sites identified in the project area, the applicant is proposing that seventy-two (72) be preserved, eighty (80) be subject to data recovery and "no further work" for one hundred eight-nine (189). At this time, OHA has been unable to comprehensively review the descriptions or contextual information to provide specific comments on the proposed mitigation for every identified site at this time. We do offer general comments on the proposed mitigation for every identified site at this time. We do offer general comments on the proposed mitigation to emphasize our position that the unresolved status of the Chapter 6E, HRS process inhibits the ability to assess the impacts of this project on the resources, and the traditional and customary practices of the Native Hawaiian people.

Response: The Petitioner acknowledges that OHA was unable to provide specific comments on the proposed mitigation for each identified site and general comments were provided.

SHPD is a critical party in reviewing and commenting on the reports as part of the overall compliance with Chapter 6E, HRS. The Petitioner will continue to follow up with SHPD regarding their review.

Thirty (30) of the sites proposed for preservation are burials. Pursuant to State law, the Hawaii Island Burial Council (HIBC) has the statutory authority to render a determination of preservation in place or relocation for these burials and make recommendations to the SHPD on short and long-term mitigation measures. The HIBC considers the views of recognized lineal and cultural descendants in determining burial treatment. The DEIS and project AIS contains no discussion on the status of consultation with lineal and/or cultural descendants and the impact this project will have on traditional and customary practices and beliefs associated with these specific burials is completely unknown at this time.

Response: The Kaloko Makai project team is fully committed to addressing the previously identified Native Hawaiian burial sites as per HAR 13-300-33 in consultation with the Hawaii Island Burial Council, the State Historic Preservation Division and any recognized cultural and/or lineal descendants. The Kaloko Makai project team looks forward to moving forward with consultation following SHPD acceptance of the archaeological inventory survey report(s).

The data recovery of eighty (80) sites will be conducted pursuant to a plan developed in accordance with State law. This plan will identify a research objective which will be addressed through the data recovery effort. The applicant has proposed six (6) possible data recovery research objectives (objectives). OHA views all of these proposed objectives as having a possible impact on the traditional beliefs of the Native Hawaiian people, but OHA and other parties will not be able to provide substantive comments until an objective is selected, a plan developed and the results of data recovery published in a report.

Response: It is understood that OHA will not be able to provide substantive comments regarding data recovery until data recovery objectives are selected and a data recovery plan developed. The Kaloko Makai project team looks forward to consultation with OHA on the data recovery plan. The development of data recovery plan(s) will have to await SHPD acceptance of the archaeological inventory survey report(s).

OHA appreciates the applicant's acknowledgement of community concerns relative to an extensive network of traditional and historic trails which extend throughout the project area. The mauka-makai Kohanaiki Trail, which historically extended continuously from the Kohanaiki Homesteads (mauka of the project) to the coastal lands now managed by the NPS is of specific concern. It is important to note, that the significance and practical use of these trails are not from the distant past, as there are members of our community with us today who utilized these trails in their lifetimes. The NPS and DLNR-Na Ala Hele Program have expressed a specific interest in ensuring that mauka-makai trails extending through the project area maintain connectivity to surrounding areas which have a traditional or cultural connection. While certain mitigation measures relative to trails have been proposed, it is unknown whether they are adequate in addressing community concerns or will be approved by regulatory agencies.

Response: The project team shares OHA's concerns for the mauka-makai Kohanaiki Trail and has been working with the NPS towards the preservation of this trail alignment. We look forward to continuing consultation with OHA as plans progress.

Request for Additional Information relative to Site 20720

It is our understanding that a 1996 archaeological study, which included the project area identified eight possible burial sites. The project AIS conducted testing of these possible burial sites. This testing resulting in five sites being confirmed as "non-burial" and two sites as "probable burial". The eighth site (Site 20720) was "determined to have been destroyed". OHA requests additional information on the circumstances which led to the destruction of Site 20720, as this matter may require an investigation into possible violations of Chapter 6E, HRS.

Response: Historic Property SIHP 50-10-27-20720 was identified in Collin et al. (1996:84 & 88) draft study in TMK 7-3-009:017 just north of Hinalani Road as a terrace and possible burial. Cultural Surveys Hawaii's Bell et al. (2008:147) study details our repeated effort to relocate this site and concluded: "All that remains in this likely location of site -20720 is a pile of boulders and a remnant tumulus bedrock. As a result of these observations, all lines of evidence indicate this site has been destroyed. The outcrop appears to have been almost entirely destroyed by heavy machinery and is located near the end of a fan-shaped bulldozed area originating at Hina Lani and approximately 30 m (98.4 ft.) in diameter. This bulldozing is believed to have occurred between 1996 and 2008 but by whom and why is unclear.

Site 26452

Site 26452 is described as a lava tube which is accessed through an opening within the project area, but extends outside of the project area where at least eight (8) confirmed burials have been identified. OHA recognizes that the applicant cannot propose mitigation for portion of the lava tube outside of the project area. We do hope that the applicant and neighboring landowner will collaborate to propose mitigation measures for the site that are consistent. OHA will also be seeking assurances from the SHPD that the owner of the parcel under which the lava tube extends and the burials are situated has been formally notified of their presence.

Response: As part of the burial treatment plan addressing SIHP # 50-10-28-26452 in TMK parcel 7-3-009:028 documentation will be provided regarding consultation with the owner of the parcel under which the lava tube extends and the burials are situated, documenting that they have been formally notified of their presence and efforts to coordinate burial protection.

Conclusion on Chapter 6E, Hawaii Revised Statutes

OHA views the unresolved issues relative to the Chapter 6E, HRS as inhibiting LUC's and all other government agencies ability to adequately assess the impacts this project will have on the resources, and traditional and customary practices and beliefs of the

Native Hawaiian people. The submittal of the project AIS to the SHPD for review does little to resolve this issue. OHA advocates that the Chapter 6E, HRS process be completed before the LUC takes any action on the environmental impact statement so that the consultation effort which leads to final mitigation measures being approved can be considered by decision makers.

Response: SHPD is a critical party in reviewing and commenting on the reports as part of the overall compliance with Chapter 6E, HRS. The Petitioner will continue to follow up with SHPD regarding their review.

Cultural Impact Assessment

In 2000, the Hawai'i State Legislature found that: [T]he 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 exercise thereof is necessary to ensure the continued existence, development, and exercise of native Hawaiian culture.
The result of this finding was an amendment to the definitions of "environmental impact statement" and "significant effect" contained within §343-2, HRS to now include the terms "welfare" and "cultural practices". The preparation of a cultural impact assessment (CIA), as a technical report to support the findings and conclusions in a Chapter 343, HRS document is how an assessment of the affects of an action on the resources and exercise of the "native Hawaiian culture", along with proposed mitigation to address these affects is usually attempted to fulfill the requirements of this amendment.

With our substantial concerns relative to groundwater, dryland forest and archaeological resources (resources) which are directly related to the perpetuation of traditional and customary practices (practices) and beliefs of the Native Hawaiian people in mind, OHA respectfully concludes that the project CIA is woefully inadequate. The mitigation measures proposed as a result of the CIA, while appreciated are elementary when considering the substantial and long term impacts this project could have.

Outside of the amendments to Chapter 343, HRS and a CIA, the Hawai'i Supreme Court established a specific analytical framework in order for the LUC to complete a proper analysis of the impacts of a given action on Native Hawaiian resources, beliefs and traditional and customary practices. This judicial guidance applies to all State and county agencies and requires an agency to:
(1) Identify and scope of "valued cultural, historical, or natural resources" in the petition area, including the extent to which traditional and customary native Hawaiian rights are exercised in the petition area; (2) Extent to which those resources-

including traditional and customary native Hawaiian rights- will be affected or impaired by the proposed action; and (3) Feasible action, if any, to be taken by the [agency] to reasonably protect native Hawaiian rights if they are found to exist.

As we have already mentioned, the unresolved issues related to resources inhibits all agencies', including the LUC's, ability to apply this framework and complete a sufficient analysis. Considering the clear threat to resources which are essential to the perpetuation of Native Hawaiian traditional and customary practices, OHA hopes that the LUC will agree with our position and require the applicant to provide additional information in order to fulfill your affirmative duty to protect the reasonable exercise of traditional and customary rights.

Response: A good faith effort was made to identify and reach out to kūpuna and kamaʻāina potentially knowledgeable about the project area. A total of twenty-five people were contacted for the purposes of this CIA; 18 people responded; and 12 kūpuna and/or kamaʻāina were interviewed for more in-depth contributions. Reported kamaʻāina interviews are from Mr. Herman Kunewa, Uncle Karin Haleamau, Uncle Arthur Mahi, Mr. Peter Keka, Mrs. Cynthia Nazara, Mr. Duane Keanaaina, Uncle Valentine K. Ako, Kahu Norman Keanaaina and Mr. George Van Gieson. Cultural Surveys Hawaii tried to faithfully summarize the concerns of these kūpuna and safeguard the reasonable exercise of traditional and customary rights.

Public Services and Facilities

The applicant's proposals and commitments relative to public facilities and services are all appreciated as they have the potential to positively impact the North Kona Community in general. When considering that the full build-out of the Department of Hawaiian Homelands (DHHL) Lai Opua residential development in Kealakehe will concentrate a significant Native Hawaiian Population in the region, these facilities and services are of elevated importance to OHA and DHHL beneficiaries.

Response: The above comments have been noted.

Regional Hospital

OHA looks forward to seeing the development of a new regional hospital moving forward on 40 acres of land within the project area the applicant has committed to provide. The need for a new regional hospital is clearly recognized as it will increase accessibility and decrease travel times for the North Kona Community. The Kona Community Hospital in Kealakekua (15 miles south) and North Hawaii Community Hospital (35 miles north) currently service the emergency and trauma needs of this area. We applaud all involved in the effort to develop this much needed facility.

Response: The Petitioner appreciates OHA's support of a new regional hospital within the Kaloko Makai development.

Kona Judiciary Complex

We also applaud the applicant for committing 10 acres of land within the project area for the possible development of the new Kona Judiciary Complex (complex). It is our understanding that the State Department of Accounting and General Services (DAGS) has commissioned a selection study to determine the most viable alternative locations (locations) for the complex. These locations will be comprehensively assessed in a forthcoming draft environmental impact statement prepared by DAGS.

Response: Since the publication of the Draft EIS, DAGS selected Kealakehe as the future site of the Kona Judiciary Complex. The forthcoming Second DEIS has been revised accordingly.

Schools

The State Department of Education (DOE) has informed the applicant that this project will have a "significant impact" on DOE facilities in West Hawaii. The project is within the West Hawaii School Impact Fee District and thus, the applicant is subject to impact land and cash payment fee components (impact fees). The applicant references a July 21, 2011 meeting with the DOE to discuss impact fees, but it is unclear whether the results of this meeting ensure compliance with applicable State laws. This information should be provided in the DEIS.

Response: The discussion on schools has been revised in the forthcoming Second DEIS to include an update on consultations with the State DOE.

Housing

We appreciate that the applicant is committed to providing 700 "affordable" units with pricing to be determined in consultation with government agencies.

A "Social Impact Assessment" (SIA) was prepared as a technical report to support the DEIS. Twenty-four (24) interviewees or "stakeholders" representing a "wide spectrum of beliefs and interests" were deliberately selected to share their thoughts on: issues independent of the project affecting West Hawaii, overall issues specific to the project and specific issues related to project elements. Interestingly, the "affordable housing" criteria established by the U.S. Department of Housing and Urban Development (HUD) and how this criteria affects the community in general, and specifically Native Hawaiians was a prevailing theme during these interviews. The SIA then attempted to determine the extent of "actual inequities" in HUD and County of Hawaii affordable housing guidelines and criteria.

The SIA analysis of the potential "inequities" in affordable housing guidelines and criteria concludes that "all groups ...face serious affordability issues in regard to housing in West Hawai'i (especially North Kona)" and that "Native Hawaiians (and perhaps Filipinos) are particularly challenged in West Hawaii 'due to lower overall incomes that reflect differences in overall education, age, and family structure". This conclusion seems to be ambiguously dismissed by a closing comment on this issue that:

the social challenges facing West Hawai'i will probably have less to do with the fairness of "affordable housing" guidelines than with the soaring prices of market housing. The social impact of the Kaloka Makai project will be positive to the extent that it succeeds in the goal of providing more affordable market housing to working families- a goal that would likely be achieved by greater densities consistent with the Kona Community Development Plan

OHA sees the conclusion and closing statement in the SIA as doing very little to address the concerns of interviewees, or comprehensively assessing any actual inequities in HUD or County of Hawaii affordable housing criteria and guidelines that adversely affect Native Hawaiians. OHA sees the DEIS preparer's outright dismissal of concerns relative to affordable housing expressed by SIA interviewees as a "fleeting fantasy" as extremely alarming. We urge caution in the approach the applicant utilized to discuss this important issue.

Response: The purpose of the Social Impact Assessment (SIA) is to investigate and disclose findings as a basis for assessing the social impacts of the proposed action. While such findings may suggest potential inequities of governmental housing programs, any such perceived inequities would not be an impact of the proposed action. Therefore, the Petitioner has no basis for recommending changes in governmental policy as a mitigation measure for the proposed action.

The forthcoming Second Draft EIS will be revised to state the following:

> *Kaloko Makai will contribute to ameliorating Kona's housing supply issues through (a) market-priced housing aimed primarily at working families rather than off-shore buyers, and (b) 700 "affordable" units with pricing to be determined in consultation with government agencies. These contributions cannot totally reverse the high land and development costs that have kept Hawai 'i among the most expensive housing markets in the nation for the past 50 or 60 years. However, failure to*

> *provide housing supply in pace with increasing demand by local residents would worsen rather than help the overall housing affordability situation.*

Conclusion

The aspects of this project ranging from housing to employment and economic benefits that are offered as "beneficial impacts" must be carefully balanced against the long term vision of the Kona Community and impacts to resources that we must ensure are available for future generations.

As we have already recognized, this project area is consistent with uses described in the County general Plan and is within the Urban Area designated within the Kona Community Development Plan (CDP). Thus the years of planning which went into the CDP, seems to confirm the community's long term vision that this project would one day become a reality.

What the elements of the CDP do not specifically provide for or address however, is how the direct, secondary and cumulative affects of each project will impact our resources and this is the source of our opposition to seeing this project move forward at this time. OHA believes that our review of this DEIS provides adequate evidence that the project will result in adverse impacts to three resources (groundwater, native dryland forest species, and archaeological and burial sites) of importance to the Native Hawaiian people and to a certain extent all of Hawaii. These adverse impacts are both extreme and unresolved and thus, the LUC and other decision makers are unable to fulfill their responsibilities to conduct informed decision making in accordance with constitutional and statutory mandates and judicial opinion.

We believe that these impacts and unresolved issues can be addressed, but it will take a comprehensive and collaborative effort (effort) that involves all stakeholders. We look forward to participating, as appropriate or needed to advocate for the interests of our beneficiaries in this effort. As we await a response, we will caution the applicant that unless the recommended effort is reflected and all concerns of all DEIS reviewers addressed, rather than simply responded to, we will continue to be opposed to this project.

Response: Please refer to our previous responses regarding groundwater, native dryland forest species and archaeological and burial sites. Based on the findings of studies to be included in the forthcoming Second DEIS, we feel that sufficient information is available for the LUC and other decision makers to consider in their deliberations and render an informed decision.

Your letter, along with this response, will be reproduced and included in the forthcoming Second DEIS. We appreciate your participation in the EIS review process.

Sincerely,

Earl Matsukawa, AICP
Project Manager

cc: Mr. Jay Nakamura, Stanford Carr Development
Mr. Daniel Orodenker, State Land Use Commission

FAX TRANSMITTAL SHEET

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DATE: 09/21/2011

FROM: Philip Moravcik
Water Resources Research Center
956-3097

TO: SCD-TSA Kaloko Makai, LLC (Peter Phillips)
537-1801

State of Hawaii Office of Environmental Quality Control (OEQC)
586-4186

State of Hawaii Land Use Commission (LUC)
587-3827

Wilson Okamoto Corporation (Earl Matsukawa)
946-2253

SUBJECT: **Draft Environmental Impact Statement**
Kaloko Makai, Hawaii

No. of Pages: including cover sheet: 8

Water Resources Research Center
Environmental Center

UNIVERSITY of HAWAI'I
MĀNOA

September 21, 2011
RE: 0809

Peter Phillips
SCD-TSA Kaloko Makai LLC
1100 Alakea Street, 27th Floor
Honolulu, HI 96804
VIA FAX TO (808) 537-1801

Dear Mr. Phillips,

Draft Environmental Impact Statement
Kaloko Makai, Hawaii

SCD-TSA Kaloko Makai LLC proposes to reclassify 224.430 acres of land within the state conservation district, and approximately 724.436 acres of land within the state agricultural district, as state urban district land. The purpose of the proposed reclassification would be to construct 5,000 new residential housing units and 120 visitor accommodation units; provide 75 acres of land for light industrial uses; accommodate 25 acres of new commercial space; and construct associated infrastructure and support facilities (including new water sources and a wastewater treatment plant), altogether covering over 1,100 acres in Kaloko and Kohanaiki, North Kona, Hawaii. Future use of the proposed project area could also include up to three public schools, a fire station, a police substation, a hospital/medical center, and a transit station.

This review of SCD-TSA Kaloko Makai LLC's Draft Environmental Impact Statement (DEIS) is a service activity of the University of Hawaii's Environmental Center to help determine and maintain the optimum quality of the environment. It is not intended to represent the official views of the University of Hawaii. The objectives of our review process are to enhance environmental consciousness, encourage cooperation and coordination, and facilitate public participation. These comments were drafted with the assistance of George A. Wilkins (Hawaii Institute of Geophysics, retired), James Beets (UH-Hilo, Marine Science Department), and David Penn, Environmental Center.

General Comments

1. EIS Trigger and Focus

Because the preparation of this DEIS was triggered by the reclassification of Conservation District lands within the project area, we suggest that the FEIS highlight (1) the specific details of the proposed changes to the Conservation District lands, and (2) the potential impact of removing these particular Conservation District lands from their present use, including an assessment of their site-specific function and value as open space under the current General subzone designation.

2. Unresolved Issues

The DEIS identifies several unresolved issues that should be advanced towards resolution in the Final EIS (FEIS). One of the unresolved issues discussed on pages 1-17 to 1-18, State Historic Preservation Division review of archaeological inventory surveys, raises a recurring concern. In general, we suggest that historic preservation consultation with DLNR-SHPD be completed as early as possible in the environmental impact assessment process, preferably before a DEIS is issued. This would maximize the opportunity for disclosure and meaningful public review of potential cultural impacts and proposed mitigation measures within the context of the process governed by Hawaii Revised Statutes Chapter 343.

Throughout the DEIS it is difficult to determine if the footprint for the impact analysis includes the full build-out of public facilities on lands within the proposed project area that would be dedicated for public purposes. Therefore, we suggest that the potential additional impacts of the future construction of schools, fire/police facilities, a hospital, and a transit station may represent an additional unresolved issue that should be more directly addressed in the FEIS, particularly with regard to traffic impacts, water and energy demands, and waste disposal capacity.

3. Cumulative Impacts

In the 37 years that have elapsed since the State of Hawaii first established its EIS requirements, the North Kona region has been subjected to a multitude of environmental impacts and mitigating measures that were identified in accepted EISs. Similarly, the proposed action represents just one set of another multitude of environmental impacts and mitigating measures that may be imposed on the region in the future. Therefore, we suggest that the cumulative impacts analysis in the DEIS be based on a more comprehensive regional, historical approach to the environmental quality of Kaloko, Kohanaiki, and adjacent areas that includes the following components:

1. Compare environmental quality in 1974 with present environmental quality.

2. Identify and quantify the land use changes that occurred from 1974 to present, including a table of completed actions that were the subject of an accepted EIS, and a matrix of anticipated impacts and actual mitigation measures.

3. Compare the size and scope (potential impacts) of all planned actions (including the proposed action) with the cumulative size and scope (actual impacts) of all past actions.

4. Compare the size and scope of the proposed action with the cumulative size and scope of all other planned actions.

For example, in this regard, Table 8-1 of the DEIS would be more useful if it included additional features of planned developments in the project vicinity (e.g. change in impermeable surface)

and provided a cumulative, regional subtotal for each development feature (e.g. number of residential units). This approach would help to clarify the size and scope of the proposed action within the context of past and future changes in environmental quality.

5. Housekeeping

In order to improve the utility of Chapter 1, Introduction and Summary, we suggest that each section of the chapter provide a cross-reference to the portion of the main document that addresses the same content as that section. For example, "Parties Consulted During the EISPN Process," page 1-4, would direct the reader to Chapter 9, Consultation, for the complete discussion of this topic.

Consultation

The comments and responses associated with each consulted party are not indexed or grouped in a manner that would facilitate their readability. For example, although page 9-2 indicates that four programs within the state department of health (DOH) submitted comments, these comments (and responses) are scattered throughout Appendix S, which makes it overly burdensome for the reader to review DOH program comments and responses as a whole. Therefore, in order to better communicate the results of EISPN process, we suggest that the Consultation chapter of the FEIS indicate the pages of the FEIS that document the pertinent communications for each consulted party. We also suggest that the appendix containing the comments and responses organize them so that they are grouped in accordance with the listing presented in the text of the Consultation chapter (e.g. pages 9-1 to 9-3). Typically this is accomplished by providing, in the appendix, a table of contents that lists each commenter and the pages of the appendix that include the associated comment and response letter. We also suggest that the FEIS employ this same mode of organization for comments and responses on the DEIS.

Page Numbering, Bookmarking, and Digital Page Orientation

Page numbering in the paper version of the DEIS is confusing and leads to the appearance of missing pages within the document. For example, Figures 2-11 to 2-14 appear between pages 2-30 and 2-39 on four consecutive, unnumbered, fold-out pages. According to the Table of Contents these figures appear on pages 2-31, 2-33, 2-35, and 2-37, respectively. Therefore, we suggest numbering the pages of the paper FEIS so as to remove all doubt that pages 2-32, 2-34, 2-36, and 2-38 may be missing from the document, consistent with the page numbering in the digital version of the DEIS.

In order to facilitate the readability of the digital version of the FEIS, we suggest (1) detailed bookmarking of the digital document that corresponds with the lowest level of subheadings that appears in the table of contents, and (2) vertical orientation of all pages such that the reader need not rotate a digital page in order to read it onscreen from a normal orientation.

Land Use Allocation

Throughout the DEIS, Kaloko Makai's footprint is billed as "an approximately 1,139 acre" area that also includes a well field of approximately 18 acres of land mauka of the proposed project site. However:

(1) Table 2-6, Estimated Allocation by Land Use Type and Phase, shows a total estimated area of only 1,039 acres;

(2) the numbers in the "Estimated Area" column of Table 2-6 add up to 1,041; and

(3) the total acreage for all land use types indicated in the legend of Figures 2-11 to 2-14 is 1,065.5 acres.

Therefore, we suggest that the FEIS include corrections and additions to Table 2-6, Figures 2-11 to 2-14, and all related content such that the project acreage calculations are more consistent throughout the document, and include the 18 acre well field, along with any additional area that would be required for water transmission from the well field to the proposed project site.

Moreover, the names and acreages assigned to the different land use types shown in Table 2-6 do not match those listed in the legend of Figures 2-11 to 2-14. Again, for the sake of consistency, we suggest corrections and additions to Table 2-6, Figures 2-11 to 2-14, and all related content such that the information presented in Table2-6 is directly comparable with the information presented in Figures 2-11 to 2-14.

Specific Comments:

1. Water sources

Because the DEIS raises the possibility of desalination as a water source solution, we suggest that the FEIS clarify the nature of federal and state regulations with regard to the salinity of water supplied for domestic use. Federal and state regulations do not establish enforceable standards for chloride content in drinking water, they merely include notification requirements for water that exceeds a certain chloride level. In this regard, we also suggest that the FEIS quantify the volume and constituents of the process water that would be generated by desalination, in order to better account for the potential cumulative impact of wastewater, stormwater, and process water injection throughout the proposed project area.

The Draft Groundwater Assessment (Appendix C) notes that "[t]he [Hawaii County Water Use & Development Plan] WUDP acknowledges that there is not sufficient supply to accommodate the worst-case scenario (full build out of land uses . . .)" and "serves to alert decision makers that the current [Land Use Pattern Allocation Guide] LUPAG designations and zoning classifications cannot be supported with existing water resources." Therefore, we suggest that overall impact of the proposed action, and other planned actions, on water resource availability be further disclosed in the cumulative impacts analysis and the alternatives analysis,

such that trade-offs between the water resource impacts and other environmental impacts of all planned future actions can be better addressed in the land use decisionmaking address.

2. Water quality impacts in inland and marine receiving waters

The proposed action would alter pollutant loading dynamics in ways that are insufficiently identified and quantified in the DEIS. Although "[e]ffluent disposal for the Private WWTP shall be in accordance with all applicable laws" (page 3-43), the ultimate effluent disposal method is not entirely clear. Effluent injection and effluent reuse are both lawful disposal methods, but their environmental impacts could differ significantly. Would the proposed WWTP use injection wells, as well as effluent reuse, for effluent disposal purposes, or would it employ reuse only, as implied (but not explicitly stated) in the DEIS? Where and how would the necessary back-up storage capacity for a reuse facility be provided? Would the self-sufficiency of the on-site WWTP include its energy supply?

For analytical purposes, we suggest that the DEIS include greater detail about (1) the location, volume, and content of wastewater inputs and altered stormwater inputs that would be generated by the proposed action, and (2) their transport and fate in the environment. For example, the DEIS states (Groundwater Assessment, p.16) "As the excess irrigation water percolates downward through the unsaturated zone to the groundwater, removal rates of nitrogen and phosphorus from the water will be significant." This statement is meaningless without numbers (goals), rates, and variances. We suggest that the DEIS more thoroughly identify the volume and quality of effluent that would be produced, and the location, timing, and rate of proposed reuse applications. The DEIS states that "estimates of cumulative changes to groundwater from the total assemblage of existing and proposed projects also do not appear to have the potential for alterations to pond or marine habitats." We suggest that the DEIS reference the source of these estimates and of the technical analysis that leads to this conclusion.

Specifically, we suggest that any reinjection scheme proposed for effluent and runoff disposal be very site specific. The injection site would be thoroughly described with regard to characteristics such as location, flow rate, dispersal depth (re sea level), and expected surface emergence locale relative to the shoreline. Under no conditions should this exit point be mauka of the reef (or, say, into ocean depths less than 200 feet). We suggest that piping of R-1 effluent to a point near the shoreline, followed by directional drilling of a sub-seafloor pipe to the final exit point, should be considered as a technologically valid option.

The analysis of water quality conditions, impacts, and mitigation that is presented in the DEIS suffers from several regulatory and administrative mischaracterizations that warrant correction:

(1) The Land Use Commission (LUC) does not have the authority to determine whether or not violations of the state water quality standards have occurred in state waters. Absent a record of a violation notice, declaratory ruling, impairment decision under Clean Water Act Section 303(d), or other official action of the State Department of Health (DOH), we suggest that

the violations of water quality standards previously recorded as LUC Findings of Fact should not be relied upon to determine the regulatory compliance status of receiving waters that would be affected by the proposed action. The principal authority on the water quality status of state receiving waters is the 2006 Water Quality Monitoring and Assessment Report published by DOH. The assessments of other government agencies and private parties are not jurisdictional in this regard.

(2) Some of the receiving waters within the national park boundaries may be more properly classified as class 1.a. inland waters, not class AA marine waters. Moreover, these inland waters may include waterbody types for which specific numeric water quality criteria that regulate conventional pollutants, other than bacterial indicator criteria, do not exist or apply. This implies that a more exhaustive analysis may be desirable in order to evaluate the compliance or noncompliance of the proposed action with the state water quality antidegradation policy.

(3) In many cases DOH is not obligated to review, comment on, accept, or approve the various water quality management proposals that are volunteered by the proponent of the proposed action or that may be required by the LUC. The LUC does not have the authority to require that DOH review, endorse, or otherwise approve water quality monitoring plans, water quality data, water quality assessments, best management practices, pollution prevention plans, etc., even though the LUC typically requires DOH involvement as a condition of approving the proposed action. Therefore, we suggest that the DEIS describe an alternative approach for assuring the adequacy of the proposed water pollution mitigation measures and water quality management programs that would be part of the proposed action.

Overall, we suggest that a more collaborative, regionalized approach to water quality monitoring and assessment be developed and implemented by all of the parties concerned, particularly DOH, LUC, the County of Hawaii, the National Park Service, other landowners, and developers. It would be useful for the DEIS to describe and incorporate the current objectives and status of ongoing University of Hawaii investigations in this area. In particular, we suggest that this monitoring program address the detection of changes in contaminant flows toward the sea along the shorelines of Kaloko National Historical Park and/or Honokohau Harbor. The harbor's mauka third, for example, has well over 1 million gallons of brackish water seaward flow per day, however the magnitude and impact of the pollutant load carried by this flow is currently unknown.

Thank you for considering our comments on this Draft Environmental Impact Statement We hope that our comments will help the Land Use Commission to weigh carefully whether the social benefits of the proposed action would justify the environmental impacts that would likely occur. When the Final Environmental Impact Statement is distributed, please send one printed copy to the Environmental Center.

Sincerely,

P. Moravcik

Philip Moravcik
Water Resources Research Center

cc: State of Hawaii Office of Environmental Quality Control (OEQC)
Chittaranjan Ray, Interim Director, Water Resources Research Center, UH Manoa
Orlando Dan Davidson, State of Hawaii Land Use Commission
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7469-01
July 25, 2013

Mr. Phillip Moravcik
Water Resources Research Center
Environmental Center
University of Hawaii
2500 Dole Street, Krauss Annex 19
Honolulu, Hawai'i 96822

Subject: Draft Environmental Impact Statement (DEIS)
Kaloko Makai
Kaloko and Kohanaiki, North Kona, Hawaii
Tax Map Key: (3) 7-3-09: 017, 025, 026, and 028

Dear Mr. Moravcik:

Thank you for your letter dated September 21, 2011 (RE:0809). The Petitioner is preparing a Second DEIS to address changes in the proposed project that will be reassessed, as needed, in the forthcoming document. You will be notified of its availability for review and comment pursuant to Chapter 343, Hawaii Revised Statutes (HRS) and Title 11, Chapter 200 Hawaii Administrative Rules (Department of Health).

With regard to your comments on the subject DEIS, we offer the following in response to your comments:

General Comments

1. *EIS Trigger and Focus*
Because the preparation of this DEIS was triggered by the reclassification of Conservation District lands within the project area, we suggest that the FEIS highlight (1) the specific details of the proposed changes to the Conservation District lands, and (2) the potential impact of removing these particular Conservation District lands from their present use, including an assessment of their site-specific function and value as open space under the current General subzone designation.

Response: Although the EIS process under Chapter 343, Hawaii Revised Statutes was "triggered" by the reclassification of State Conservation District designated land, there is no requirement under Chapter 343 or its rules under Title 11, Chapter 200 Hawaii Administrative Rules, to single out component(s) of a project for assessment because it is the "trigger." To the contrary, Section 11-200-7 requires

that when components of a project are part of a larger action, they must be treated as a single action.

2. *Unresolved Issues*
The DEIS identifies several unresolved issues that should be advanced towards resolution in the Final EIS (FEIS). One of the unresolved issues discussed on pages 1-17 to 1-18, State Historic Preservation Division review of archaeological inventory surveys, raises a recurring concern. In general, we suggest that historic preservation consultation with DLNR-SHPD be completed as early as possible in the environmental impact assessment process, preferably before a DEIS is issued. This would maximize the opportunity for disclosure and meaningful public review of potential cultural impacts and proposed mitigation measures within the context of the process governed by Hawaii Revised Statutes Chapter 343.

Response: The Kaloko Makai AIS was submitted to DLNR-SHPD on October 30, 2008. To date we have not received comments from them regarding the AIS. We acknowledge that the AIS will not be considered finalized until the AIS is approved by SHPD.

Throughout the DEIS it is difficult to determine if the footprint for the impact analysis includes the full build-out of public facilities on lands within the proposed project area that would be dedicated for public purposes. Therefore, we suggest that the potential additional impacts of the future construction of schools, fire/police facilities, a hospital, and a transit station may represent an additional unresolved issue that should be more directly addressed in the FEIS, particularly with regard to traffic impacts, water and energy demands, and waste disposal capacity.

Response: The DEIS traffic study includes factors for traffic generation by public facilities, as does the preliminary engineering report for water and wastewater demand. The air quality study includes factors for energy consumption by public facilities. Although difficult to separate the impact of the full build-out of public facilities entirely from the rest of the project, Kaloko Makai has made an effort to show the demands in the DEIS and forthcoming Second DEIS. We generally reserve the identification of unresolved issues for areas of discussion for which insufficient information could significantly affect the outcome of an impact.

3. *Cumulative Impacts*
In the 37 years that have elapsed since the State of Hawaii first established its EIS requirements, the North Kona region has been subjected to a multitude of environmental impacts and mitigating measures that were identified in accepted EISs. Similarly, the proposed action represents just one set of another multitude of

environmental impacts and mitigating measures that may be imposed on the region in the future. Therefore, we suggest that the cumulative impacts analysis in the DEIS be based on a more comprehensive regional, historical approach to the environmental quality of Kaloko, Kohanaiki, and adjacent areas that includes the following components:

a. *Compare environmental quality in 1974 with present environmental quality.*
b. *Identify and quantify the land use changes that occurred from 1974 to present, including a table of completed actions that were the subject of an accepted EIS, and a matrix of anticipated impacts and actual mitigation measures.*
c. *Compare the size and scope (potential impacts) of all planned actions (including the proposed action) with the cumulative size and scope (actual impacts) of all past actions.*
d. *Compare the size and scope of the proposed action with the cumulative size and scope of all other planned actions.*
e. *For example, in this regard, Table 8-1 of the DEIS would be more useful if it included additional features of planned developments in the project vicinity (e.g. change in impermeable surface) and provided a cumulative, regional subtotal for each development feature (e.g. number of residential units). This approach would help to clarify the size and scope of the proposed action within the context of past and future changes in environmental quality.*

Response: Neither Chapter 343, HRS nor its implementing rules under Title 11, Chapter 200 HAR require that the baseline for assessing cumulative impact be set at 1974 when Chapter 343 was enacted. In practice, the description of the affected environment generally begins with present conditions and, if relevant, some historic context for those conditions. This establishes the cumulative impacts of past actions in the area. In considering future cumulative impacts, known projects that may cumulatively affect the proposed project's impacts would be discussed or quantitatively included, such as in a traffic study.

The type of study you suggest to assess cumulative impact throughout a region would more appropriately be undertaken by government, such as in conjunction with a community development plan. The Kona Community Development Plan (CDP), for example, took a long view of historic trends and the community's vision for the future. Notably, the Kaloko Makai project is consistent with the Kona CDP, as discussed in the DEIS and the forthcoming Second DEIS.

4. *Housekeeping*

a. *In order to improve the utility of Chapter I, Introduction and Summary, we suggest that each section of the chapter provide a cross-reference to the portion of the main document that addresses the same content as that section. For example, "Parties Consulted During the EISPN Process," page 1-4, would direct the reader to Chapter 9, Consultation, for the complete discussion of this topic.*

Response: The rules for EIS content, under Section 11-200-17 do not require such cross-referencing. Nevertheless, per your suggestions, cross-references will be included in the forthcoming Second DEIS.

b. *Consultation*
The comments and responses associated with each consulted party are not indexed or grouped in a manner that would facilitate their readability, For example, although page 9-2 indicates that four programs within the state department of health (DOH) submitted comments, these comments (and responses) are scattered throughout Appendix S, which makes it overly burdensome for the reader to review DOH program comments and responses as a whole, Therefore, in order to better communicate the results of EISPN process, we suggest that the Consultation chapter of the FEIS indicate the pages of the FEIS that document the pertinent communications for each consulted party. We also suggest that the appendix containing the comments and responses organize them so that they are grouped in accordance with the listing presented in the text of the Consultation chapter (e,g, pages 9-1 to 9-3). Typically this is accomplished by providing, in the appendix, a table of contents that lists each commenter and the pages of the appendix that include the associated comment and response letter, We also suggest that the FEIS employ this same mode of organization for comments and responses on the DEIS.

Response: The rules for EIS content, under Section 11-200-17 do not require such indexing. Nevertheless, per your suggestion, the comment and response letters will be organized in accordance with the listing presented in the text of Chapter 9 Consultation in the forthcoming Second DEIS. Adding the page number to the letters in the Appendix is not practical since revisions requiring re-pagination frequently occur as the document is being finalized. This would require multiple repagination.

c. *Page Numbering, Bookmarking, and Digital Page Orientation*
Page numbering in the paper version of the DEIS is confusing and leads to the appearance of missing pages within the document. For example, Figures 2-11

to 2-14 appear between pages 2-30 and 2-39 on four consecutive, unnumbered, fold-out pages, According to the Table of Contents these figures appear on pages 2-31, 2-33, 2-35, and 2-37, respectively. Therefore, we suggest numbering the pages of the paper FEIS so as to remove all doubt that pages 2-32, 2-34, 2-36, and 2-38 may be missing from the document, consistent with the page numbering in the digital version of the DEIS.

Response: The current requirement for preparing documents in paper and electronic formats is challenging for a document that is typically undergoing refinements under a filing deadline. Nevertheless, we will take your suggestion in consideration in preparing the Second DEIS.

In order to facilitate the readability of the digital version of the DEIS, we suggest (1) detailed bookmarking of the digital document that corresponds with the lowest level of subheadings that appears in the table of contents, and (2) vertical orientation of all pages such that the reader need not rotate a digital page in order to read it onscreen from a normal orientation.

Response: Your comments regarding facilitating the readability of the digital version of the DEIS have been noted.

d. *Land Use Allocation*
Throughout the DEIS, Kaloko Makai's footprint is billed as "an approximately 1,139 acre" area that also includes a well field of approximately 18 acres of land mauka of the proposed project site. However:
   a. *Table 2-6, Estimated Allocation by Land Use Type and Phase, shows a total estimated area of only 1,039 acres;*
   b. *the numbers in the "Estimated Area" column of Table 2-6 add up to 1,041; and*
   c. *the total acreage for all land use types indicated in the legend of Figures 2-11 to 2-14 is 1,065.5 acres.*
   d. *Therefore, we suggest that the FEIS include corrections and additions to Table 2-6, Figures 2- 11 to 2-14, and all related content such that the project acreage calculations are more consistent throughout the document, and include the 18 acre well field, along with any additional area that would be required for water transmission from the well field to the proposed project site.*

   Moreover, the names and acreages assigned to the different land use types shown in Table 2-6 do not match those listed in the legend of Figures 2-11 to 2-14. Again, for the sake of consistency, we suggest corrections and additions to Table 2-6, Figures 2-11 to 2-14, and all related content such

that the information presented in Table 2-6 is directly comparable with the information presented in Figures 2-11 to 2-14.

Response: The approximate acreage of the entire project is 1,139 acres. The off-site potable well site has been removed from consideration. The amended approximate acreage of the project site is reflected throughout the forthcoming Second DEIS. Additionally, the tables referenced above have been revised to be consistent.

Specific Comments:

1. *Water sources*
Because the DEIS raises the possibility of desalination as a water source solution, we suggest that the FEIS clarify the nature of federal and state regulations with regard to the salinity of water supplied for domestic use. Federal and state regulations do not establish enforceable standards for chloride content in drinking water, they merely include notification requirements for water that exceeds a certain chloride level. In this regard, we also suggest that the FEIS quantify the volume and constituents of the process water that would be generated by desalination, in order to better account for the potential cumulative impact of wastewater, storm-water, and process water injection throughout the proposed project area.

Response: The desalinized water that would be used as the drinking water supply will comply with the EPA and DOH secondary standard limit for chlorides which is 250 MG/L. In reality, the actual chloride level of the desalinized water will be 120 MG/L or less to avoid taste and other issues. The 2012 report by Tom Nance Water Resource Engineering identifies the potential impacts of the desalinization process, including disposal of the concentrate (wastewater). This report will be included in the forthcoming Second DEIS.

The Draft Groundwater Assessment (Appendix C) notes that "[t]he [Hawaii County Water Use & Development Plan] WUDP acknowledges that there is not sufficient supply to accommodate the worst-case scenario (full build out of land uses ...)" and "serves to alert decision makers that the current [Land Use Pattern Allocation Guide] LUPAG designations and zoning classifications cannot be supported with existing water resources." Therefore, we suggest that overall impact of the proposed action, and other planned actions, on water resource availability be further disclosed in the cumulative impacts analysis and the alternatives analysis, such that trade-offs between the water resource impacts and other environmental impacts of all planned future actions can be better addressed in the land use decision making address.

Response: The 2012 report by Tom Nance Water Resource Engineering discusses water resource impacts in detail. It might also be noted that a recent USGS study estimated recharge for the Keauhou Aquifer to be 1.77 times greater than the amount used by the State Commission on Water Resource Management to set the aquifer's sustainable yield at 38 MGD. As most of this greater recharge is in the high rainfall belt overlying the high level groundwater body, this new information suggests the aquifer's actual sustainable yield is more than twice the current 38 MGD regulatory amount. Current aquifer pumpage is 14 MGD, less than 20 percent of the aquifer's likely sustainable yield.

2. *Water quality impacts in inland and marine receiving waters*
The proposed action would alter pollutant loading dynamics in ways that are insufficiently identified and quantified in the DEIS. Although "[e]ffluent disposal for the Private WWTP shall be in accordance with all applicable laws" (page 3-43), the ultimate effluent disposal method is not entirely clear. Effluent injection and effluent reuse are both lawful disposal methods, but their environmental impacts could differ significantly. Would the proposed WWTP use injection wells, as well as effluent reuse, for effluent disposal purposes, or would it employ reuse only, as implied (but not explicitly stated) in the DEIS? Where and how would the necessary back-up storage capacity for a reuse facility be provided? Would the self sufficiency of the on-site WWTP include its energy supply?

Response: The amount of R-1 treated effluent will exceed its onsite irrigation reuse. If other uses cannot be found, this excess would be disposed of in injection wells located at on-site wastewater treatment plant (WWTP).

All of the questions raised in this comment are dealt with in detail in the 2012 report by Tom Nance Water Resource Engineering.

For analytical purposes, we suggest that the DEIS include greater detail about (1) the location, volume, and content of wastewater inputs and altered storm water inputs that would be generated by the proposed action, and (2) their transport and fate in the environment. For example, the DEIS states (Groundwater Assessment, p. 16) "As the excess irrigation water percolates downward through the unsaturated zone to the groundwater, removal rates of nitrogen and phosphorus from the water will be significant." This statement is meaningless without numbers (goals), rates, and variances. We suggest that the DEIS more thoroughly identify the volume and quality of effluent that would be produced, and the location, timing, and rate of proposed reuse applications. The DEIS states that "estimates of cumulative changes to groundwater from the total assemblage of existing and proposed projects also do not appear to have the potential for alterations to pond or marine habitats."

We suggest that the DEIS reference the source of these estimates and of the technical analysis that leads to this conclusion.

Response: An Assessment of the Potential Impact of the Proposed Kaloko Makai Project on Water Resources has been prepared by Tom Nance Water Resource Engineering 2012 and will be included in the forthcoming Second DEIS. This report will replace the draft groundwater report included in the DEIS. The forthcoming Second DEIS references the source of the estimates and technical analysis used in the analysis of water quality.

As with the response above, all of the information requested in this comment is presented in detail in the 2012 report by Tom Nance Water Resource Engineering.

Specifically, we suggest that any reinjection scheme proposed for effluent and runoff disposal be very site specific. The injection site would be thoroughly described with regard to characteristics such as location, flow rate, dispersal depth (re sea level), and expected surface emergence locale relative to the shoreline. Under no conditions should this exit point be mauka of the reef (or, say, into ocean depths less than 200 feet). We suggest that piping of R-1 effluent to a point near the shoreline, followed by directional drilling of a sub-seafloor pipe to the final exit point, should be considered as a technologically valid option.

Response: The 2012 report by Tom Nance Water Resource Engineering provides information on the disposal of excess R-1 and desalinization concentrate. In both cases, injection wells would be used to deliver wastewater into the saline groundwater zone, thereby using movement of this saline groundwater beneath the basal lens to offshore discharge. Cost and property ownerships make your suggestion of directional drilling for disposal infeasible. The Tom Nance Water Resource Engineering-proposed disposal scheme makes it unnecessary.

The analysis of water quality conditions, impacts, and mitigation that is presented in the DEIS suffers from several regulatory and administrative mischaracterizations that warrant correction:

(1) The Land Use Commission (LUC) does not have the authority to determine whether or not violations of the state water quality standards have occurred in state waters. Absent a record of a violation notice, declaratory ruling, impairment decision under Clean Water Act Section 303(d), or other official action of the State Department of Health (DOH), we suggest that the violations of water quality standards previously recorded as LUC Findings of Fact should not be relied upon to determine the regulatory compliance status of receiving waters that would be affected by the

proposed action. The principal authority on the water quality status of state receiving waters is the 2006 Water Quality Monitoring and Assessment Report published by DOH. The assessments of other government agencies and private parties are not jurisdictional in this regard.

Response: We acknowledge that the LUC does not have the authority to determine whether or not violations of the State water quality standards have occurred in State waters.

(2) Some of the receiving waters within the national park boundaries may be more properly classified as class 1.a. inland waters, not class AA marine waters. Moreover, these inland waters may include water body types for which specific numeric water quality criteria that regulate conventional pollutants, other than bacterial indicator criteria, do not exist or apply. This implies that a more exhaustive analysis may be desirable in order to evaluate the compliance or noncompliance of the proposed action with the state water quality antidegradation policy.

Response: Class 1.a brackish waters have no specific compliance criteria, and are subject to only basic criteria set forth in section 11-54-4. As there is no discharge into these waters, basic criteria are met.

We acknowledge that your department considers receiving waters within the national park boundaries as class 1.a. inland waters, not class AA marine waters.

(3) In many cases DOH is not obligated to review, comment on, accept, or approve the various water quality management proposals that are volunteered by the proponent of the proposed action or that may be required by the LUC. The LUC does not have the authority to require that DOH review, endorse, or otherwise approve water quality monitoring plans, water quality data, water quality assessments, best management practices, pollution prevention plans, etc., even though the LUC typically requires DOH involvement as a condition of approving the proposed action. Therefore, we suggest that the DEIS describe an alternative approach for assuring the adequacy of the proposed water pollution mitigation measures and water quality management programs that would be part of the proposed action.

Response: The Petitioner will prepare a pollution prevention plan (PPP) that provides best management practices (BMP), including structural BMP, for pollution prevention that address all categories of permitted uses within the project, and shall address environmental stewardship and the non-point sources of water pollution that can be generated from uses allowed within the project.

The Petitioner will also comply with applicable Federal, State and County regulations.

Overall, we suggest that a more collaborative, regionalized approach to water quality monitoring and assessment be developed and implemented by all of the parties concerned, particularly DOH, LUC, the County of Hawaii, the National Park Service, other landowners, and developers. It would be useful for the OBIS to describe and incorporate the current objectives and status of ongoing University of Hawaii investigations in this area. In particular, we suggest that this monitoring program address the detection of changes in contaminant flows toward the sea along the shorelines of Kaloko National Historical Park and/or Honokōhau Harbor. The harbor's mauka third, for example, has well over I million gallons of brackish water seaward flow per day, however the magnitude and impact of the pollutant load carried by this flow is currently unknown.

Response: Should a regional monitoring program be established, the Petitioner will participate in a regional water quality monitoring program based on its pro-rata interest.

Thank you for considering our comments on this Draft Environmental Impact Statement We hope that our comments will help the Land Use Commission to weigh carefully whether the social benefits of the proposed action would justify the environmental impacts that would likely occur. When the Final Environmental Impact Statement is distributed, please send one printed copy to the Environmental Center.

Response: The DEIS is being revised and one printed copy of the forthcoming Second DEIS will be mailed to you.

Your letter, along with this response, will be reproduced and included in the forthcoming Second DEIS. We appreciate your participation in the environmental review process.

Sincerely,

Earl Matsukawa, AICP
Project Manager

cc: Mr. Jay Nakamura, Stanford Carr Development
Mr. Daniel Orodenker, State Land Use Commission

DEPARTMENT OF WATER SUPPLY • COUNTY OF HAWAI'I
345 KEKŪANAŌ'A STREET, SUITE 20 • HILO, HAWAI'I 96720
TELEPHONE (808) 961-8050 • FAX (808) 961-8657

September 26, 2011

RECEIVED
SEP 27 2011
WILSON OKAMOTO CORPORATION

Orlando Dan Davidson, Executive Officer
Department of Business, economic Development & Tourism
State Land Use Commission
P.O. Box 2359
Honolulu, HI 96804

DRAFT ENVIRONMENTAL IMPACT STATEMENT
TAX MAP KEY 7-3-009:017, 025 (PORTION), 026, AND 028

Thank you for allowing us the opportunity to comment on the subject Draft Environmental Impact Statement and have the following comments.

We would like to confirm that the County of Hawai'i, Department of Water Supply is in discussions with the developers of Kaloko Makai with respect to the options available for the potable water supply for the proposed development.

The developer will be required to enter into a Water Development Agreement with the Water Board, which will establish the necessary offsite water system improvements required to support the development and the allocation of water commitments from any new source(s) developed. Water service within the proposed development will not be granted until the necessary offsite and onsite water system improvements are completed and accepted by/dedicated to the Water Board.

Should the integration of a desalination facility for source development be required, the design, construction, operation and maintenance would be the responsibility of the developer because the Department's water System Standards and Rules & Regulations do not cover such treatment facilities. The possibility to dedicate the desalination facility will be subject to the review and approval of the Water Board.

Any amendments to prior water development agreements will have to be approved by the Water Board. The "transfer" of water commitments should be revised to "assigned" or "allocated", as our Rules and Regulations does not allow the transfer of water commitments that have been issued.

Alternative #5 - The current water availability conditions in the area, which are subject to change without notice, provides for the same number of water units as the number of lots or dwelling units allowable under the current zoning, not to exceed a maximum of 50 units of water, per existing lot of record. Six (6) additional units of water are available, per existing lot of record, if a change of zone

application is approved. For your information, one unit of water is equal to a maximum daily usage of 600 gallons per day, which is suitable for only one single-family dwelling. As the existing lot of record has been subdivided several times, additional water is not available under this alternative.

Should there be any questions, please contact Mr. Ryan Quitoriano of our Water Resources and Planning Branch at 961-8070, extension 256.

Sincerely yours,

Milton D. Pavao, P.E.
Manager-Chief Engineer

RQ:dfg

copy – SCD Kaloko Makai, LLC
Wilson Okamoto Corporation

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7469-01
July 25, 2013

Mr. Quirino Antonio, Manager
Department of Water Supply
County of Hawaii
345 Kekuanao'a Street, Suite 20
Hilo, HI 96720

Subject: Draft Environmental Impact Statement (DEIS)
Kaloko Makai
Kaloko and Kohanaiki, North Kona, Hawaii
Tax Map Key: (3) 7-3-09: 017, 025, 026, and 028

Dear Mr. Antonio:

Thank you for your letter dated September 26, 2011. The Petitioner is preparing a Second DEIS to address changes in the proposed project that will be reassessed, as needed, in the forthcoming document. You will be notified of its availability for review and comment pursuant to Chapter 343, Hawaii Revised Statutes (HRS) and Title 11, Chapter 200 Hawaii Administrative Rules (Department of Health).

With regard to your comments on the subject DEIS, we offer the following in response to your comments:

We would like to confirm that the County of Hawaii, Department of Water Supply is in discussions with the developers of Kaloko Makai with respect to the options available for the potable water supply for the proposed development.

The developer will be required to enter into a Water Development Agreement with the Water Board, which will establish the necessary offsite water system improvements required to support the development and the allocation of water commitments from any new source(s) developed. Water service within the proposed development will not be granted until the necessary offsite and onsite water system improvements are completed and accepted by/dedicated to the Water Board.

Response: The Petitioner confirms and appreciates the discussions with the County of Hawaii, Department of Water Supply with respect to the options available for the potable water supply to serve the proposed development.

The Petitioner acknowledges the requirement of entering into a Water Development Agreement with the Water Board and that water service within the proposed development will not be granted until the necessary offsite and

onsite water system improvements are completed and accepted by/dedicated to the Water Board.

Should the integration of a desalination facility for source development be required, the design, construction, operation and maintenance would be the responsibility of the developer because the Department's water System Standards and Rules & Regulations do not cover such treatment facilities. The possibility to dedicate the desalination facility will be subject to the review and approval of the Water Board.

Response: The forthcoming Second DEIS includes the alternative of constructing a desalination facility complying with all applicable State Department of Health and DWS standards, with the potential for dedication to DWS. The Petitioner acknowledges that the design, construction, operation and maintenance of the desalination facility would be the responsibility of the Petitioner because the Department's Water System Standards and Rules & Regulations do not cover such treatment facilities.

The Petitioner will continue discussions with DWS and the Water Board regarding the possibility of dedicating the desalination facility to the County.

Any amendments to prior water development agreements will have to be approved by the Water Board. The "transfer" of water commitments should be revised to "assigned" or "allocated", as our Rules and Regulations does not allow the transfer of water commitments that have been issued.

Response: The Petitioner acknowledges that any amendments prior to water development agreements will have to be approved by the Water Board.

Per your suggestion, the references to "transfer" of water commitments in the Second DEIS has been changed to "assigned" or "allocated" water commitments throughout the document.

Alternative #5 - The current water availability conditions in the area, which are subject to change without notice, provides for the same number of water units as the number of lots or dwelling units allowable under the current zoning, not to exceed a maximum of 50 units of water, per existing lot of record. Six (6) additional units of water are available, per existing lot of record, if a change of zone application is approved. For your information, one unit of water is equal to a maximum daily usage of 600 gallons per day, which is suitable for only one single-family dwelling. As the existing lot of record has been subdivided several times, additional water is not available under this alternative.

Response: The Petitioner acknowledges your explanation of the current water availability conditions in the area and that additional water is not available under Alternative #5.

Your letter, along with this response, will be reproduced and included in the forthcoming Second DEIS. We appreciate your participation in the EIS review process.

Sincerely,

Earl Matsukawa, AICP
Project Manager

cc: Mr. Jay Nakamura, Stanford Carr Development
Mr. Daniel Orodenker, State Land Use Commission

William P. Kenoi
Mayor

William T. Takaba
Managing Director

Dora Beck, P.E.
Acting Director

Hunter Bishop
Deputy Director

County of Hawai'i

DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

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August 9, 2011

State Land Use Commission
Department of Business, Economic Development & Tourism
P. O. Box 2359
Honolulu, HI 96804

Attention: Mr. Orlando Dan Davidson
Executive Officer

RE: Draft EIS
Kaloko Makai
Kaloko & Kohanaiki, North Kona
TMK: (3) 7-3-00917, 019 (port.), 025, 026, 028, 063 (port.) and 063

Dear Mr. Davidson,

We have no comments to offer on the subject project.

Thank you for allowing us to review and comment on this project.

Sincerely,

Dora Beck

Dora Beck, P.E.
~~ACTING DIRECTOR~~

cc: SCD – TSA Kaloko Makai, LLC
1100 Alakea St., 27th Floor
Honolulu, HI 96813
Attention: Mr. Peter Phillips

Wilson Okamoto Corp.
1907 South Beretania St., Suite 400
Honolulu, HI 96826
Attention: Mr. Earl Matsukawa, AICP

County of Hawai'i is an Equal Opportunity Provider and Employer.

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7469-01
July 25, 2013

Ms. Bobby Jean Leithead-Todd, Director
Department of Enviromental Management
County of Hawaii
25 Aupuni Street
Hilo, HI 96720

Subject: Draft Environmental Impact Statement (DEIS)
Kaloko Makai
Kaloko and Kohanaiki, North Kona, Hawaii
Tax Map Key: (3) 7-3-09: 017, 025, 026, and 028

Dear Ms. Leithead-Todd:

Thank you for your letter dated August 9, 2011. The Petitioner is preparing a Second DEIS to address changes in the proposed project that will be reassessed, as needed, in the forthcoming document. You will be notified of its availability for review and comment pursuant to Chapter 343, Hawaii Revised Statutes (HRS) and Title 11, Chapter 200 Hawaii Administrative Rules (Department of Health).

With regard to your comments on the subject DEIS, we acknowledge that you have no comments to offer at this time.

Your letter, along with this response, will be reproduced and included in the forthcoming Second DEIS. We appreciate your participation in the EIS review process.

Sincerely,

Earl Matsukawa, AICP
Project Manager

cc: Mr. Jay Nakamura, Stanford Carr Development
Mr. Daniel E. Orodenker, State Land Use Commission

William P. Kenoi
Mayor

County of Hawai'i
POLICE DEPARTMENT
349 Kapi'olani Street • Hilo, Hawai'i 96720-3998
(808) 935-3311 • Fax (808) 961-2389

Harry S. Kubojiri
Police Chief

Paul K. Ferreira
Deputy Police Chief

EM

August 18, 2011

Mr. Earl Matsukawa, AICP
Project Manager
Wilson Okamoto Corporation
1907 South Beretania Street
Artesian Plaza, Suite 400
Honolulu, Hawaii 96826

Dear Mr. Matsukawa:

SUBJECT: Draft Environmental Impact Statement (DEIS)
Kaloko Makai
Kaloko and Kohanaiki, North Kona, Island of Hawaii
Tax Map Keys: (3) 7-3-009: 017, 019 (port.), 025, 026, 028, 062 (port.) and 063

The above-referenced Draft Environmental Impact Statement (DEIS) has been reviewed, and we have the following comments.

We continue to express our concerns that a development of this size will increase traffic on all roadways associated with the development. Major roadways affected will include Hina Lani Street, Mamalahoa Highway, Queen Kaahumanu Highway, and Palani Road.

Thank you for the opportunity to comment. Should you have any questions, please contact Captain Samuel Kawamoto, Commander of the Kona District, at (808)326-4646, ext. 299.

Sincerely,

HARRY S. KUBOJIRI
POLICE CHIEF

PAUL H. KEALOHA JR.
ASSISTANT POLICE CHIEF
AREA II OPERATIONS

SK:dmv
RS100754

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7469-01
July 25, 2013

Mr. Harry S. Kubojiri, Chief of Police
Police Department
County of Hawaii
349 Kapiolani Street
Hilo, HI 96720

Subject: Draft Environmental Impact Statement (DEIS)
Kaloko Makai
Kaloko and Kohanaiki, North Kona, Hawaii
Tax Map Key: (3) 7-3-09: 017, 025, 026, and 028

Dear Mr. Kubojiri:

Thank you for your letter dated August 18, 2011. The Petitioner is preparing a Second DEIS to address changes in the proposed project that will be reassessed, as needed, in the forthcoming document. You will be notified of its availability for review and comment pursuant to Chapter 343, Hawaii Revised Statutes (HRS) and Title 11, Chapter 200 Hawaii Administrative Rules (Department of Health).

With regard to your comments on the subject DEIS, we acknowledge your concerns about the potential impacts the proposed project will have on nearby roadways. As discussed in the DEIS and in the forthcoming Second DEIS traffic in Kona is expected to increase even if Kaloko Makai is not built.

The County of Hawaii General Plan Section 15.1 (February 2005, as amended) calls for the preparation of community development plans "to translate the broad General Plan statements to specific actions as they apply to specific geographical areas." The General Plan requires CDPs be adopted as an "ordinance," giving the plans force of law. The CDPs are long-term plans with a planning horizon to the year 2020, consistent with the General Plan.

The Kona CDP is the first community development plan to commence under the framework of the February 2005 County of Hawaii General Plan. The Kona CDP was adopted by County Council via ordinance in September 2008. The purposes of the Kona CDP are:

- Articulate Kona's residents' vision for the planning area;
- Guide regional development in accordance with that vision, accommodating future growth while preserving valued assets;
- Provide a feasible infrastructure financing plan to improve existing deficiencies and proactively support the needs of future growth;

- Direct growth to appropriate areas;
- Create a plan of action where government and the people work in partnership to improve the quality of life in Kona for those who live, work, and visit;
- Provide a framework for monitoring the progress and effectiveness of the plan and to make changes and update it, if necessary.

The General Plan notes, Urban Expansion Areas allow for a mix of high density, medium density, low density, industrial, industrial-commercial and/or open designations in areas where new settlements may be desirable, but where the specific settlement pattern and mix of uses have not yet been determined.

The Kona CDP recognizes that the General Plan LUPAG Urban Area is larger than needed in order to accommodate the projected growth within the planning horizon, so it emphasizes that future growth within the urban area is encouraged in a pattern of compact villages at densities that support public transit.

Transit-Oriented Developments (TODs) and Traditional Neighborhood Developments (TNDs) are identified as the planning tool to manage this anticipated growth within the defined "Kona Urban Area." The Kona CDP defines these as compact mixed-use villages, characterized by a village center within a higher-density urban core, roughly equivalent to a 5-minute walking radius (1/4-mile), surrounded by a secondary mixed-use, mixed-density area with an outer boundary roughly equivalent to a 10-minute walking radius from the village center (1/2-mile).

The State and County of Hawai'i have many roadway improvements planned to meet the expected growth in the area and to expanded roadway networks. Kaloko Makai will be part of the regional solution to address congestion and improve traffic circulation.

Widening, improving and extending major arterials, as well as increasing connectivity between and within existing and future development are necessary to enhance mobility in Kona. As noted in the Second DEIS, priority arterial highway projects include widening Queen Kaahumanu Highway between Henry Street and the airport and Ane Keohokalole Highway. These will reduce demands on the existing regional facilities.

As noted in the Kona CDP, transit oriented development are contingent upon the development of compact mixed-use villages in the Kona Urban Area, served by a road network in the Official Transportation Network Map. The new Ane Keohokalole Highway (Mid-Level Road) will function as the trunk transit route connecting Kailua Village with the airport, along which TODs will be located.

Through the Kona CDP, the Kona Urban Area is designated as a "critical road area," as defined in HCC 25-2-46. Rezonings within the Kona Urban Area will comply with the Official Concurrency Map that identifies the road segments to be constructed concurrent with occupancy of units as the minimum "area mitigation," as defined in HCC 25-2-46 (Zoning Code).

Kona CDP Prioritized Road Improvements - In order to rectify existing deficiencies and influence the pattern of future growth and new roads, the following are priorities in the vicinity of Kaloko Makai:

- Keanalehu Street-Manuwalea Street
- Ane Keohokalole Highway (Mid-Level Road), Phase I Palani to Kealakehe Parkway
- Kamanu Street Extension
- Ane Keohokalole Highway (Mid-Level Road), Phase II, Kealakehe Parkway to Hina Hani Street
- Kealakaa Street Extension
- Ane Keohokalole Highway (Mid-Level Road), Phase III, Hina Lani Street to Kaiminani Drive
- University Drive

The Petitioner will coordinate with the Police Department to address service capabilities of police operations, address concerns, and develop appropriate mitigation measures, as appropriate.

Your letter, along with this response, will be reproduced and included in the forthcoming Second Draft EIS. We appreciate your participation in the EIS review process.

Sincerely,

Earl Matsukawa, AICP
Project Manager

cc: Mr. Jay Nakamura, Stanford Carr Development
Mr. Daniel Orodenker, State Land Use Commission

William P. Kenoi
Mayor

Darryl J. Oliveira
Fire Chief

Glen P. I. Honda
Deputy Fire Chief

EM

County of Hawai'i

HAWAI'I FIRE DEPARTMENT
25 Aupuni Street • Suite 2501 • Hilo, Hawai'i 96720
(808) 932-2900 • Fax (808) 932-2928

August 26, 2011

Mr. Earl Matsukawa
Wilson Okamoto Corporation
1907 South Beretania Street, Suite 400
Honolulu, Hawaii 96826

SUBJECT: DRAFT ENVIRONMENTAL IMPACT STATEMENT
KALOKO MAKAI
KALOKO AND KOHANAIKI, NORTH KONA
TMK: (3) 7-3-009:017, 019 (POR), 025, 026, 028, 062 (POR) and 063

In regards to the above-mentioned draft Environmental Impact Statement, currently we find there no special environmental impacts or conditions however the Fire Department would require the following, at a minimum:

Fire apparatus access roads shall be in accordance with UFC Section 10.207:

"**Fire Apparatus Access Roads**

"**Sec. 10.207.** (a) **General.** Fire apparatus access roads shall be provided and maintained in accordance with the provisions of this section.

"(b) **Where Required.** Fire apparatus access roads shall be required for every building hereafter constructed when any portion of an exterior wall of the first story is located more than 150 feet from fire department vehicle access as measured by an unobstructed route around the exterior of the building.

"**EXCEPTIONS:** 1. When buildings are completely protected with an approved automatic fire sprinkler system, the provisions of this section may be modified.

"2. When access roadways cannot be installed due to topography, waterways, nonnegotiable grades or other similar conditions, the chief may require additional fire protection as specified in Section 10.301 (b).

"3. When there are not more than two Group R, Division 3 or Group M Occupancies, the requirements of this section may be modified, provided, in the opinion of the chief, fire-fighting or rescue operations would not be impaired.

"More than one fire apparatus road may be required when it is determined by the chief that access by a single road may be impaired by vehicle congestion, condition of terrain, climatic conditions or other factors that could limit access.

"For high-piled combustible storage, see Section 81.109.

"(c) **Width.** The unobstructed width of a fire apparatus access road shall meet the requirements of the appropriate county jurisdiction.

"(d) **Vertical Clearance.** Fire apparatus access roads shall have an unobstructed vertical clearance of not less than 13 feet 6 inches.

"**EXCEPTION:** Upon approval vertical clearance may be reduced, provided such reduction does not impair access by fire apparatus and approved signs are installed and maintained indicating the established vertical clearance.

"(e) **Permissible Modifications.** Vertical clearances or widths required by this section may be increased when, in the opinion of the chief, vertical clearances or widths are not adequate to provide fire apparatus access.

"(f) **Surface.** Fire apparatus access roads shall be designed and maintained to support the imposed loads of fire apparatus and shall be provided with a surface so as to provide all-weather driving capabilities." (20 tons)

"(g) **Turning Radius.** The turning radius of a fire apparatus access road shall be as approved by the chief." (45 feet)

"(h) **Turnarounds.** All dead-end fire apparatus access roads in excess of 150 feet in length shall be provided with approved provisions for the turning around of fire apparatus.

"(i) **Bridges.** When a bridge is required to be used as access under this section, it shall be constructed and maintained in accordance with the applicable sections of the Building Code and using designed live loading sufficient to carry the imposed loads of fire apparatus.

"(j) **Grade.** The gradient for a fire apparatus access road shall not exceed the maximum approved by the chief." (15%)

"(k) **Obstruction.** The required width of any fire apparatus access road shall not be obstructed in any manner, including parking of vehicles. Minimum required widths and clearances established under this section shall be maintained at all times.

"(l) **Signs.** When required by the fire chief, approved signs or other approved notices shall be provided and maintained for fire apparatus access roads to identify such roads and prohibit the obstruction thereof or both."

Water supply shall be in accordance with UFC Section 10.301(c):

"(c) **Water Supply.** An approved water supply capable of supplying required fire flow for fire protection shall be provided to all premises upon which buildings or portions of buildings are hereafter constructed, in accordance with the respective county water requirements. There shall be provided, when required by the chief, on-site fire hydrants and mains capable of supplying the required fire flow.

"Water supply may consist of reservoirs, pressure tanks, elevated tanks, water mains or other fixed systems capable of providing the required fire flow.

"The location, number and type of fire hydrants connected to a water supply capable of delivering the required fire flow shall be protected as set forth by the respective county water requirements. All hydrants shall be accessible to the fire department apparatus by roadways meeting the requirements of Section 10.207.

DARRYL OLIVEIRA
Fire Chief

RP:lpc

CC: Orlando Dan Davidson - State Land Use Commision, DBEDT
Peter Phillips – SCD, TSA Kaloko Makai, LLC

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7469-01
July 25, 2013

Mr. Darren J. Rosario, Fire Chief
Fire Department
County of Hawaii
25 Aupuni Street
Hilo, HI 96720

Subject: Draft Environmental Impact Statement (DEIS)
Kaloko Makai
Kaloko and Kohanaiki, North Kona, Hawaii
Tax Map Key: (3) 7-3-09: 017, 025, 026, and 028

Dear Mr. Rosario:

We received a comment letter from former Fire Chief Darryl Oliveira dated August 26, 2011. The Petitioner is preparing a Second DEIS to address changes in the proposed project that will be reassessed, as needed, in the forthcoming document. You will be notified of its availability for review and comment pursuant to Chapter 343, Hawaii Revised Statutes (HRS) and Title 11, Chapter 200 Hawaii Administrative Rules (Department of Health).

With regard to your comments on the subject DEIS, the forthcoming Second DEIS will be revised to state that Kaloko Makai will contain complete fire prevention measures including access roads in accordance with Uniform Fire Code (UFC) Section 10.207, water supply for fire suppression in accordance with UFC Section 10.301(c), and buildings under construction in compliance with the provisions of UFC Article 87.

The Petitioner will coordinate with the Fire Department to address service capabilities of fire protection services, address their concerns and develop appropriate mitigation measures, if appropriate. Plans include providing a site for a Fire Station with room for a Police Sub-Station on Hina Lani Street.

The Fire Department's letter, along with this response, will be reproduced and included in the forthcoming Second DEIS. We appreciate your participation in the EIS review process.

Sincerely,

Earl Matsukawa, AICP
Project Manager

cc: Mr. Jay Nakamura, Stanford Carr Development
Mr. Daniel Orodenker, State Land Use Commission

Hawaii Electric Light Company, Inc. • PO Box 1027 • Hilo, HI 96721-1027

September 13, 2011

EM
TF

Wilson Okamoto Corporation
Attention: Mr. Earl Matsukawa, AICP
1907 South Beretania Street
Artesian Plaza, Suite 400
Honolulu, Hawaii 96826

RECEIVED
SEP 15 2011
WILSON OKAMOTO CORPORATION

Gentlemen:

SUBJECT: Draft Environmental Impact Statement (DEIS)
Kaloko Makai, North Kona, Hawai'i
TMK: 7-3-009:017, 019 (port.), 025, 026, 028, 062 (port.) and 063

Thank you for the opportunity to comment on the subject's Draft Environmental Impact Statement (DEIS). HELCO's response to the subject's EA/EISPN dated October 1, 2010 has not changed. It is stated as follows:

HELCO will be able to provide electrical service to the proposed development in North Kona. A detailed analysis will be performed after the receipt of the consultant's detailed design drawings and estimated load. The following is a summary of our comments:

1. Generation capacity - HELCO's current system peak load is 194,600kW and our total generation system capability is 285,800kW. Our reserve margin is 37% and may have adequate generation to serve the above.

2. Electrical Substation - The area is served by our existing Kaloko electrical substation and a 12,470 volt underground distribution along Hina Lani Street. The capacity of our existing substation is not adequate to serve the anticipated load. A lot with a minimum size of 250' x 250' must be deeded to HELCO for the construction of a new substation.

3. Off-Site Electrical Transmission System – The existing 69,000 volt transmission line along Queen Kaahumanu Highway will need to be extended to the new electrical substation.

4. Off-Site Electrical Distribution System – The existing off-site 12,470 volt distribution system along Hina Lani Street is not adequate to serve the proposed development. Off-site 12,470 volt distribution lines and easements from the new substation to the on-site development are required to serve the anticipated load.

5. On-Site Electrical Distribution System – On-site distribution line extensions and easements are required on the developer's property to serve the anticipated load.

After the development's detailed loading and civil plans are submitted, HELCO will prepare a firm cost to provide electrical power to this development.

HELCO recommends energy efficient and conservation measures to reduce the maximum electrical demand and energy consumption. The developer may call HELCO's Energy Services department at (808) 935-1171 for questions or details on available programs.

It is encouraged that the developer's electrical consultant open a service request with HELCO Engineering department as soon as practicable to ensure timely electrical facility installation. If you have any questions, please contact me at (808) 969-0222 or Shelley Doctor at (808) 327-0504.

Sincerely,

Kevin K.M. Waltjen
Manager, Engineering Department

KKMW:SD:bb

cc: H. Kamigaki
S. Doctor
K. Whitener

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7469-01
July 25, 2013

Mr. Kevin K.M. Waltjen, Manager
Engineering Department
Hawaii Electric Light Company
P.O. Box 1027
Hilo, Hawaii 96721-1027

Subject: Draft Environmental Impact Statement (DEIS)
Kaloko Makai
Kaloko and Kohanaiki, North Kona, Hawaii
Tax Map Key: (3) 7-3-09: 017, 025, 026, and 028

Dear Mr. Waltjen:

Thank you for your letter dated September 13, 2011. The Petitioner is preparing a Second DEIS to address changes in the proposed project that will be reassessed, as needed, in the forthcoming document. You will be notified of its availability for review and comment pursuant to Chapter 343, Hawaii Revised Statutes (HRS) and Title 11, Chapter 200 Hawaii Administrative Rules (Department of Health).

With regard to your comments on the subject DEIS, we offer the following responses in the order of your comments:

1. Generation capacity - HELCO's current system peak load is 194,600 kW and our total generation system capability is 285,800 kW. Our reserve margin is 37% and may have adequate generation to serve the above.

Response: The Petitioner acknowledges that HELCO has adequate generation to serve the project.

2. Electrical Substation - The area is served by our existing Kaloko electrical substation and a 12,470 volt underground distribution along Hina Lani Street. The capacity of our existing substation is not adequate to serve the anticipated load. A lot with a minimum size of 250' x 250' must be deeded to HELCO for the construction of a new substation.

Response: The Petitioner acknowledges that HELCO will require a lot with a minimum size of 250' x 250' to be deeded to HELCO for the construction of a new substation. A substation site has been noted on the makai-north portion of the project plan.

3. Off-Site Electrical Transmission System - The existing 69,000 volt transmission line along Queen Kaahumanu Highway will need to be extended to the new electrical substation.

Response: The Petitioner acknowledges that the existing 69,000 volt transmission line along Queen Kaahumanu Highway will need to be extended to the new electrical substation.

4. Off-Site Electrical Distribution System - The existing off-site 12,470 volt distribution system along Hina Lani Street is not adequate to serve the proposed development. Off-site 12,470 volt distribution lines and easements from the new substation to the on-site development are required to serve the anticipated load.

Response: The Petitioner acknowledges that the existing off-site volt distribution system along Hina Lani Street is not adequate to serve the proposed development and that volt distribution lines and easements from the new substation to the on-site development are required to serve the anticipated load.

5. On-Site Electrical Distribution System - On-site distribution line extensions and easements are required on the developer's property to serve the anticipated load.

After the development's detailed loading and civil plans are submitted, HELCO will prepare a firm cost to provide electrical power to this development. HELCO recommends energy efficient and conservation measures to reduce the maximum electrical demand and energy consumption.

It is encouraged that the developer's electrical consultant open a service request with HELCO Engineering department as soon as practicable to ensure timely electrical facility installation.

Response: The Petitioner acknowledges that on-site distribution line extensions and easements are required to accommodate the anticipated load and that HELCO will prepare a firm cost to provide electrical power to Kaloko Makai.

Attached within the Exhibits of the forthcoming Second DEIS is a Sustainability Plan, which will include a discussion of priority guidelines and principles to promote sustainability within the project.

Pursuant to Chapter 344 (State Environmental Policy) and Chapter 226 (Hawaii State Planning Act), HRS, all Kaloko Makai activities, buildings and grounds will be

designed with a significant emphasis on energy conservation and efficiency. Efficient design practices and technologies will be the cornerstone of Kaloko Makai's design phase. Buildings within Kaloko Makai will further comply with the County of Hawaii Energy Code (Hawaii County Code, Section 5, Article 2). Furthermore, solar water heaters will be utilized as made requisite under Section 196-6.5, HRS.

Response: The Petitioner will confer with HELCO in regards to suggestions and proposals for customized demand-oriented management programs offering rebates for the installation of alternative energy efficient technologies and measures

The Petitioner is committed to renewable energy and energy efficiently as ways to reduce environmental harm and self sufficiency. The Petitioner will continue to improve programs and create new programs as the development is initiated.

The Petitioner will open a service request with HELCO's Engineering department as soon as practicable to ensure timely electrical facility installation.

Your letter, along with this response, will be reproduced and included in the forthcoming Second DEIS. We appreciate your participation in the EIS review process.

Sincerely,

Earl Matsukawa, AICP
Project Manager

cc: Mr. Jay Nakamura, Stanford Carr Development
Mr. Daniel Orodenker, State Land Use Commission

KONA
COMMUNITY HOSPITAL
Care You Can Count On

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SEP 15 2011
WILSON OKAMOTO CORPORATION

September 6, 2011

Wilson Okamoto Corporation
Engineers and Planners
1907 South Beretania Street, Suite 400
Honolulu, Hawaii 96826

Re: Kaloko Makai - Comments on draft EIS

Gentlemen:

We would like to thank you for the opportunity to provide these comments on the draft EIS for the Kaloko Makai project in Kailua Kona.

First of all, on behalf of the members of the Kona Community Hospital Regional Board of Directors and its Strategic Planning Committee, I want to thank Kaloko Makai representatives for taking the time to meet with us on several occasions to discuss the prospect of locating a new acute care hospital within the Kaloko Makai project. We look forward to continued discussions.

Relative to this, please use this letter as confirmation of our request to relocate the hospital site within the Kaloko Makai project to the north-mauka corner of the Hina Lani Street/Ane Keohokalole Highway intersection. We believe this is the appropriate location for the hospital and we are hopeful that it does not complicate nor negatively impact the project planning for Kaloko Makai.

Again, we appreciate Kaloko Makai's willingness to work with us to provide a new acute care hospital within the Kaloko Makai project.

With kind regards,

Bruce S. Anderson, Ph.D.
HHSC President & CEO

Alistair Bairos, MD
Chairman, WHR Board of Directors

Jay E. Kreuzer
West Hawaii Regional CEO

cc: Alice Hall, HHSC

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7469-01
July 25, 2013

Dr. Bruce S. Anderson, Ph.D., HHSC President & CEO
Kona Community Hospital
Hawaii Health Systems Corporation
79-1019 Haukapila Street
Kealekekua, Hawaii 96750

Subject: Draft Environmental Impact Statement (DEIS)
Kaloko Makai
Kaloko and Kohanaiki, North Kona, Hawaii
Tax Map Key: (3) 7-3-09: 017, 025, 026, and 028

Dear Dr. Anderson:

Thank you for your letter dated September 6, 2011. The Petitioner is preparing a Second DEIS to address changes in the proposed project that will be reassessed, as needed, in the forthcoming document. You will be notified of its availability for review and comment pursuant to Chapter 343, Hawaii Revised Statutes (HRS) and Title 11, Chapter 200 Hawaii Administrative Rules (Department of Health).

With regard to your comments on the subject DEIS, we offer the following in response to your comments:

We would like to thank you for the opportunity to provide these comments on the draft EIS for the Kaloko Makai project in Kailua Kona.

First of all, on behalf of the members of the Kona Community Hospital Regional Board of Directors and its Strategic Planning Committee, I want to thank Kaloko Makai representatives for taking the time to meet with us on several occasions to discuss the prospect of locating a new acute care hospital within the Kaloko Makai project. We look forward to continued discussions. Relative to this, please use this letter as confirmation of our request to relocate the hospital site within the Kaloko Makai project to the north-mauka corner of the Hina Lani Street/Ane Keohokalole Highway intersection. We believe this is the appropriate location for the hospital and we are hopeful that it does not complicate nor negatively impact the project planning for Kaloko Makai.

Again, we appreciate Kaloko Makai's willingness to work with us to provide a new acute care hospital within the Kaloko Makai project.

Response: Per your request, the Petitioner has relocated the hospital site within the Kaloko Makai project to the north-mauka corner of the Hina Lani

Street/Ane Keohokalole Highway intersection. The relocation does not complicate nor negatively impact the project planning for Kaloko Makai.

The forthcoming Second DEIS reflects the location change of the hospital site.

The Petitioner looks forward to continued discussions with you regarding the prospect of locating a new acute care hospital within the Kaloko Makai project.

Your letter, along with this response, will be reproduced and included in the forthcoming Second DEIS. We appreciate your participation in the EIS review process.

Sincerely,

Earl Matsukawa, AICP
Project Manager

cc: Mr. Jay Nakamura, Stanford Carr Development
Mr. Daniel Orodenker, State Land Use Commission

TF

RECEIVED
SEP 22 2011

September 20, 2011

Aloha mai kākou,

This letter is in regards to specific items found in the draft Environmental Impact Statement for the proposed development of Kaloko Makai.

If not known, the lowland dryforest ecosystems of Hawai'i are the most endangered ecosystems with less than 10% still remaining. Of that approximate 10%, only fractions of that are actually healthy and intact. Kaloko Makai is one of those remnant healthy patches and is in grave danger of the threat of habitat destruction by way of human development.

The Habitat Conservation Plan (HCP) for the dryland forest preserve states many positive conservation actions that must be implemented to see this lowland dryforest ecosystem into perpetuity. Certainly, the planned conservation efforts and "Best Management Practices" are responsible and well thought out, yet there are some problems posed by the HCP and those points of concern need to be addressed prior to any development. Such items as the "3-for-1" planting plan and the potential issuance of the Incidental Take License (ITL) must be further reviewed and re-assessed.

"3 outplanted indiviuduals-for the invaluable price of 1 endangered, elder tree" does not sound like a balanced figure. Especially when we know that dryland trees are extremely slow growing. Furthermore, it is with an irresponsible environmental ethic that a plant's survival is gauged off a three year period. A forest does not grow in three years, and after all numbers are met, does the active restoration come to a halt?

Moreover, if this 150-acre preserve really is being managed to ensure that this dryforest exists for generations to come, then why would the development propose to jeopardize the lives of a certain few of our critical genetic materials sources? Not to mention, these are highly endangered species, so protected by law, that unless permitted, you cannot even take a dead twig from the plant. Yet, somehow the proposed development can call for the extraction of a whole living tree?

If an ITL is entitled and the Hala pepe (*Pleomele hawaiiensis)* and 'Aiea (*Nothocestrum breviflorum)* are to be moved, the chances of survival after re-location are extremely low. These plants have environmental conditions that are hard enough and to attempt to "take" these individuals would be detrimental. Not only detrimental to this specific ecosystem, but also to our Hawaiian culture. The richness of our unique Hawaiian flora and fauna mirror the richness of our cultural heritage, and with every species lost, every individual lost, we lose another facet of our history. This is why it is imperative that the ITL is not permitted and either there be a "no action alternative" or perhaps the development of a mini-preserve alternative to manage the individual trees where they currently exist in-situ.

The plans of action for restoration and stewardship of the Kaloko Makai dryforest preserve are wonderful; but there must be some revision to certain aspects of the proposed HCP as a part of the proposed development. As a conservationist in the lowlands of North Kona, it is evident that there are building pressures upon our remaining lowland forest ecosystems, yet I am consistently dumbfounded by the short-sightedness of development projects.

The natural and cultural resources of Kaloko Makai are inherently intertwined and they must be protected in all entirety. We cannot expect to grow a forest; we cannot expect nature to live on the same time scale as humans, but we can expect and hope that all persons or parties involved with the decision making process for land use entitlements, make their decisions on a basis of responsible, long term opportunity. The idea of havng the opportunity to save and preserve that which is so rare, and that which already exists.

Please feel free to contact me if there are any questions or comments to the matters addressed within this letter.

Aloha 'Āina,

Wilds Pihanui Ilaitia Brawner
Site Manager, Ka'ūpūlehu and La'i'ōpua Dryland Forest Preserves
808.987.0305
wilds.hfia@hawaiiforest.org

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7469-01
July 25, 2013

Ms. Wilds Pihanui Ilaitia Brawner, Site Manager
Kaupulehu and Laiopua Dryland Forest Preserves
Hawaii Forest Industry Association
P.O. Box 66
Ookala, HI 96774

Subject: Draft Environmental Impact Statement (DEIS)
Kaloko Makai
Kaloko and Kohanaiki, North Kona, Hawaii
Tax Map Key: (3) 7-3-09: 017, 025, 026, and 028

Dear Ms. Brawner:

Thank you for your letter dated September 20, 2011. The Petitioner is preparing a Second DEIS to address changes in the proposed project that will be reassessed, as needed, in the forthcoming document. You will be notified of its availability for review and comment pursuant to Chapter 343, Hawaii Revised Statutes (HRS) and Title 11, Chapter 200 Hawaii Administrative Rules (Department of Health).

With regard to your comments on the subject DEIS, we offer the following in response to your comments:

If not known, the lowland dry forest ecosystems of Hawaii are the most endangered ecosystems with less than 10% still remaining. Of that approximate 10%, only fractions of that are actually healthy and intact. Kaloko Makai is one of those remnant healthy patches and is in grave danger of the threat of habitat destruction by way of human development.

> Response: Recognizing the importance of the Dryland Forest, the Petitioner incorporated a large portion (150-acres) of the Dryland Forest into their preliminary design as the Kaloko Makai Dryland Forest Preserve. By preserving these 150-acres, the Petitioner is ensuring that the Kaloko Dryland Forest is preserved for generations to come.

The Habitat Conservation Plan (HCP) for the dryland forest preserve states many positive conservation actions that must be implemented to see this lowland dry forest ecosystem into perpetuity. Certainly, the planned conservation efforts and "Best Management Practices" are responsible and well thought out, yet there are some problems posed by the HCP and those points of concern need to be addressed prior to any development. Such items as the "3-for-1" planting plan and the potential issuance of the Incidental Take License (ITL) must be further reviewed and re-assessed.

"3 outplanted individuals-for the invaluable price of 1 endangered, elder tree" does not sound like a balanced figure. Especially when we know that dryland trees are

extremely slow growing. Furthermore, it is with an irresponsible environmental ethic that a plant's survival is gauged off a three year period. A forest does not grow in three years, and after all numbers are met, does the active restoration come to a halt?

> Response: The Kaloko Makai property has been the subject of numerous botanical surveys over the years. Based on these surveys, four listed endangered plant species are found within the project site.
>
> - 'aiea (Nothocestrum breviflorum)
> - hala pepe (Pleomele hawaiiensis)
> - uhiuhi (Caesalpinia kavaiensis)
> - ma'aloa (Neraudia ovata)
>
> In the anticipated development discussed in the Draft EIS, only one 'aiea and two hala pepe plants are found outside the dryland forest preserve; the action, then, proposed removal of these plants due to the proposed development. Based on comments during the DEIS process and further evaluation of the project layout, under the development proposal described in the Second Draft EIS, none of the listed endangered plants situated outside the dryland forest preserve will be "taken" in the development and construction of the Kaloko Makai project. It is not anticipated that a Habitat Conservation Plan (HCP) will be prepared.
>
> Instead, Kaloko Makai will leave those plants in place and incorporate a 50-foot buffer around the one 'aiea and two hala pepe and any structure within the project. The plants will be incorporated into landscaping within the 50-foot buffers.
>
> Kaloko Makai will set aside 150-acres in the Kaloko Makai Dryland Forest. Within this preserve, a variety of endangered species will have continued protection and their habitats set aside in perpetuity, enhancing their prospects for survival.

Moreover, if this 150-acre preserve really is being managed to ensure that this dry forest exists for generations to come, then why would the development propose to jeopardize the lives of a certain few of our critical genetic materials sources? Not to mention, these are highly endangered species, so protected by law, that unless permitted, you cannot even take a dead twig from the plant. Yet, somehow the proposed development can call for the extraction of a whole living tree?

If an ITL is entitled and the Hala pepe (Pleomele hawaiiensis) and Aiea (Nothocestrum breviflorum) are to be moved, the chances of survival after re-location are extremely low. These plants have environmental conditions that are hard enough and to attempt to "take" these individuals would be detrimental. Not only detrimental to this specific ecosystem, but also to our Hawaiian culture. The richness of our

unique Hawaiian flora and fauna mirror the richness of our cultural heritage, and with every species lost, every individual lost, we lose another facet of our history. This is why it is imperative that the ITL is not permitted and either there be a "no action alternative" or perhaps the development of a mini-preserve alternative to manage the individual trees where they currently exist in-situ.

Response: See previous response.

The plans of action for restoration and stewardship of the Kaloko Makai dry forest preserve are wonderful; but there must be some revision to certain aspects of the proposed HCP as a part of the proposed development. As a conservationist in the lowlands of North Kona, it is evident that there are building pressures upon our remaining lowland forest ecosystems, yet I am consistently dumbfounded by the shortsightedness of development projects.

The natural and cultural resources of Kaloko Makai are inherently intertwined and they must be protected in all entirety. We cannot expect to grow a forest; we cannot expect nature to live on the same time scale as humans, but we can expect and hope that all persons or parties involved with the decision making process for land use entitlements, make their decisions on a basis of responsible, long term opportunity. The idea of having the opportunity to save and preserve that which is so rare, and that which already exists.

Response: Recognizing the importance of the Dryland Forest, the Petitioner incorporated a large portion (150-acres) of the Dryland Forest into their preliminary design as the Kaloko Makai Dryland Forest Preserve. By preserving these 150-acres, the Petitioner is ensuring that the Kaloko Dryland Forest is preserved for generations to come.

Your letter, along with this response, will be reproduced and included in the forthcoming Supplemental DEIS. We appreciate your participation in the EIS review process.

Sincerely,

Earl Matsukawa, AICP
Project Manager

cc: Mr. Jay Nakamura, Stanford Carr Development
Mr. Daniel Orodenker, State Land Use Commission

EM

SIERRA CLUB, HAWAII CHAPTER
MOKU LOA GROUP
P.O.Box 1137
Hilo HI 96721

September 20, 2011

OCT 11 2011

Mr Peter Phillips,
SCD-TSA Kaloko Makai LLC
1100 Alakea St 27th Floor
Honolulu HI 968133

Wilson Okamoto Corp
1907 S Beretania, St Ste 400
Honolulu HI 96826
Attn: Mr Earl Matsumoto AICP

State Land Use Commission
DBEDT
P.O. Box 2539
Honolulu HI 96804
Mr Orlando Dan Davison, Exec Officer

RE: Kaloko Makai, North Kona, Hawaii Island TMK (3) 7-3-09:, 017. 025, 026, 028, 63, 19, 62

Dear Mr Philipps et al,

Sierra Club is writing in response the EIS for the proposed Kaloko Makai development project. We are concerned that the project could have significant, deleterious and irreversible effects on the natural and cultural resources of the Kaloko Honokohau National Historical Park (KHNHP), which is situated downslope of the development proposed.

The KHNHP is comprised of significant cultural resources, including ancient Hawaiian fishponds, anchialine ponds, and nearshore coastal waters important for fishing and gathering by native Hawaiians, and for education and recreation for the public including Sierra Club members. The water features provide habitat for federally protected and candidate endangered species, including the Hawaiian stilt and Hawaiian coot, migratory waterfowl, and hoary bat. The near shore waters and coral reef ecosystems are host to native endemic and indigenous species.

We are concerned that the development and use of wells in the high level aquifer to support the project may affect the availability of groundwater that supports the fishponds, wetlands, and anchialine ponds downslope. The anchialine ponds support endemic and native flora and fauna that depend on brackish groundwater. The pools, ponds, wetlands and offshore coral reef ecosystems are all dependent on freshwater stored in the basal lens and perched aquifers. Withdrawals from the high-level aquifer could affect the basal lens, decreasing water levels and increasing salinity.

4.10.1 Water System
The DEIS (p 4-106) projects 3-4.7 million gallons a day demand for the project at build-out. The water in the high level aquifer identified may or may not be of sufficient quantity or quality to provide potable water at this rate. The Water Use and Development Plan states that the demand for water for existing permitted uses (not including this proposal) is twice the amount available in the aquifer. The DEIS does not provide the necessary quantitative data to describe or assess the environmental impacts to regional groundwater and to the National Park, whose cultural and natural resources are dependent on groundwater quantity and quality. A plan to secure water quantities for the proposed development is not complete, and data is not provided to show sustainable use. As a result, the impacts to the National Park and mitigation measures have not been adequately addressed in this DEIS. The lack of information is demonstrated by the proposal that desalinization may be necessary of groundwater is too saline or insufficient. If 3-4.7 MGD is required to develop the project, what is the full hydrologic implication of removal of that quantity of water on regional sustainability? Oki et al. (1999) showed that groundwater flux to the coast along Kaloko-Honokohau NHP has decreased by ~50% and water levels throughout the National Park have dropped by ~0.6 ft since 1978 in response to modest levels of withdrawal. The demand for this project requires much higher withdrawal levels. Saltwater intrusion into the local aquifers would be an irreversible, significant long-term adverse impact to the local ecosystem and future groundwater use.

The desalination option proposed would source water from a source not identified. After reverse osmosis, the project would discharge concentrated saline brine and conditioning chemicals into a proposed well below the basal lens. The discharge could have unknown and unforeseen impacts on the coral reef ecosystems along the coastline.

4.10.2 Wastewater System and 4.10.3 Drainage System
The area proposed for development has highly permeable lava with little soil. Rain and surface runoff carry pollutants, both to groundwater discharged offshore, and to surface waters that enter the wetlands, pools, ponds and coastline downslope. The impact of polluted surface-water runoff from roadways, houses, commercial areas, hospital, schools, irrigation of recreation facilities and more, on increased nutrients and pollutants (such as petroleum products, metals, pesticides) in surface runoff is inadequately described. The total amount of nutrients to the nearshore will be greater due to the increased flow rates exacerbated by paving areas that are now permeable.

Sheet flow of storm runoff will occur on the proposed development. Surface water runoff even during low rainfall will carry pollutants and nutrients to groundwater and coastal waters Mitigation should discuss a ten year flood and a 100 year flood, and outline the overall stormwater management plan, impacts, and responsibilities.

The claim on the same page that "surface runoff does not occur" due to the high permeability of the natural ground surface, is not grounded. Surface runoff is high following rainfall events. For example on July 29, 2006, Hurricane Daniel led to rainfall measuring 1.08 inches per hour was observed by NPS staff, with large quantities of water flowing as sheet flow across areas of natural unpaved ground and impervious surfaces. In February 1, 2007, more than 3 inches in 3 hours (4.37 inches of rainfall in 24-hr) fell in the area, according the NPS RAWS rainfall data. The Rainfall Atlas of Hawaii provides a range of 19.6-29.5 inches per year. Planning for retention of runoff during the high rainfall events is the only way to reduce the impact on the sensitive ecosystems downslope. Unmitigated, this discharge water would to enter the enter Class AA waters. HAR §11-54-03(c) (1) states, in part, "It is the objective of Class AA

waters that these waters remain in their natural pristine state as nearly as possible with an **absolute minimum of pollution or alteration of water quality from any human-caused source or actions.** [emphasis added] To the extent practicable, the wilderness character of these areas shall be protected." As a result of this development, water quality would be significantly altered by human caused actions in contradiction to HAR §11-54-03(c) (1).

According to the DEIS (p 4-132) Stormwater over the site to be developed (changed from permeable surface to paved hardened surface) will either percolate directly into the ground or will be collected in catch basins and disposed of in drywells throughout the developed area. There is no discussion of the treatment or filtration of the runoff for non-point source pollutants prior to percolation into the groundwater that will directly affect the National Park downslope. The DEIS offers few details on the site design of stormwater system, the discharge points for 10-yr and 100-yr stormwaters, or impacts to receiving water bodies. County and state stormwater requirements are not designed to protect ecosystems, only drinking water. The drywell system is no more than a hole in the ground and offers no additional protections to groundwater.

The DEIS (p 4-132) assumes that 15% of applied R-1 (recycled water) irrigation water percolates downward to the groundwater, and that removal rates of nitrogen and phosphorus from the water "will be significant".

Hawaii water quality standards state the following for basic water quality criteria applicable to all waters: "All waters shall be free of substances attributable to domestic, industrial, or other controllable sources of pollutants, including ... (5) Substances or conditions or combinations thereof in concentrations which produce undesirable aquatic life;" [HAR §11-54-4 (a)] It is possible that the significant changes resulting from the various aspects of the water features may create conditions that are beneficial to pathogens or alien invasive species. Currently, the state of West Hawaii's reefs is good (e.g., Waddell 2005). However, a current University of Hawaii study contracted by the County of Hawaii (Wiegner et al. 2006) analyzed available long term water quality data for coastal developments in West Hawaii and suggests that "conditions in West Hawaii may be developing for extreme environmental degradation, possibly resulting in algal blooms like those in West Maui" (Wiegner et al. 2006, page 5).

Protective measures regarding non-point source pollution could include storm drain, roadway and parking lot drainage wells to filter petrochemical pollutants in the drainage basin. Fertilizers and pesticides applied to landscaped areas also affect surface water runoff, and percolation through thin undeveloped soil layers will not mediate these pollutants. Ideally all surface runoff would be subject to waste water treatment. Pollutants in surface water not subject to treatment will *not* be effectively filtered by the porous basalt.

Mitigation measures proposed in the DEIS include recommendations and suggestions that others, including homeowners, would be encouraged to follow. None are required, and the agencies reviewing have no means to require the implementation, nor is there a timetable for implementation, monitoring or reporting. The BMPs mentioned are not discussed in detail.

The groundwater monitoring program described on 3-45 should be increased in frequency; monthly monitoring beginning before the initiation of the project, and continuing for at least ten years following completion should be included as a condition.

Natural Resources

Anchialine pools in particular could be susceptible to degradation by poor water quality. The loss of anchialine pools and their rare endemic inhabitants (two of which are candidate endangered species) would be significant and irreversible. Anchialine pools are an important cultural and natural resource being lost island-wide to development. The pools on this site in particular have **national significance** and were specifically described in the nomination form designating the Honokohau Settlement National Historic Landmark. Preservation of these unique and nationally significant resources is of paramount importance.

Page 3-57 states "The development of this site does not pose direct threats to these (wetland bird) species or their habitat, although, the potential exists that the development could pose secondary threats to the National Park and to its endangered birds if noxious substances such as petroleum, oils lubricants, and sewage were to migrate downslope (makai) from the project into the Park."

Primary threats, such as reduced groundwater flow into the wetlands, pools and coastal reefs, and secondary threats, such as polluted runoff, are significant, and are not sufficiently addressed in the DEIS.

Botanical Resources
The Dryland Forest comprises 265 Acres, and includes four endangered species; ma`aloa,hala pepe, uhiuhi and `aiea. Other native trees include lama, maia pilo, mamane, `ohi`a lehua, `ohe, naio, and `a`ali`i. Given the extreme rarity of intact dryland forest and the high quality of this remnant, we recommend that the entire 254 acres be preserved and managed, as opposed to the loss of 100 acres of dryland forest to development. Figure 3-15 shows only the 150 acres proposed for protection, but it would be helpful to see the entire dryland remnant in the figure.

4.2.8 Cultural Resources, Traditional Practices
Kaloko-Honokohau National Historical Park is a high cultural-use area for subsistence fishing. An outbreak of ciguatera as a result of the proposed project would affect traditional subsistence fishing, and pose a significant human health hazard. The Kona coast already leads the state in ciguatera poisoning (Gollop 1992, Ley 2002, Parsons *in press*). The ciguatera-causing dinoflagellate, *Gambierdiscus toxicus*, has been known to increase in concentrations after human or natural disturbances, including harbor construction (Randall 1958, Anderson & Lobel 1987). Thus, the project could cause a local outbreak of ciguatera in the National Park.

The Land Use commission has recognized the potential adverse impacts of upslope development , and found that "...for all proposed development adjacent to or near a National Park that raises threats of harm to the environment, cultural resources, or human health, precautionary measures should be taken to protect the NP cultural and natural resources..." (2002 Decision and Order on Docket A00-732).

3.7 Fauna
The project will cause the increase of predatory species in the area, including pets, feral cats and dogs, and invasive species such as mongoose and rats. These animals will have impacts on the native birds and waterfowl in the National Park. The predators will move into the NP lands, increasing pressure on endangered populations. The direct and cumulative impact and its mitigation is not addressed in the DEIS.

4.1 Archaeological Resources
The project proposes to permanently destroy archaeological sites Given the cultural significance of the site, and the numerous trails to the upland resources, we would prefer to see farm ore of the archeological resources set aside for preservation.

4.3 Trail Access
Trails to lava tubes used for gathering water, burial, fortification, shelter, and agriculture are ample evidence of intensive use of the area. All trails should be preserved, along with the sites associated with them.

4.10.5 Electrical (Light)
Project lighting will also have a negative effect on visual resources and nightscape in the National Park. Light pollution of the night sky will interfere with visitor experience and evening traditional cultural practices. No impact analysis of light pollution, or its mitigation, to the National Park is made in the DEIS. Page 3-57 does say "The principal potential impact that the development of this site poses to Hawaiian Petrels and Newell's Shearwaters is the increased threat that birds will be downed after becoming disoriented by external lights associated with the new development. To reduce the potential for interactions between nocturnally flying birds with external lights and man-made structures, any external lighting that may be required in conjunction with development of the project will be shielded. This mitigation would serve the dual purpose of minimizing the threat of disorientation and downing of birds, while at the same time complying with the Hawai'i County Code § 14 – 50 *et seq.* which requires the shielding of exterior lights so as to lower the ambient glare caused by unshielded lighting to the astronomical observatories located on Mauna Kea."

Page 3-60 "Light is attractive to all arthropods. The potential presence of *Manduca blackburni* in the greater area makes shielded lighting an important protection for this endangered invertebrate. As discussed in 3.7 external lights will be shielded and comply with the Hawai'i County Code § 14 – 50 *et seq.*"

We would like to see discussion of the lighting effects on species of concern from sources such as the Kilauea National Refuge on Kauai to discern the applicability of the lighting codes for species protection.

8.2 Cumulative Impacts

Cultural and Recreational impacts:
The preferred alternative would lead to Irretrievable loss of open space and would obscure mauka-makai views to the shoreline. The cultural sense of place at the National Park would be impacted by the urban expansion. The view from shoreline to the summit of Hualalai would be impacted by development. The views of the mountain and the entire viewshed are of utmost importance to traditional practices. It is not clear in the DEIS how makai to mauka viewsheds would be preserved by the proposed construction. The DEIS does not provide a visual impact analysis of vertical structures proposed for the site on surrounding view-planes, including from within the National Park. This type of analysis is critical for public review and comment. Visual impact analysis that takes into account the estimates of the proposed site grading heights and height details of each building to reveal how each would be elevated above the current natural grade, or above a baseline of sea level.

8.5 Probably Adverse Environmental Effects that Cannot be Avoided

The absence of discussion regarding the impacts to the National Park is notable. This glaring omission provides grounds to request that this DEIS be withdrawn, to be resubmitted with completed studies in place.

Review of the DEIS shows that the proposed development is incompatible with the KHNHP, and would have major, adverse, long-term irreversible impacts to the natural and cultural resources. The precautionary principle must be applied in this case, and we recommend the no action alternative be applied in this case.

Sincerely,

Deborah Ward

Deborah Ward
Conservation Committee
Moku Loa Group, Sierra Club, Hawaii Chapter

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7469-01
July 25, 013

Ms. Deborah Ward
Conservation Committee
Moku Loa Group, Sierra Club, Hawaii Chapter
P.O. Box 918
Kurtistown, HI 96760

Subject: Draft Environmental Impact Statement (DEIS)
Kaloko Makai
Kaloko and Kohanaiki, North Kona, Hawaii
Tax Map Key: (3) 7-3-09: 017, 025, 026, and 028

Dear Ms. Ward:

Thank you for your letter dated September 20, 2011. The Petitioner is preparing a Second DEIS to address changes in the proposed project that will be reassessed, as needed, in the forthcoming document. You will be notified of its availability for review and comment pursuant to Chapter 343, Hawaii Revised Statutes (HRS) and Title 11, Chapter 200 Hawaii Administrative Rules (Department of Health).

With regard to your comments on the subject DEIS, we offer the following in response to your comments:

Sierra Club is writing in response the EIS for the proposed Kaloko Makai development project. We are concerned that the project could have significant, deleterious and irreversible effects on the natural and cultural resources of the Kaloko Honokohau National Historical Park (KHNHP), which is situated downslope of the development proposed.

The KHNHP is comprised of significant cultural resources, including ancient Hawaiian fishponds, anchialine ponds, and nearshore coastal waters important for fishing and gathering by native Hawaiians, and for education and recreation for the public including Sierra Club members. The water features provide habitat for federally protected and candidate endangered species, including the Hawaiian stilt and Hawaiian coot, migratory waterfowl, and hoary bat. The near shore waters and coral reef ecosystems are host to native endemic and indigenous species.

We are concerned that the development and use of wells in the high level aquifer to support the project may affect the availability of groundwater that supports the fishponds, wetlands, and anchialine ponds downslope. The anchialine ponds support endemic and native flora and fauna that depend on brackish groundwater. The pools, ponds, wetlands and offshore coral reef ecosystems are all dependent on freshwater

stored in the basal lens and perched aquifers. Withdrawals from the high-level aquifer could affect the basal lens, decreasing water levels and increasing salinity.

Response: Two deep monitor wells (State Nos. 3858-01 and 3959-01) have provided insight on the occurrence of high level groundwater and its relationship to the brackish basal lens that exists in the nearshore area including Kaloko-Honokōhau National Historic Park. These deep monitor wells establish that most, if not all of the high level groundwater passes far beneath the basal groundwater rather than discharging into it. Results of these two wells indicate that the subsurface "mechanism" creating the high level groundwater and its physical separation from the basal lens is a series of poorly permeable lavas flows which total hundreds of feet thick and create an effective hydrologic separation between the two groundwater bodies.

The water supply alternatives for the Kaloko Makai project have been developed specifically to eliminate any impact on the basal groundwater that flows beneath the Kaloko-Honokōhau National Historic Park and discharges along its shoreline. A well will be drilled at the upper end of the project site. If it encounters a developable supply of "high level" groundwater from the strata at depth below the confining poorly permeable lava flows, pump testing and extensive monitoring during this testing would be undertaken to demonstrate that drawing water from this stratum would have no impact on the basal lens, hence no impact on Kaloko-Honokōhau National Historic Park. If that fact is affirmatively demonstrated, on-site production wells would be developed to tap this resource.

In the event that groundwater at depth below the basal lens can not be developed at all or without impact to the basal lens, desalinization would be utilized as the project's source of drinking water supply. In this case, wells would be developed at lower elevation on the project site and they would draw saline groundwater from beneath the basal lens, again with the affirmative demonstration that this use would not impact the overlying basal groundwater that flows through Kaloko-Honokōhau National Historic Park and discharges at the shoreline.

Section 3.5 in the forthcoming Second DEIS includes a discussion on groundwater source alternatives, potential impacts to groundwater resources and nearshore marine environment.

4.10.1 Water System
The DEIS (p 4-106) projects 3-4.7 million gallons a day demand for the project at build-out. The water in the high level aquifer identified may or may not be of sufficient

quantity or quality to provide potable water at this rate. The Water Use and Development Plan states that the demand for water for existing permitted uses (not including this proposal) is twice the amount available in the aquifer. The DEIS does not provide the necessary quantitative data to describe or assess the environmental impacts to regional groundwater and to the National Park, whose cultural and natural resources are dependent on groundwater quantity and quality. A plan to secure water quantities for the proposed development is not complete, and data is not provided to show sustainable use. As a result, the impacts to the National Park and mitigation measures have not been adequately addressed in this DEIS. The lack of information is demonstrated by the proposal that desalinization may be necessary of groundwater is too saline or insufficient. If 3-4.7 MGD is required to develop the project, what is the full hydrologic implication of removal of that quantity of water on regional sustainability? Oki et al. (1999) showed that groundwater flux to the coast along Kaloko-Honokohau NHP has decreased by ~50% and water levels throughout the National Park have dropped by ~0.6 ft since 1978 in response to modest levels of withdrawal. The demand for this project requires much higher withdrawal levels. Saltwater intrusion into the local aquifers would be an irreversible, significant long-term adverse impact to the local ecosystem and future groundwater use.

Response:

There are several points to be made in response to this comment:

- As is shown in the Second DEIS, at full build out, the project's potable and non-potable supply requirements will be 2.18 and 0.58 MGD, respectively.
- The non-potable supply will be provided by recycled, R-1 quality wastewater.
- The potable supply will be provided by one of the three alternatives described in the first response above, none of which would diminish the flowrate in the basal lens passing through Honokohau National Park.
  - If wells at 710-foot elevation tapping high level groundwater at depth do not require desalination treatment, they would be dedicated to DWS with one third of their capacity used by DWS for other users in North Kona. Total draft of groundwater would be 3.27 MGD, 2.18 MGD for the Kaloko Makai project and the remainder for other DWS customers.
  - If the 710-foot wells require desalination threatment, they would remain private. At a product recovery rate on the order of 60 to 70 percent, total groundwater pumpage would be about 3.33 MGD. The additional 1.15 MGD would be concentrate from the desalination plant which would be disposed of into the lower part of the basal lens at a depth of comparable salinity. Such disposal would actually increase the flow of basal groundwater flowing beneath the Park.
  - If the potable supply is produced using low elevation wells (363-foot elevation) drawing saline groundwater from beneath the basal lens, this draft and its RO concentrate disposal would have no impact on the basal lens.
- The Oki et al (1999) study you reference does not incorporate recent findings of the high level groundwater occurrence. It also does not have the benefit of the recent assessment of groundwater recharge by the US Geological Survey (Engott, 2011) which shows the recharge in the Keauhou Aquifer to be 77 percent greater than in the CWRM's 2008 Water Resource Protection Plan.

The desalination option proposed would source water from a source not identified. After reverse osmosis, the project would discharge concentrated saline brine and conditioning chemicals into a proposed well below the basal lens. The discharge could have unknown and unforeseen impacts on the coral reef ecosystems along the coastline.

Response: The forthcoming Second DEIS will discuss alternative sources of water, including those that will require desalination through reverse osmosis (RO). All chemicals used in the periodic maintenance of the RO desalinization filters would be collected, neutralized, and then treated prior to disposal. The concentrate produced by RO desalinization will be disposed of in deep wells which will deliver the concentrate into the saline zone far below the basal lens. It will discharge at depth offshore and have no impact to the coastal ecosystem.

4.10.2 Wastewater System and 4.10.3 Drainage System

The area proposed for development has highly permeable lava with little soil. Rain and surface runoff carry pollutants, both to groundwater discharged offshore, and to surface waters that enter the wetlands, pools, ponds and coastline downslope. The impact of polluted surface-water runoff from roadways, houses, commercial areas, hospital, schools, irrigation of recreation facilities and more, on increased nutrients and pollutants (such as petroleum products, metals, pesticides) in surface runoff is inadequately described. The total amount of nutrients to the nearshore will be greater due to the increased flow rates exacerbated by paving areas that are now permeable.

Response: Potential sources and their respective amounts of nutrients that would be added to the basal groundwater by the project are identified and calculated in "An Assessment of the Potential Impact of the Proposed Kaloko

Makai Project on Water Resources" by Tom Nance Water Resource Engineering (2013), which will be appended to the upcoming RDEIS. These results are summarized in Table 4 of that report as follows: a 6.2% increase in the basal groundwater flowrate; a -5.1 % decrease in the salinity of the basal groundwater; a 5.2% increase in nitrogen; and a 2.1% increase in phosphorus.

As anchialine pools have been shown not to be nutrient limited systems, these small increases in nutrients in groundwater will have no effect on pools or fishponds. In addition, the flux of nutrients to the nearshore ocean off the project site has been reported and discussed in the Assessment of Marine and Pond Environments prepared by Marine Research Consultants. The assessment will be included in the forthcoming Second DEIS. In brief, the expected change in nutrient flux to the ocean will be inconsequential in terms of effects to marine biotic community structure owing to rapid mixing. Much of the coastal areas of West Hawaii receive far more nutrient input from naturally occurring groundwater with no effect.

Sheet flow of storm runoff will occur on the proposed development. Surface water runoff even during low rainfall will carry pollutants and nutrients to groundwater and coastal waters Mitigation should discuss a ten year flood and a 100 year flood, and outline the overall stormwater management plan, impacts, and responsibilities.

Response: The design concept for the drainage system is to eliminate surface runoff from leaving the site in compliance with County of Hawaii design standards. These standards are not directly based on a specific flood event. Natural areas, seepage pits, and dry wells will collect runoff and allow it to infiltrate rather than leave the site as surface water. The passage of such runoff from the ground surface to the groundwater below, though the unsaturated (vadose) zone, provides natural filtration and adsorption. Surface runoff from most of the developed areas in Kailua-Kona is handled in a similar manner without identifiable adverse impacts to groundwater or the makai environment.

The claim on the same page that "surface runoff does not occur" due to the high permeability of the natural ground surface, is not grounded. Surface runoff is high following rainfall events. For example on July 29, 2006, Hurricane Daniel led to rainfall measuring 1.08 inches per hour was observed by NPS staff, with large quantities of water flowing as sheet flow across areas of natural unpaved ground and impervious surfaces. In February 1, 2007, more than 3 inches in 3 hours (4.37 inches of rainfall in 24-hr) fell in the area, according the NPS RAWS rainfall data. The Rainfall Atlas of Hawaii provides a range of 19.6-29.5 inches per year. Planning for retention of runoff during the high rainfall events is the only way to reduce the impact on the sensitive ecosystems downslope. Unmitigated, this discharge water would to

enter the enter Class AA waters. HAR §11-54-03(c) (1) states, in part, "It is the objective of Class AA waters that these waters remain in their natural pristine state as nearly as possible with an ***absolute minimum of pollution or alteration of water quality from any human-caused source or actions.*** *[emphasis added] To the extent practicable, the wilderness character of these areas shall be protected." As a result of this development, water quality would be significantly altered by human caused actions in contradiction to HAR §11-54-03(c) (1).*

Response: Rainfall runoff does occur locally from impervious surfaces, both natural and manmade, but as soon as this surface flow crosses into a naturally pervious area, it is lost to seepage. Development of the project will obviously create additional impervious surfaces. However, this surface flow will be directed to pits, sumps, drywells and naturally pervious areas such that surface runoff will not leave the project site. Contaminants in the surface runoff disposed of in this manner, in the process of percolating downward though the unsaturated lavas to the basal groundwater below, will be naturally filtered and adsorbed, thereby removing a substantial fraction of these contaminants. Virtually all of Kailua-Kona has handled surface runoff in this manner for decades with no identifiable negative impacts on coastal resources.

Storm events which create sufficient runoff for continuous surface flow from the project site, across or beneath Queen Kaahumanu Highway, and across the Park property to discharge at the shoreline would leave unmistakable eroded pathways and deposits of soil washed down with the runoff. There is no such physical evidence on the project site or anywhere across the Park site. The project site and the Park site downgradient do not have such runoff potential.

According to the DEIS (p 4-132) Stormwater over the site to be developed (changed from permeable surface to paved hardened surface) will either percolate directly into the ground or will be collected in catch basins and disposed of in drywells throughout the developed area. There is no discussion of the treatment or filtration of the runoff for non-point source pollutants prior to percolation into the groundwater that will directly affect the National Park downslope. The DEIS offers few details on the site design of stormwater system, the discharge points for 10-yr and 100-yr stormwaters, or impacts to receiving water bodies. County and state stormwater requirements are not designed to protect ecosystems, only drinking water. The drywell system is no more than a hole in the ground and offers no additional protections to groundwater.

Response: The design concept for the drainage system is to eliminate surface runoff from leaving the site. Use of detention basins, natural swales, pits, and dry wells will collect runoff and allow it to infiltrate rather than leave the site as surface water. The passage of such runoff from the ground surface to the

groundwater below, though the unsaturated (vadose) zone, provides natural filtration and adsorption. Surface runoff from most of the developed areas in Kailua-Kona is handled in a similar manner without identifiable adverse impacts to groundwater or the makai environment. This information will be included in the forthcoming Second DEIS.

The DEIS (p 4-132) assumes that 15% of applied R-1 (recycled water) irrigation water percolates downward to the groundwater, and that removal rates of nitrogen and phosphorus from the water "will be significant".

Hawaii water quality standards state the following for basic water quality criteria applicable to all waters: "All waters shall be free of substances attributable to domestic, industrial, or other controllable sources of pollutants, including ... (5) Substances or conditions or combinations thereof in concentrations which produce undesirable aquatic life;" [HAR §11-54-4 (a)] It is possible that the significant changes resulting from the various aspects of the water features may create conditions that are beneficial to pathogens or alien invasive species. Currently, the state of West Hawaii's reefs is good (e.g., Waddell 2005). However, a current University of Hawaii study contracted by the County of Hawaii (Wiegner et al. 2006) analyzed available long term water quality data for coastal developments in West Hawaii and suggests that "conditions in West Hawaii may be developing for extreme environmental degradation, possibly resulting in algal blooms like those in West Maui" (Wiegner et al. 2006, page 5).

Response: The report by Wiegner et al. 2006 has been shown to be without merit for many reasons and does not present a valid interpretation of long-term trends of impacts (or lack of impacts) from shoreline development to marine waters. As an example, this report is seriously flawed in that it does not recognize that naturally occurring groundwater contains nutrient concentrations far above marine waters. For this reason alone, this report cannot be cited as a justification of environmental degradation.

The Second DEIS includes an assessment of potential impacts to water resources which estimates an increase of 5.2% in nitrogen and 2.1% increase in phosphorous over present groundwater flow as a result of excess applied irrigation.

Protective measures regarding non-point source pollution could include storm drain, roadway and parking lot drainage wells to filter petrochemical pollutants in the drainage basin. Fertilizers and pesticides applied to landscaped areas also affect surface water runoff, and percolation through thin undeveloped soil layers will not mediate these pollutants. Ideally all surface runoff would be subject to waste water

treatment. Pollutants in surface water not subject to treatment will not be effectively filtered by the porous basalt.

Response: We acknowledge your comments regarding protective measures and. The design concept for the drainage system is to eliminate surface runoff from leaving the site. Use of detention basins, natural swales, seepage pits, and dry wells will collect runoff and allow it to infiltrate rather than leave the site as surface water. The passage of such runoff from the ground surface to the groundwater below, though the unsaturated (vadose) zone, provides natural filtration and adsorption. Surface runoff from most of the developed areas in Kailua-Kona is handled in a similar manner without identifiable adverse impacts to groundwater or the makai environment.

Mitigation measures proposed in the DEIS include recommendations and suggestions that others, including homeowners, would be encouraged to follow. None are required, and the agencies reviewing have no means to require the implementation, nor is there a timetable for implementation, monitoring or reporting. The BMPs mentioned are not discussed in detail.

Response: As mentioned in the Draft EIS, all drainage improvements will be developed in accordance with the applicable DOH and County drainage requirements regarding runoff and non-point source pollution.

To reduce the potential non-point source pollution to impact groundwater and marine waters Kaloko Makai will:

- Design and construct best management practices to prevent violation of State water quality standards as a result of storm runoff discharges originating from Kaloko Makai. To the extent practicable and consistent with applicable laws, Kaloko Makai will design storm and surface runoff BMPs to treat the first flush runoff volume to remove pollutants from storm and surface runoff.
- Where applicable, design sub-surface drainage structures with a debris catch basin to allow the detention and periodic removal of rubbish and sediments deposited by runoff. Storm water runoff shall first enter the debris catch basin before flowing into any subsurface drainage structures. The debris catch basin's volume will be designed using current industry and engineering standards.
- Design and construct to the extent practicable and consistent with applicable laws, landscaped areas, including grassed or vegetative swales, grass filter strips, vegetated open space areas, or other advance storm water BMPs.

- Provide signs for all subsurface drainage structures with warnings such as "Dump No Wastes. Goes to Groundwater and Ocean. Help Protect Hawai'i's Environment."
- Develop Pollution Prevention Plan (PPP), before constructing Kaloko Makai that: 1) addresses environmental stewardship and non-point sources of water pollution that can be generated in residential areas, 2) provides BMPs for pollution prevention. The PPP will include water conservation, landscape runoff, erosion control, use of fertilizers and other chemicals, environmentally safe automobile maintenance, and management of household chemicals. The PPP will also include information on the National Park and the significant natural and cultural resources within the Park.

The groundwater monitoring program described on 3-45 should be increased in frequency; monthly monitoring beginning before the initiation of the project, and continuing for at least ten years following completion should be included as a condition.

Response: The developer will conduct quarterly monitoring prior to the start of construction, monthly during initial construction and one year following, and then quarterly thereafter for five years.

Natural Resources
Anchialine pools in particular could be susceptible to degradation by poor water quality. The loss of anchialine pools and their rare endemic inhabitants (two of which are candidate endangered species) would be significant and irreversible. Anchialine pools are an important cultural and natural resource being lost island-wide to development. The pools on this site in particular have ***national significance*** *and were specifically described in the nomination form designating the Honokohau Settlement National Historic Landmark. Preservation of these unique and nationally significant resources is of paramount importance.*

Page 3-57 states "The development of this site does not pose direct threats to these (wetland bird) species or their habitat, although, the potential exists that the development could pose secondary threats to the National Park and to its endangered birds if noxious substances such as petroleum, oils lubricants, and sewage were to migrate downslope (makai) from the project into the Park."

Primary threats, such as reduced groundwater flow into the wetlands, pools and coastal reefs, and secondary threats, such as polluted runoff, are significant, and are not sufficiently addressed in the DEIS.

Response: As indicated in a previous response, the impacts to water resources are identified and quantified in the 2013 report by TNWRE. The report will be included in the forthcoming Second Draft EIS.

As reported in TNWRE 2013, the proposed project will actually increase the potential for maintaining the health of anchialine pools by increasing hydraulic flux. As noted in Marine Research Consultants 2012, anchialine pools are not nutrient limited systems, so the small increases in nutrients that may result from the development will not change pond dynamics. The major factor responsible for degradation of anchialine pools is introduction of non-native fish, which prey upon naturally occurring pond biota which disrupts the metabolic balance.

Botanical Resources
The Dryland Forest comprises 265 Acres, and includes four endangered species; ma`aloa, hala pepe, uhiuhi and `aiea. Other native trees include lama, maia pilo, mamane, `ohi`a lehua, `ohe, naio, and `a`ali`i. Given the extreme rarity of intact dryland forest and the high quality of this remnant, we recommend that the entire 254 acres be preserved and managed, as opposed to the loss of 100 acres of dryland forest to development. Figure 3-15 shows only the 150 acres proposed for protection, but it would be helpful to see the entire dryland remnant in the figure.

Response: The entire Kaloko Makai project area is within the Kona Urban Area as set forth in the Kona Community Development Plan, and is designated as a TOD under the Official Kona Land Use Map. Additionally, Figure 2-7 "County General Plan Land Use Pattern Allocation Guide" delineates the portion of the dryland forest below (south) of Hina Lani as conservation and above (north) of Hina Lani as Urban Expansion. This is consistent with Kaloko Makai's land use plan and the boundaries of the Kaloko Makai Dryland Forest preserve.

The 150-acres of the proposed Kaloko Makai Dryland Forest Preserve was determined in consultation with the USFWS, FHWA and County of Hawaii. The Petitioner continues to consult with USFWS regarding the dryland forest.

4.2.8 Cultural Resources, Traditional Practices
Kaloko-Honokohau National Historical Park is a high cultural-use area for subsistence fishing. An outbreak of ciguatera as a result of the proposed project would affect traditional subsistence fishing, and pose a significant human health hazard. The Kona coast already leads the state in ciguatera poisoning (Gollop 1992, Ley 2002, Parsons in press). The ciguatera-causing dinoflagellate, Gambierdiscus toxicus, has been known to increase in concentrations after human or natural disturbances,

including harbor construction (Randall 1958, Anderson & Lobel 1987). Thus, the project could cause a local outbreak of ciguatera in the National Park.

The Land Use commission has recognized the potential adverse impacts of upslope development , and found that "...for all proposed development adjacent to or near a National Park that raises threats of harm to the environment, cultural resources, or human health, precautionary measures should be taken to protect the NP cultural and natural resources..." (2002 Decision and Order on Docket A00-732).

Response: The project's water supply will be designed to have no impact on the basal groundwater flowing beneath Kaloko-Honokōhau National Historic Park. These alternatives have been described above in an earlier response.

No aspect of this project will change any physical attributes of the Park, and the project does not include any harbor construction. Hence, the assumption that ciguatera outbreaks could result from the project has no basis.

3.7 Fauna
The project will cause the increase of predatory species in the area, including pets, feral cats and dogs, and invasive species such as mongoose and rats. These animals will have impacts on the native birds and waterfowl in the National Park. The predators will move into the NP lands, increasing pressure on endangered populations. The direct and cumulative impact and its mitigation is not addressed in the DEIS.

Response: The proposed project will increase the population of pets in the presently undeveloped Kaloko Makai project site. There is no evidence, however, to suggest that the existing feral dog and cat population in the area is at a threshold, such that any increase would cause their behavior to turn to predation upon native birds and waterfowl at the National Park. There has long been a feral dog and cat population in the vicinity of Honokohau Harbor that has thrived without becoming an increasing threat to native birds and waterfowl at the park.

4.1 Archaeological Resources
The project proposes to permanently destroy archaeological sites. Given the cultural significance of the site, and the numerous trails to the upland resources, we would prefer to see far more of the archeological resources set aside for preservation.

Response: All archaeological sites that were found and recorded in our AIS were given recommendations by the archeologists of Cultural Surveys Hawaii as to how the sites should be preserved. It is recommended that of the 341

sites in the project area, 80 sites be subjected to a program of data recovery to address scientific and informational concerns, and a total of 72 sites be preserved. The remaining 189 sites are not recommended to undergo further research, as the documentation and plotting during the survey has addressed the limited information available at these sites. These sites are classified under Criterion D significance only and are generally characterized as sites in poor structural condition, or sites such as minimally modified lava tubes, trail remnants, agricultural features or animal husbandry walls that lack excavation potential. Therefore, following additional data collection for the 80 sites, a total of 269 sites will not be preserved and may be impacted as construction work proceeds.

4.3 Trail Access
Trails to lava tubes used for gathering water, burial, fortification, shelter, and agriculture are ample evidence of intensive use of the area. All trails should be preserved, along with the sites associated with them.

Response: It should indeed be understood that all discussion of site types, functions, and mitigations should not be considered finalized until the AIS is approved by SHPD. We acknowledge that lava tubes were used for gathering water, burial, fortification, shelther and agriculture. A total of 57 trail remnants are described. While many of these are recommended for preservation it is true that many are recommended for no further work. Many of these trail segments are on the order of 10 m long. The SHPD has always supported judicious consideration of site preservation typically on a case-by-case basis.

4.10.5 Electrical (Light)
Project lighting will also have a negative effect on visual resources and nightscape in the National Park. Light pollution of the night sky will interfere with visitor experience and evening traditional cultural practices. No impact analysis of light pollution, or its mitigation, to the National Park is made in the DEIS.

Page 3-57 does say "The principal potential impact that the development of this site poses to Hawaiian Petrels and Newell's Shearwaters is the increased threat that birds will be downed after becoming disoriented by external lights associated with the new development. To reduce the potential for interactions between nocturnally flying birds with external lights and man-made structures, any external lighting that may be required in conjunction with development of the project will be shielded. This mitigation would serve the dual purpose of minimizing the threat of disorientation and downing of birds, while at the same time complying with the Hawai'i County Code § 14 – 50 et seq. which requires the shielding of exterior lights so as to lower the

ambient glare caused by unshielded lighting to the astronomical observatories located on Mauna Kea."

Page 3-60 "Light is attractive to all arthropods. The potential presence of Manduca blackburni in the greater area makes shielded lighting an important protection for this endangered invertebrate. As discussed in 3.7 external lights will be shielded and comply with the Hawai'i County Code § 14 – 50 et seq."

We would like to see discussion of the lighting effects on species of concern from sources such as the Kilauea National Refuge on Kauai to discern the applicability of the lighting codes for species protection.

Response: Kaloko Makai lighting mitigation measures will be in compliance with Hawaii County Code § 14 – 50, as stated in Section 3.7 of the DEIS. Thus, project lighting should not effect any species of concern.

8.2 Cumulative Impacts
Cultural and Recreational impacts:
The preferred alternative would lead to Irretrievable loss of open space and would obscure mauka-makai views to the shoreline. The cultural sense of place at the National Park would be impacted by the urban expansion. The view from shoreline to the summit of Hualalai would be impacted by development. The views of the mountain and the entire viewshed are of utmost importance to traditional practices. It is not clear in the DEIS how makai to mauka viewsheds would be preserved by the proposed construction. The DEIS does not provide a visual impact analysis of vertical structures proposed for the site on surrounding view-planes, including from within the National Park. This type of analysis is critical for public review and comment. Visual impact analysis that takes into account the estimates of the proposed site grading heights and height details of each building to reveal how each would be elevated above the current natural grade, or above a baseline of sea level.

Response: The entire Kaloko Makai project area is within the Kona Urban Area as set forth in the Kona Community Development Plan, and is designated as a TOD under the Official Kona Land Use Map. The development will change the visual appearance of the property from vacant land to a built environment in accordance with Kona CDP. The project area is flanked by light industrial uses along Hulikoa Drive and Kaloko Industrial Park to the south. In addition, the Kaloko Heights development is proposed immediately mauka of Kaloko Makai. Much of the viewplane of the project area from Queen Kaahumanu Highway is presently blocked by industrial/commercial developments.

8.5 Probably Adverse Environmental Effects that Cannot be Avoided
The absence of discussion regarding the impacts to the National Park is notable. This glaring omission provides grounds to request that this DEIS be withdrawn, to be resubmitted with completed studies in place.

Response: To the extent that impacts to the National Park can be determined, they were discussed in the DEIS and will be discussed in the forthcoming Second Draft EIS, based on comments received on the DEIS. Some of the concerns you raise regarding impacts via groundwater movement, however, were not substantiated by the *Assessment of the Potential Impact of the Kaloko Makai on Water Resources* (TNWRE, 2013) and the *Marine Assessment Report* (Marine Research Consultants, 2012) that will be appended in the forthcoming Second DEIS.

Review of the DEIS shows that the proposed development is incompatible with the KHNHP, and would have major, adverse, long-term irreversible impacts to the natural and cultural resources. The precautionary principle must be applied in this case, and we recommend the no action alternative be applied in this case.

Response: Please refer to our preceding response. The EIS process is intended to disclose potential environmental impacts. The decision to approve the project or pursue a no action alternative will be determined through the subsequent land use entitlement processes.

Your letter, along with this response, will be reproduced and included in the forthcoming Second DEIS. We appreciate your participation in the EIS review process.

Sincerely,

Earl Matsukawa, AICP
Project Manager

cc: Mr. Jay Nakamura, Stanford Carr Development
Mr. Daniel Orodenker, State Land Use Commission

Yukino Tanaka

From: Earl Matsukawa
Sent: Thursday, October 06, 2011 1:14 PM
To: Yukino Tanaka
Subject: FW: Kaloko comments with Surfrider heading included

Attachments: _kaloko DEIS-final KKE comments.docx

_kaloko DEIS-final KKE comment...

From: Janice Palma-Glennie [mailto:palmtree7@hawaiiantel.net]
Sent: Thursday, October 06, 2011 12:58 PM
To: Earl Matsukawa
Subject: Kaloko comments with Surfrider heading included

Aloha, earl,
Sorry about this. I just realized I hadn't said from whence the comments I sent came!
Please use this final draft as our testimony.
Mahalo again,
Janice

Surfrider Foundation Kona Kai Ea chapter
c/o P.O. Box 4849
Kailua-Kona, Hawai`I 96745

Mr Peter Phillips,
SCD-TSA Kaloko Makai LLC
1100 Alakea St 27th Floor
Honolulu HI 968133

State Land Use Commission
DBEDT
P.O. Box 2539
Honolulu HI 96804
Mr Orlando Dan Davison, Exec Officer

Wilson Okamoto Corp
1907 S Beretania, St Ste 400
Honolulu HI 96826
Attn: Mr Earl Matsumoto AICP

October 2, 2011

RE: Kaloko Makai, North Kona, Hawaii Island TMK (3) 7-3-09:, 017. 025, 026, 028, 63, 19, 62

Aloha Mr Philipps et al,

I am writing on behalf of our group's members in response to theproposed Kaloko Makai Draft Environmental Impact Statement (DEIS). Our concerns are based on the potential and irreversible damage which the project could have on natural resources, including the nearshore waters and cultural resources of the Kaloko Honokohau National Historical Park, Kohanaiki, `O`oma, and beyond.

Recreation, Culture, Water Quality
Our local organization's hundreds of members as well as thousands of national and international members and their ohana depend upon the health of both coastal waters and the aquifers which feed into them. Many of our members' involvement in surfing, paddling, fishing, and other ocean-related activities is based upon the cultural origin and historical value of those activities. As is true of many aspects of Hawaiian culture, the continuation of those practices depends upon the waters of this state being protected as Public Trust resources, as they are legally mandated to be. As is questioned in the National Park Service and other expert testimony, the DEIS for this proposed project does not provide evidence that assures the protection of those resources.

Native Habitat
The offshore waters fed by the aquifer which would flow from the proposed project are habitat to rare and endangered indigenous and endemic species of flora and fauna. Those species are culturally important as well as environmentally and economically significant to Hawai`I's residents and their quality of life. Environmentally sensitive wetlands, anchialine ponds, and fishponds are significant features directly downslope of this proposed development. As has been shown by studies including those of the University of Hawai`I, the integrity of these coastal ecosystems is being undermined by expanding urban and resort development. In the DEIS, there appear to be no guarantees that potential and extreme harm to sensitive habitat caused by excessive upslope development will, or realistically can be, mitigated.

Potable Water
A sufficient, reliable source for potable water has not been clearly identified.

Kona Community Development Plan (KCDP)
Our group supports implementation of the Kona Community Development Plan (KCDP). While that plan supports a Transit Oriented Development (TOD) to be created in this general area, the public charette process and comments of thousands of members of the public who took part in that process have made it clear that *their top priority for regional planning is protection of coastal resources, including cultural and environmental resources.* The most dense T-5 Urban Center is what this developer is requesting as described by the DEIS. However, a less dense T-3 or T-4 development would fulfill the KCDP's "Smart Growth" goals while creating far less damage to the fragile coastal resources mauka of it.

In relation to a potable water source, the North Kona region is known for being arid. Some water experts deny that there is enough potable water in this aquifer to sustain development already permitted and entitled in the proposed project area, no less to support the additional needs of such a high density, T-5 development.

In conclusion, a healthy coastline supports the recreational, cultural, and spiritual activities upon which our members depend for their quality of life. Because of that and other reasons, we question the proposed development's compatibility with the long-term goals of our community, especially as it relates to sustainable and smart regional growth. Meanwhile, we fully support and defer to the Kaloko-Honokohau National Cultural Park's experts regarding critical questions related to the proposed development and its DEIS. There are enough unanswered questions and inconsistencies in the document that relate to the potential damage to water quality, cultural integrity, and the flora and fauna that lead us to ask that this proposal be denied as described and outlined in the DEIS.

Mahalo for your consideration of our views and for this opportunity to work within the State's critical and public-inclusive land use process. Your decision of this project is critical to the well-being of our members and their extended island ohana.

Sincerely,

Janice Palma-Glennie
For the Surfrider Foundation's Kona Kai Ea chapter

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7469-01
July 25, 2013

Ms. Janice Palma-Glennie
Surfrider Foundation Kona Kai Ea Chaper
P.O. Box 4849
Kailua-Kona, HI 96745

Subject: Draft Environmental Impact Statement (DEIS)
Kaloko Makai
Kaloko and Kohanaiki, North Kona, Hawaii
Tax Map Key: (3) 7-3-09: 017, 025, 026, and 028

Dear Ms. Palma-Glennie:

Thank you for your letter dated October 2, 2011. The Petitioner is preparing a Second DEIS to address changes in the proposed project that will be reassessed, as needed, in the forthcoming document. You will be notified of its availability for review and comment pursuant to Chapter 343, Hawaii Revised Statutes (HRS) and Title 11, Chapter 200 Hawaii Administrative Rules (Department of Health).

With regard to your comments on the subject DEIS, we offer the following responses in the respective order of your comments:

1. *Recreation, Culture, Water Quality: Our local organization's hundreds of members as well as thousands of national and international members and their ohana depend upon the health of both coastal waters and the aquifers which feed into them. Many of our members' involvement in surfing, paddling, fishing, and other ocean-related activities is based upon the cultural origin and historical value of those activities. As is true of many aspects of Hawaiian culture, the continuation of those practices depends upon the waters of this state being protected as Public Trust resources, as they are legally mandated to be. As is questioned in the National Park service and other expert testimony, the DEIS for this proposed project does not provide evidence that assures the protection of those resources.*

   Response: We acknowledge your concerns regarding potential impacts on coastal, natural and cultural resources.

2. *Native Habitat: The offshore waters fed by the aquifer which would flow from the proposed project are habitat to rare and endangered indigenous and endemic species of flora and fauna. Those species are culturally important as well as environmentally and economically significant to Hawaii's residents*

and their quality of life. Environmentally sensitive wetlands, anchialine ponds, and fishponds are significant features directly downslope of this proposed development. As has been shown by studies including those of the University of Hawaii, the integrity of these coastal ecosystems is being undermined by expanding urban and resort development. In the DEIS, there appear to be no guarantees that potential and extreme harm to sensitive habitat caused by excessive upslope development will, or realistically can be, mitigated.

   Response: An Assessment of the Potential Impact on Water Resources and An Assessment of Marine and Pond Environments were prepared for the project by Tom Nance Water Resource Engineering (TNWRE) and Marine Research Consultants (MRC), respectively. Both reports will be included in the forthcoming Second DEIS.

   Results of analyses of changes to groundwater resulting from the proposed project as reported by TNWRE indicate that there will be an increase in hydraulic flux as well as a slight reduction in salinity of groundwater reaching the ponds. As sensitive wetland, anchialine pools and fishponds rely on input of freshwater, the predicted changes will not provide any detrimental alteration to these water bodies. In addition, as anchialine pools and fishponds are not nutrient limited, the small additions of dissolved nutrients that will be added to groundwater will not create any detrimental alteration to groundwater dynamics within ponds or wetlands. Time-course measurements reported by Marine Research Consultants in the fishponds indicate no detrimental changes to metabolic functioning within these water bodies resulting from existing development upslope of KAHO, which indicates that future increments of development will similarly have little or no effect.

3. *Potable Water: A sufficient, reliable source for potable water has not been clearly identified.*

   Response: Kaloko Makai is aware of the range of opinions that exist among water experts regarding ground water resources pertaining to development within the North Kona region. The Second DEIS includes a discussion of ground water resources and provides an outline of the proposed project's plans to source sufficient potable to water to sustain development, as well as measures to mitigate the water demands of such development.

   The alternatives being considered for the Project's drinking water supply have been narrowed down to those that can be affirmatively demonstrated as having no impact on the basal lens. These are limited to use of the high-level groundwater drawn from strata far below the basal groundwater so as not to

impact it and desalinizing saline groundwater, also drawn from below the basal lens.

A well will be drilled at the upper end of the Project Site. If it encounters a developable supply of high level groundwater from the strata at depth below the confining poorly permeable lava flows, pump testing and extensive monitoring during this testing would be undertaken to demonstrate that drawing water from this stratum would have not impact on the basal lens. If that fact is affirmatively demonstrated, on-site production wells would be developed to tap this resource.

In the event groundwater at depth below the basal lens cannot be developed at all or without impact to the basal lens, desalinization would be utilized as the project's source of drinking water. In this case, wells would be developed at lower elevation on the Project Site, drawing saline groundwater from beneath the basal lens.

4. *Kona Community Development Plan: Our group supports implementation of the Kona Community Development Plan (KCDP). While that plan supports a Transit Oriented Development (TOD) to be created in this general area, the public charette process and comments of thousands of members of the public who took part in that process have made it clear that their top priority for regional planning is protection of coastal resources, including cultural and environmental resources. The most dense T-5 Urban Center is what this developer is requesting as described by the DEIS. However, a less dense T-3 or T-4 development would fulfill the KCDP's "Smart Growth" goals while creating far less damage to the fragile coastal resources mauka of it.*

   In relation to a potable water source, the North Kona region is known for being arid. Some water experts deny that there is enough potable water in this aquifer to sustain development already permitted and entitled in the proposed project area, no less to support the additional needs of such a high density, T-5 development.

   In conclusion, a healthy coastline supports the recreational, cultural, and spiritual activities upon which our members depend for their quality of life. Because of that and other reasons, we question the proposed development's compatibility with the long-term goals of our community, especially as it relates to sustainable and smart regional growth. Meanwhile, we fully support and defer to the Kaloko-Honokohau National Cultural Park's experts regarding critical questions related to the proposed development and its DEIS. There are enough unanswered questions and inconsistencies in the document that relate

to the potential damage to water quality, cultural integrity, and the flora and fauna that lead us to ask that this proposal be denied as described and outlined in the DEIS.

Response: The Kaloko Makai development is consistent with the Kona CDP. The CDP was developed through, as you state, "the public charrette process and comments of thousands of members of the public who took part in that process". What was developed from the process was the CDP with which Kaloko Makai is in conformance.

Although the Kona CDP allows Kaloko Makai to be a Regional Center TOD, since the proposal includes reserve land for a regional hospital, heading the communities desire for a lower density development, Kaloko Makai has decided to develop a Neighborhood TOD with or without a hospital, as shown on the Official Kona Land Use Map of the Kona CDP. This change has been reflected in the Second DEIS.

The Kona CDP defined Transit-Oriented Development (TOD) as "The development of compact, mixed-use villages which would integrate housing, employment, shopping, and recreation opportunities. Villages would be designed around transit stations/stops which would reduce the need for daily trips and financially support the expanded transit system."

Additionally, please note that one of the alternatives described within the Second DEIS is the development of a "Neighborhood TOD with Maximum Density Permitted Under Kona CDP Guidelines".

This alternative assumes the existing Kaloko Makai layout (Figure 2-11,) including the GB, T3, T4, T5 and SD1 transects, and the Traditional Neighborhood Design component in the mauka-south portion of the property, are allocated units to each "T" transect according to the maximum allowable density permitted in the Kona CDP.

As noted, the maximum densities for the three primary transects of the Kona CDP are as follows: T3 Sub-Urban Zone, 6 units/acre; T4 General Urban Zone, 12 units/acre; T5 Urban Center Zone, 30 units per acre. Given the proposed Kaloko Makai layout, this equates to approximately 11,400-allowable residential units (however, Kaloko Makai is proposing a total of 5,000-units, less than half the total allowable unit count.)

Kaloko Makai proposes up to 600,000-square feet of gross leasable area of various commercial uses, including retail and office. The market analysis

supported development of previously proposed 1.1-million square feet (more than double the presently-proposed commercial space.)

In addition, as supported by the market analysis and consistent with the Kona CDP, a hospital site, 120 room Lodge and Business Center, 75 acres of SD1 and 150 acre dryland forest preserve will make up the balance of the development.

The Second DEIS also contains discussions of impacts to coastal resources, including cultural and environmental resources. This information will be considered in the processing of entitlements for the proposed project.

The County of Hawaii General Plan section 15.1 (February 2005, as amended) calls for the preparation of community development plans "to translate the broad General Plan statements to specific actions as they apply to specific geographical areas." The General Plan requires CDPs be adopted as an "ordinance", giving the plans force of law. The CDPs are long-term plans with a planning horizon to the year 2020, consistent with the General Plan.

The Hawaii County Planning Department recognized that only with broad public input can the Kona residents take ownership of the Kona Community Development Plan (Kona CDP,) by which they may embrace the vision and commit to a better future. Initiated in September 2005, this plan is the result of an extensive public process.

The Hawaii County Mayor and the Hawaii County Council appointed 15 citizens to serve on the Kona CDP Steering Committee, representing a cross-section of the Kona community. Several large community meetings were held. Additionally, recognizing that the process needed to go to the people, meetings were held at people's homes, churches and community centers.

One-hundred-and-nine meetings were held throughout Kona from November 2005 through January 2006. All these meetings received input from a balanced demographic and geographic representation of the North and South Kona Districts. Over 800 residents participated in the individual meetings.

Three-hundred-and-fifty people attended the Mapping the Future Workshop to brainstorm where future growth should occur. Breakout groups also addressed critical questions such as housing choice and affordability, agriculture, transportation and land use, congestion, parks/recreation/open space, protection of the environment, hazard mitigation, protection of ancestral and historic sites, community character, retail and tourism.

There were two charrettes, the first held in March 2006 and the other in June 2006. In the first charrette, the public identified alternative growth scenarios and selected a preferred scenario. In the second charrette, the public articulated desired principles to provide details for a preferred scenario.

Eleven working groups made up of citizens and community stakeholders met monthly, from May 2006 – September 2006, to focus in more detail on specific issue areas. Finally, the draft plan was recommended for approval by the Steering Committee, and then it was approved by the County Council and signed into law by the Mayor.

The Kona CDP is the first community development plan to commence under the framework of the February 2005 County of Hawai'i General Plan. The Kona CDP was adopted by County Council via ordinance in September 2008. The purposes of the Kona CDP are:

- Articulate Kona's residents' vision for the planning area;
- Guide regional development in accordance with that vision, accommodating future growth while preserving valued assets;
- Provide a feasible infrastructure financing plan to improve existing deficiencies and proactively support the needs of future growth;
- Direct growth to appropriate areas;
- Create a plan of action where government and the people work in partnership to improve the quality of life in Kona for those who live, work, and visit;
- Provide a framework for monitoring the progress and effectiveness of the plan and to make changes and update it, if necessary.

According to the General Plan, Urban Expansion Areas allow for a mix of high density, medium density, low density, industrial, industrial-commercial and/or open designations in areas where new settlements may be desirable, but where the specific settlement pattern and mix of uses have not yet been determined.

The Kona CDP recognizes that the General Plan Land Use Pattern Allocation Guide (LUPAG) Urban Area is larger than needed to accommodate the projected growth within the planning horizon, so it emphasizes that future growth within the urban area should be encouraged in a pattern of compact villages at densities that support public transit.

Transit-Oriented Developments (TODs) and Traditional Neighborhood Developments (TNDs) are identified as the planning tool to manage this anticipated growth within the defined "Kona Urban Area." The Kona CDP

defines these as compact mixed-use villages, characterized by a village center within a higher-density urban core, roughly equivalent to a 5-minute walking radius (1/4-mile), surrounded by a secondary mixed-use, mixed-density area with an outer boundary roughly equivalent to a 10-minute walking radius from the village center (1/2-mile).

The distinction between a TOD and TND is that the approximate location of a TOD is currently designated on the Official Kona Land Use Map along the trunk or secondary transit route and contains a transit station. TND locations, on the other hand, have not been designated and may be located off of the trunk or secondary transit route at a location approved by a rezoning action.

According to the Kona-CDP, Transit Oriented Development (TOD) and Traditional Neighborhood Design (TND) Village developments shall exhibit the following characteristics and conform to the following design principles:

a) Commercial Village or Neighborhood Villages with mixed uses. A mixture of non-residential and residential uses of various densities, intensities and types designed to promote walking between uses and a variety of transportation modes such as bicycles, transit, and automobiles.
b) Functional Villages. Villages are located and designed to embrace a full range of urban facilities including neighborhood retail centers, a variety of housing types, public/civic space and a variety of open space amenities,
c) Walkable streets. Village designs are based on reasonable walking distances, the location of parking and the design of streetlights, signs and sidewalks.
d) Interconnected circulation network. An interconnected street system that prioritizes pedestrians and bicycle features and links neighborhoods to shopping areas, civic uses, parks and other recreational features.
e) Respect for natural and cultural features. Development activity recognizes the natural and environmental features of the area and incorporates the protection, preservation and enhancement of these features.
f) Public Transit. A major public transit stop shall be located within the Village Center of most Villages.

Transit-Oriented Development (TOD) would integrate housing, employment, shopping and recreation opportunities. Villages would be designed around transit stations/stops, which would reduce the need for daily trips and financially support the expanded transit system. TOD Urban Villages are

located a minimum of one mile apart, between major transit stations, along the Keohokālole Highway trunk route, in order to preserve the transit efficiency of this route.

Transect Zones (T-Zones) organize the density, complexity and intensity of the land use within the TOD Village. The operating principle is that there is an urban core with a main center focus such as a transit station and plaza. This urban core area, which is spatially defined based on walkable distances called Pedestrian Sheds, has the highest density, complexity, and intensity of uses. The land uses transition to less dense uses moving away from the center.

The Transect Zones that correspond to the urban core, secondary area and greenbelt referred to in the Kona CDP and Village Design Guidelines are as follows (also noted are the allowable residential densities and building heights in each transect zone):

i. Urban Core
   1. T-5 Urban Center (Maximum density - 30 units per acre)
      i. Mix of residential units, such as townhouses, and apartments mixed with commercial, offices and retail
      ii. Typical Building Height: 2- to 5-Story with some variation (all, excluding attics and raised basements)
   2. T-4 General Urban (Maximum density - 12 units per acre)
      i. Neighborhood commercial uses with single-family and multi-family residential
      ii. Typical Building Height: 2- to 3-Story with a few taller Mixed Use buildings
ii. Secondary Area
   1. T-3 Suburban (Maximum density - 6 units per acre)
      i. Single-family units, with ancillary community and public uses, and neighborhood and convenience-type commercial uses
      ii. Typical Building Height is 1- to 2-Story with some 3-Story
iii. Greenbelt
   1. GB1, GB2 (Maximum density .25 units per acre)
      i. Greenbelt is an undeveloped area and may also serve multi-purpose uses, such as for drainage (e.g., flow ways or retention basins), sensitive resource preserves or wildfire protection buffers
iv. Mixed-Use Industrial
   1. SD1 (Maximum density - 12 units per acre)

The Kaloko Makai project was conceived, planned and designed to be consistent with the Hawaii County General Plan, the Keāhole to Kailua Development Plan (K-to-K Plan) and the Kona Community Development Plan (Kona CDP.) Kaloko Makai is situated in the Kona Urban Area of the Kona CDP and Urban Expansion Area in the General Plan and serves to implement these planning documents.

Kaloko Makai is a compact, mixed-use, master-planned community offering a wide range of housing types and affordability, and a variety of businesses and employment opportunities, focused around an initial urgent care medical facility with land available (at no cost) for a new Kona regional hospital.

Kaloko Makai has been designated as a Neighborhood Transit Oriented Development (TOD) in the Official Kona Land Use Map of the Kona Community Development Plan. Kaloko Makai also supports many of the Guiding Principles. Kaloko Makai:

- Directs future growth patterns toward compact centers – Kaloko Makai is planned around a compact urban center within the Kona Urban Area.
- Provides connectivity and transportation choices – Kaloko Makai will be transit-ready and is located along key alignments for regional transportation. The Petitioner will also contribute to the development of Ane Keohokālole Highway. The Project itself is planned to offer walking and biking trails in addition to vehicular roads.
- Provides housing choices – Kaloko Makai will offer a broad range of housing types including affordable as well as "market-priced" housing units. Offerings will range from traditional single-family homes to mid- and higher-density multifamily homes, and may include live-work and mixed use developments.
- Provides recreation opportunities – Kaloko Makai features a 150-acre dryland forest preserve, as well as numerous community parks, a district-scale park and trails.
- Provides infrastructure and essential facilities concurrent with growth – In addition to the recreational and transportation contributions noted above, Kaloko Makai is planned to include a Hospital and medical complex, Lodge and Business Center, two Elementary Schools and a Middle School.

Kaloko Makai is situated in a region that is rapidly developing, with immediate access to Kona International Airport and is adjacent to the well established commercial and light industrial-service centers of North Kona and Kailua

Kona which serve the needs of the visitor, agriculture, ranching and technology industries, among others, that populate the western half of the island.

As indicated in the Market Study prepared for the project (Appendix A in the DEIS and updated in the forthcoming Second DEIS) Kaloko Makai is planned to respond to the market and demographic trends, as well as community needs. The project will serve a County population that is changing in terms of size, geographic dispersion, age profile and lifestyle. Over the course of approximately 30-years Kaloko Makai will deliver the anticipated needed homes in a diverse, planned community.

The target market is the local, rather than the offshore, buyer. Overall, the project is intended to respond to already-anticipated economic growth, rather than to generate more of it. The project's inventory could represent a significant solution for the anticipated future unmet demand for some 9,400-new housing units through 2040, based on currently entitled projects and their plan maximums.

As noted, the maximum densities for the three primary transects of the Kona CDP are as follows: T3-Sub-Urban Zone, 6-units/acre; T4-General Urban Zone, 12-units/acre; T5-Urban Center Zone, 30-units per acre. Given the proposed Kaloko Makai layout, this equates to approximately 11,400-allowable residential units however, Kaloko Makai is proposing a total of 5,000-units, less than half the total allowable unit count.

Your letter, along with this response, will be reproduced and included in the forthcoming Second DEIS. We appreciate your participation in the EIS review process.

Sincerely,

Earl Matsukawa, AICP
Project Manager

cc: Mr. Jay Nakamura, Stanford Carr Development
Mr. Daniel Orodenker, State Land Use Commission

Ruth Aloua
MA Student
Department of Archaeology
Simon Fraser University
8888 University Drive
Burnaby, British Columbia V5A 1S6
808-326-4893 ~ raloua@sfu.ca

TF

SEP 22 2011

20 September 2011

Subject: Kaloko Makai DEIS Comments

To: Orlando Dan Davidson
Executive Officer
Land Use Commission
Department of Business, Economic Development and Tourism
P.O. Box 2359, Honolulu, HI 96804

This letter is being written on behalf of Kailua-Kona resident, Ruth Aloua to address concerns and questions for the Kaloko Makai DEIS. Areas of concern include, but are not limited to, archaeological resource protection, environmental impacts, Hawaiian traditional cultural practices and mixed-use development plans.

Archaeological Resources

A total of 341 archaeological sites were identified in the archaeological inventory survey for four land parcels; TMK 17, TMK 25, TMK 26 and TMK 28. Seventy two of the total 341 sites surveyed will be preserved. Presumably sixty five are assumed burials leaving only seven under the category of trails, housing sites, or religious structures. According to Mitigation Measures outlined in Section 4.2, interviewed participants requested that burials,"holding corrals" (puakini), and trails be preserved and protected. Based upon the current archaeological protection plan, only seven sites in addition to the sixty five burials will be preserved. Current preservation plans should be revised in accordance with community participants (Section 4.2).

In addition to these recommendations, SCD should consult with lineal and cultural descendents to understand the significance of the sites not included for preservation. Consultation with lineal and cultural practitioners is currently listed as a mitigation measure (4-57). These consultations should be conducted prior to the destruction of any archaeological site. Knowledge and insight gained through consultation will provide a better understanding of the archaeological landscape in relation to the significance of the Kaloko Makai development. By implementing these changes Kaloko Makai will meet their vision of:

> "perpetuating the life of the land in that which is pono (righteous), and to promote better understanding and aloha among SCD and the larger community, SCD will continue to meet, consult and cooperate with cultural practitioners regarding the protection and incorporation of Hawaiian cultural perspectives, traditions and practices in appropriate areas and segments of Kaloko Makai."
>
> (Wilson Okamoto Corporation and Ho'okuleana LLC 2011: 4-57)

Cultural Resources

Section 4.2 states that no specific ongoing traditional cultural practices were identified relative to the land within the property. This is false for the community consulted voiced concerns in regard to the disturbance of Ko'oko'olau which is a traditional plant used in Hawaiian medicine. According to Hawai'i Supreme Court ruling, *Ka Pa'akai O Ka 'Aina v. Land use Commission, State of Hawai'i.* 94 Haw.31 (2000) the developer must take the protection of native Hawaiian culture and rights into consideration. By doing so, the CIA contacted twenty-five people of which eighteen responded. Kaloko Makai is obligated to respond appropriately to their concerns.

Trails and Access

The DEIS does not provide a preservation plan for the mauka-makai trail which will be opened for public use. Other than a 10-feet wide buffer, there are no mitigation measures that deal with increased pedestrian use, possible bike use, vandalism, pollution and degradation. Incorporating the trail into the development will bring resource degradation because they will be used to connect communities. The development states in Section 2.2.1 that the mixed-use community will"emphasize non-vehicular transit for mainstream community-wide travel". In addition to Section 2.2.1, Section 4.2 explicitly outlines concerns voiced by community members regarding the preservation and protection of trails. These concerns must be addressed (*Ka Pa'akai O Ka 'Aina v. Land use Commission, State of Hawai'i.* 94 Haw.31).

In addition to trail preservation, trail modifications are subject to federal, state and county rules, regulations and laws. Furthermore, the relocation and realignment of the trail and cultural features found along the existing trail should be done through consultation with community members prior to any site altercations (4-57).

Flora/Vegetation

To promote and encourage traditional and customary practices the harvesting of native and introduced woods will be permitted during development land clearing (4-56). Currently, the State of Hawai'i regulates natural resource collection. These regulations promote and encourage Hawaiian traditional and customary practices to continue because primary sources cannot be harmed during gathering processes. The large scale land clearing that will be conducted by the developer will degrade traditional and customary practices. Hawaiian cultural practices will not be perpetuated, but rather eradicated due to intense land clearing

Native Dryland Forest

Kaloko Makai recognizes that:

> " As the Kaloko Makai development is home to one of the largest remaining areas of Dry land Forest in the Hawaiian Islands. The Dryland Forest is located within the southern portion of the project site. TheDryland Forest is unique in that it has not been heavily impacted by ungulates, and therefore, has minimal impact from alien plant species. This area covers approximately 265 acres (crossing over several ownership boundaries) of an 'a'a lava flow that is much younger than the surrounding pahoehoe flow.
>
> Dryland forests are the most impacted ecosystems in the Hawaiian Islands. While 42% of the rain forests in the Hawaiian Islands have been lost, 90% of the Dryland Forests have been eliminated. The remaining 10% has been heavily degraded by introduced plants and ungulates."
>
> (Wilson Okamoto Corporation and Ho'okuleana LLC 2011:3-49)

In accordance with the mitigation measures recommended by USFWS, Kaloko Makai will create a 150 acre dryforest preserve. The developer will manage invasive species within the project area, implement a fire safety plan, and propagate plants for the impacted ecosystem. Although these mitigation measures will protect more than 90% of the endangered species surveyed, dry land forest systems account for common, threatened, and endangered plant species. Preservation of Hawaii dry land forests must take best ecosystem management practices. These practices provide equal consideration for endangered, threatened and common plant species in relation to the surrounding environment. This approach delineates artificial boundaries created by zoning infrastructure. Hawaiian dryforest ecosystems are disappearing at an alarming rate.

Environmentally responsible BMP's involve not just the consideration of endangered and threatened species, but the landscape as a whole, for the environment is comprised of common species as well. For example, common plant species such as,
pua pilo (*Capparis sandwichiana*), alahe'e (*Psydrax odoratum*), 'ōhi'a lehua (*Metrosideros polymorpha*), naio (*Myoporum sandwicense*) lama (*Diospyros sandwicensis*), and māmane (*Sophora chrysophylla*) are natural buffers that prohibit non-native plant species from establishing in the ecosystem. These common plant species are providing a refuge for endangered species like
aiea (*Nothocestrum breviflorum*), ma'oloa (*Neraudia ovata*), hala pepe (*Pleomele hawaiiensis*),and uhiuhi (*Cesalpinia kavaiensis*). Elimination of these plant species may negatively affect current species.

Secondly, the Habitat Conservation Plan (HCP) addressed anticipated impacts on the dryland forest. The proposed actions within the HCP are subject to permits and funding. Currently, no definite funds are available to form the preservation area.

Transportation Improvements

Presently, there are no allocated funds available to deal with the cumulative traffic impacts (Section 4.4). The project will increase traffic congestion within the local vicinity and local roads. Increased use by the development will degrade the current transportation infrastructure. Although there are plans for a mixed-use transit oriented development, currently no funds exist. The lack of funds and increased use will put stress on local residents and the County of Hawai'i to maintain existing standards.

Type of Transit Oriented Development Village

The applicant has offered to provide 40 acres of land for the development of a regional Hospital. The state of Hawai'i will have to allocate the funds to construct, pay for and operate the Hospital facility. These funds are currently lacking for the state is facing economic constraints with supporting existing facilities. Also, project objectives include developing health care facilities in Kona that provide a range of health care services (Section 2.2.1). The donation of 40 acres does not support the project objective. Further evidence is needed to support that West Hawai'i will be able to provide and adequately support the increased population.

Mix-Use Community

Kaloko Makai states that a project objective is to, "Cultivate intrinsic respect for the land and natural surroundings, develop an inherent Hawaiian sense of place and nourish a sustaining living environment"(Section 2.2.1). Meeting this objective is not supported or discussed in the DEIS. Section 4 outlines mitigation measures that have been discussed in previous subsections outlined above. Further evidence is needed to support this statement.

Conclusion

Responsible planning and design should break Phase developments into individual EIS. Unforeseen long scale implications, such as, environment degradation, insufficient infrastructure, project overestimations, a lack of operation and management funds and capital investment will affect current development plans. Given that one cannot foresee challenges that will arise in 30 years it is strongly suggested that Phase plans be submitted individually. Each Phase will then be better equipped to provide and adjust to the community's needs and County infrastructure. Current plans regarding health facilities, transportation infrastructure, archaeological site and

dryland forest system preservation funds are lacking. The lack of funds will affect the overall project plans discussed in the DEIS.

Thank-you for your time and consideration.

Sincerely,

Ruth Aloua

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7469-01
July 25, 2013

Ms. Ruth Aloua
Department of Archaeology
Simon Fraser University
8888 University Drive
Burnaby, British Columbia V5A 1S6

Subject: Draft Environmental Impact Statement (DEIS)
Kaloko Makai
Kaloko and Kohanaiki, North Kona, Hawaii
Tax Map Key: (3) 7-3-09: 017, 025, 026, and 028

Dear Ms. Aloua:

Thank you for your letter dated September 20, 2011. The Petitioner is preparing a Second DEIS to address changes in the proposed project that will be reassessed, as needed, in the forthcoming document. You will be notified of its availability for review and comment pursuant to Chapter 343, Hawaii Revised Statutes (HRS) and Title 11, Chapter 200 Hawaii Administrative Rules (Department of Health).

With regard to your comments on the subject DEIS, we offer the following responses in the respective order of your comments:

1. *Archaeological Resources: A total of 341 archaeological sites were identified in the archaeological inventory survey for four land parcels; TMK 17, TMK 25, TMK 26 and TMK 28. Seventy two of the total 341 sites surveyed will be preserved. Presumably sixty five are assumed burials leaving only seven under the category of trails, housing sites, or religious structures. According to Mitigation Measures outlined in Section 4.2, interviewed participants requested that burials, "holding corrals" (Puakini), and trails be preserved and protected. Based upon the current archaeological protection plan, only seven sites in addition to the sixty five burials will be preserved. Current preservation plans should be revised in accordance with community participants (Section 4.2). In addition to these recommendations, SCD should consult with lineal and cultural descendents to understand the significance of the sites not included for preservation. Consultation with lineal and cultural practitioners is currently listed as a mitigation measure (4-57). These consultations should be conducted prior to the destruction of any archaeological site. Knowledge and insight gained through consultation will provide a better understanding of the archaeological landscape in relation to the significance of the Kaloko Makai development. By implementing these changes Kaloko Makai will meet their vision of: "perpetuating the life of the land in that which is pono (righteous), and to promote better understanding and aloha among SCD and the*

larger community, SCD will continue to meet, consult and cooperate with cultural practitioners regarding the protection and incorporation of Hawaiian cultural perspectives, traditions and practices in appropriate areas and segments of Kaloko Makai." (Wilson Okamoto Corporation and Ho'okuleana LLC 2011: 4-57)

Response: Seventy two of the sites surveyed are presently recommended to be preserved. While many of these sites-to-be-preserved do have a burial function many of those sites have other functions as well. Other types of sites recommended for preservation include trails, ahupua'a walls, ceremonial enclosures and platforms (possible heiau), excellent examples of temporary and permanent habitation complexes, animal husbandry walls, activity areas, water collection features, and petroglyphs. Preservation plans will be developed in consultation with community participants and lineal and cultural descendants.

2. <u>Cultural Resources:</u> *Section 4.2 states that no specific ongoing traditional cultural practices were identified relative to the land within the property. This is false for the community consulted voiced concerns in regard to the disturbance of Ko'oko'olau which is a traditional plant used in Hawaiian medicine. According to Hawai'i Supreme Court ruling, Ka Pa'akai 0 Ka 'Aina v. Land use Commission, State of Hawai 'i. 94 Haw.31 (2000) the developer must take the protection of native Hawaiian culture and rights into consideration. By doing so, the CIA contacted twenty-five people of which eighteen responded. Kaloko Makai is obligated to respond appropriately to their concerns.*

Response: The Cultural Impact Assessment for this project makes reference to the medicinal use of ko'oko'olau (Bidens spp.) on pages v, vi, 60, 61, 72, 76 & 78 and recommends preservation of remaining areas of lowland forest in the project area containing several endangered and threatened native species, including ko'oko'olau.

Existing ko'oko'olau within the Kaloko Makai Dryland Forest Preserve will be preserved and managed through designation of the 150-acre Kaloko Makai Dryland Forest Preserve.

Kaloko Makai looks forward to working with the community on the appropriate harvesting of the ko'oko'olau for traditional and customary practices of the Native Hawaiian people within the Dryland Forest Preserve.

3. <u>Trails and Access:</u> *The DEIS does not provide a preservation plan for the mauka-makai trail which will be opened for public use. Other than a 10-feet wide buffer, there are no mitigation measures that deal with increased pedestrian use, possible bike use, vandalism, pollution and degradation. Incorporating the trail into the*

development will bring resource degradation because they will be used to connect communities. The development states in Section 2.2.1 that the mixed-use community will "emphasize non-vehicular transit for mainstream community-wide travel". In addition to Section 2.2.1, Section 4.2 explicitly outlines concerns voiced by community members regarding the preservation and protection of trails. These concerns must be addressed (Ka Pa'akai 0 Ka 'Aina v. Land use Commission, State of Hawai'i. 94 Haw.31). In addition to trail preservation, trail modifications are subject to federal, state and county rules, regulations and laws. Furthermore, the relocation and realignment of the trail and cultural features found along the existing trail should be done through consultation with community members prior to any site altercations (4-57).

Response: The Kohanaiki Trail bisects the project site and is well defined for most of its alignment until the trail reaches the TMK 7-3-009:017. SCD and their sub-consultant Cultural Surveys Hawai'i (CS) have been consulting with Na Ala Hele to determine the location of the remaining alignment. The alignment shown in Figure 2-11 is the alignment determined based on consultation with Na Ala Hele.

Treatment of Kohanaiki Trail will follow the agreement established after extensive discussions with the interested community at Kaloko Heights. This translates to a 10' wide trail pathway (meandering mauka to makai on what is believed to be the historic alignment) with a 10' wide buffer on each side of the trail (30' wide in total). In places where cut and fill are necessary, the elevation of the trail may change, but the general alignment will not be disturbed.

As noted in the DEIS, "Where the Trail intersects with Hina Lani Drive, Kaloko Makai will realign the remaining lower portion of the Trail from that point to run parallel with and adjoining the Hina Lani Street right-of-way down to Queen Ka'ahumanu Highway."

"Since the integrity of the historic trail is lost at that point, due to prior construction of Hina Lani Street, the adjoining industrial subdivision and the water tank, Kaloko Makai will realign the trail and have it run down the southern boundary of the property (fronting Hina Lani,) from the point of intersection with Hina Lani down to Queen Ka'ahumanu Highway."

"This alignment gives the users of the trail easy access to cross Queen Ka'ahumanu or Hina Lani at the bottom, as there are crosswalks with crossing signals at that point." This is also noted on the Site Plan map of the project.

Additionally, there are two trails that start at the same point on Hina Lani; one is an old stepping stone trail that leads mauka and the other runs across the dryland forest.

These trails are intended to be open for public use.

In addition, the land use plan for Kaloko Makai includes a school and park at the end of one of the trails so residents within the project will be able to walk to and from school via the trail. The other trail will connect to a public street and will allow people easy access to the trail.

The nature of the dryland forest and the reason it appears to be in the good shape is because it is rough and inhospitable a'ā flow. Over the years, even animals such as cattle and goats did not go in this area because it is so rough.

The trail system within the dryland forest will allow it to be accessed by residents and visitors and afford the ability for educational programs as well. Appropriate signage will also be developed to encourage public cooperation and discourage trespassing, vandalism or arson within the Kaloko Makai Dryland Forest Preserve.

4. *Flora/Vegetation: To promote and encourage traditional and customary practices the harvesting of native and introduced woods will be permitted during development land clearing (4-56). Currently, the State of Hawai'i regulates natural resource collection. These regulations promote and encourage Hawaiian traditional and customary practices to continue because primary sources cannot be harmed during gathering processes. The large scale land clearing that will be conducted by the developer will degrade traditional and customary practices. Hawaiian cultural practices will not be perpetuated, but rather eradicated due to intense land clearing.*

   Response: As stated in the DEIS and forthcoming Second DEIS, "To promote and encourage traditional and customary cultural practices, the harvesting of native woods (such as alahee, elama, manele, iliahi and ulei, as well as other exotics like mango) or trees during the grubbing work, will be allowed by cultural practitioners."

   As stated in the Cultural Impact Assessment, ko'oko'olau may be gathered within the existing area. Thus, existing ko'oko'olau within the Kaloko Makai dryland forest preserve will be preserved and managed through designation of the 150-acre Kaloko Makai Dryland Forest Preserve. Ko'oko'olau, as well as, a variety of endangered species within the Preserve will have continued protection and their habitats set aside in perpetuity which will enhance their prospects for survival.

Thus, Hawaiian cultural practices will be perpetuated with the perpetual protection and creation of the dryland forest preserve.

5. *Native Dryland Forest: Kaloko Makai recognizes that: "As the Kaloko Makai development is home to one of the largest remaining areas of Dry land Forest in the Hawaiian Islands. The Dryland Forest is located within the southern portion of the project site. The Dryland Forest is unique in that it has not been heavily impacted by ungulates, and therefore, has minimal impact from alien plant species. This area covers approximately 265 acres (crossing over several ownership boundaries) of an 'a'a lava flow that is much younger than the surrounding pahoehoe flow. Dryland forests are the most impacted ecosystems in the Hawaiian Islands. While 42% of the rain forests in the Hawaiian Islands have been lost, 90% of the Dryland Forests have been eliminated. The remaining 10% has been heavily degraded by introduced plants and ungulates." (Wilson Okamoto Corporation and Ho'okuleana LLC 2011:3-49)*

   In accordance with the mitigation measures recommended by USFWS, Kaloko Makai will create a 150 acre dry forest preserve. The developer will manage invasive species within the project area, implement a fire safety plan, and propagate plants for the impacted ecosystem. Although these mitigation measures will protect more than 90% of the endangered species surveyed, dry land forest systems account for common, threatened, and endangered plant species. Preservation of Hawaii dry land forests must take best ecosystem management practices. These practices provide equal consideration for endangered, threatened and common plant species in relation to the surrounding environment. This approach delineates artificial boundaries created by zoning infrastructure. Hawaiian dry forest ecosystems are disappearing at an alarming rate.

   Environmentally responsible BMP's involve not just the consideration of endangered and threatened species, but the landscape as a whole, for the environment is comprised of common species as well. For example, common plant species such as, pua pilo (Capparis sandwichiana), alahe'e (Psydrax odoratum), 'ohi'a lehua (Metrosideros polymorpha), naio (Myoporum sandwicense) lama (Diospyros sandwicensis), and mamane (Sophora chrysophylla) are natural buffers that prohibit non-native plant species from establishing in the ecosystem. These common plant species are providing a refuge for endangered species like aiea (Nothocestrum brevijlorum), ma'oloa (Neraudia ovata), hala pepe (Pleomele hawaiiensis),and uhiuhi (Cesalpinia kavaiensis). Elimination of these plant species may negatively affect current species.

   Secondly, the Habitat Conservation Plan (HCP) addressed anticipated impacts on the dryland forest. The proposed actions within the HCP are subject to permits

and funding. Currently, no definite funds are available to form the preservation area.

Response: In the anticipated development discussed in the DEIS, only one 'aiea and two hala pepe plants are found outside the dryland forest preserve; the action, then, proposed removal of these plants due to the proposed development. Based on comments during the DEIS process and further evaluation of the project layout, under the development proposal described in the Second Draft EIS, none of the listed endangered plants situated outside the dryland forest preserve will be "taken" in the development and construction of the Kaloko Makai project. It is not anticipated that a Habitat Conservation Plan (HCP) will be prepared.

Instead, Kaloko Makai will leave those plants in place and incorporate a 50-foot buffer around the one 'aiea and two hala pepe and any structure within the project. The plants will be incorporated into landscaping within the 50-foot buffers.

Kaloko Makai will set aside 150-acres in the Kaloko Makai Dryland Forest. Within this preserve, a variety of endangered species will have continued protection and their habitats set aside in perpetuity, enhancing their prospects for survival.

6. *Transportation Improvements: Presently, there are no allocated funds available to deal with the cumulative traffic impacts (Section 4.4). The project will increase traffic congestion within the local vicinity and local roads. Increased use by the development will degrade the current transportation infrastructure. Although there are plans for a mixed-use transit oriented development, currently no funds exist. The lack of funds and increased use will put stress on local residents and the County of Hawai'i to maintain existing standards.*

   Response: The Petitioner will consult with the State and the County to determine appropriate contributions for transportation improvements.

7. *Type of Transit Oriented Development Village: The applicant has offered to provide 40 acres of land for the development of a regional Hospital. The state of Hawai'i will have to allocate the funds to construct, pay for and operate the Hospital facility. These funds are currently lacking for the state is facing economic constraints with supporting existing facilities. Also, project objectives include developing health care facilities in Kona that provide a range of health care services (Section 2.2.1). The donation of 40 acres does not support the project*

objective. Further evidence is needed to support that West Hawai'i will be able to provide and adequately support the increased population.

Response: The Petitioner is actively seeking a hospital developer/operator for the new facility through a public-private partnership. As stated in the DEIS and forthcoming Second DEIS, the Petitioner intends to continue discussions with Kona Hospital, Hawai'i Health System Corporation (KCH, HHSC) concerning the new hospital at Kaloko Makai. However, Kaloko Makai is seeking private entities, as well.

The Kona CDP, as well as residents interviewed for the Social Impact Assessment prepared for this DEIS (Appendix Q), identified the need for a new, centrally-located acute care hospital in North Kona. The Kona CDP states that the new hospital should be located on Ane Keohokālole Highway (Mid-Level Road) for optimum accessibility by automobile or transit.

Given the level of existing development in the Kona region and the appropriate accommodation of projected growth called for in the recently adopted Kona CDP, the region between Kailua-Kona and the Kona Airport was identified for urban growth in both the Hawaii County General Plan and Kona CDP. The Kona CDP provides more specificity as to areas to accommodate growth, including designation of various Transit Oriented Development (TOD) sites, among which is Kaloko Makai.

Policy ECON–1.1 of the Kona CDP states that a hospital serves as a stimulus for the healthcare industry. It further states that Kona needs a new hospital to replace its existing outdated and out-of-place facility, and that the hospital should be located on Ane Keohokālole Highway (Mid-Level Road) for optimum accessibility by automobile or transit.

Additionally, the Kona CDP encourages the private sector to negotiate a site for the hospital by granting any TOD designated as a Neighborhood TOD, automatic Regional TOD status.

8. *Mix-Use Community: Kaloko Makai states that a project objective is to, "Cultivate intrinsic respect for the land and natural surroundings, develop an inherent Hawaiian sense of place and nourish a sustaining living environment"(Section 2.2.1). Meeting this objective is not supported or discussed in the DEIS. Section 4 outlines mitigation measures that have been discussed in previous subsections outlined above. Further evidence is needed to support this statement.*

Response: Preservation of the natural and archaeological resources (i.e. native dryland forest, ahupua'a wall, historic trails, activity areas, burials, habitation sites, markers, petroglyphs etc.) found within the project site will be incorporated into the development of the proposed project. Further discussion is included in the forthcoming Second DEIS.

9. *Conclusion: Responsible planning and design should break Phase developments into individual EIS. Unforeseen long scale implications, such as, environment degradation, insufficient infrastructure, project overestimations, a lack of operation and management funds and capital investment will affect current development plans. Given that one cannot foresee challenges that will arise in 30 years it is strongly suggested that Phase plans be submitted individually. Each Phase will then be better equipped to provide and adjust to the community's needs and County infrastructure. Current plans regarding health facilities, transportation infrastructure, archaeological site and dryland forest system preservation funds are lacking. The lack of funds will affect the overall project plans discussed in the DEIS.*

   Response: The DEIS and forthcoming Second DEIS are prepared pursuant to Chapter 343, HRS, and Title 11, Chapter 200, HAR, Department of Health, State of Hawai`i. The forthcoming Second DEIS includes an in-depth discussion on phasing of the project.

   SCD - TSA Kaloko Makai, LLC is the recorded fee owner of the project site. The Petitioner or its successors will be responsible to fund site work and the construction of on-site and off-site project-related infrastructure including roadways, potable water wells, reservoirs, transmission lines, wastewater transmission lines, and other utilities.

Your letter, along with this response, will be reproduced and included in the forthcoming Second DEIS. We appreciate your participation in the EIS review process.

Sincerely,

Earl Matsukawa, AICP
Project Manager

cc: Mr. Jay Nakamura, Stanford Carr Development
Mr. Daniel Orodenker, State Land Use Commission

Consultant:
Wilson Okamoto Corporation
1907 South Beretania Street, Suite 400
Honolulu, Hawaii 96826

September 20, 2011

TF

Aloha,

In regards to Hinalani development:

I am not in support of building more housing units that we do not need. Who are they for? What do they look like? Is this what the communities really want? Initial investments all look great when new, it's the upkeep after all is said and done that destroy the quality of life in communities. Communities want to be supportive and involved with decision making if they are listened to and not because they don't have the financial backing necessary to be listened to.

Who are the communities members? They are a mixed and interesting breed. If they are like myself, I would say more reserved; while others are more vocal. I am not comfortable having to defend an issue such as this in the public eye. For whatever this is worth I will convey what countless other community members may want to say.

Roadside Hinalani Street, as it stands now, is naturally appealing as it ascends skyward from the sea. It is one of few dry land forest reserves in close proximity to town and the people who live and visit here. What a rare opportunity to use this area to educate the public and visitors on how a dry land forest ecosystem works in a natural park-like setting. The community would much favor working in natural "green space" than buildings and infrastructure that go with heavy development. Treading lightly on the land suits this area best. Highlight the existing historic features of trails, plants, and cultural sites.

Planners and decision makers should work around the scenic beauty and cultural resources that already exists. Failure to do so should not allow development to proceed. Mandatory guidelines for development lack strong cultural context. Which should include seeking out community members associations and documentations to an area to be included in the EIS not only what is physically "on the ground." Our education system will thank you, our communities will love you.

Mahalo,
Lily Anne Souza
73-1223 Melomelo St.
Kailua-Kona, HI 96740

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7469-01
July 25, 2013

Ms. Lily Anne Souza
73-1223 Melomelo St.
Kailua-Kona, HI 96740

Subject: Draft Environmental Impact Statement (DEIS)
Kaloko Makai
Kaloko and Kohanaiki, North Kona, Hawaii
Tax Map Key: (3) 7-3-09: 017, 025, 026, and 028

Dear Ms. Souza:

Thank you for your letter dated September 20, 2011. The Petitioner is preparing a Second DEIS to address changes in the proposed project that will be reassessed, as needed, in the forthcoming document. You will be notified of its availability for review and comment pursuant to Chapter 343, Hawaii Revised Statutes (HRS) and Title 11, Chapter 200 Hawaii Administrative Rules (Department of Health).

With regard to your comments on the subject DEIS, we offer the following in response to your comments:

I am not in support of building more housing units that we do not need. Who are they for? What do they look like? Is this what the communities really want? Initial investments all look great when new, it's the upkeep after all is said and done that destroy the quality of life in communities. Communities want to be supportive and involved with decision making if they are listened to and not because they don't have the financial backing necessary to be listened to.

Response: The County of Hawaii General Plan section 15.1 (February 2005, as amended) calls for the preparation of community development plans "to translate the broad General Plan statements to specific actions as they apply to specific geographical areas." The General Plan requires CDPs be adopted as an "ordinance", giving the plans force of law. The CDPs are long-term plans with a planning horizon to the year 2020, consistent with the General Plan.

The Hawaii County Planning Department recognized that only with broad public input can the Kona residents take ownership of the Kona Community Development Plan (Kona CDP,) by which they may embrace the vision and commit to a better future. Initiated in September 2005, this plan is the result of an extensive public process.

The Hawaii County Mayor and the Hawaii County Council appointed 15 citizens to serve on the Kona CDP Steering Committee, representing a cross-section of the Kona community. Several large community meetings were held. In recognition that the process needed to go to the people, meetings were held at people's homes, churches, and community centers.

One-hundred-and-nine meetings were held throughout Kona from November 2005 through January 2006. All these meetings received input from a balanced demographic and geographic representation of the North and South Kona Districts. Over 800 residents participated in the individual meetings.

Three-hundred-and-fifty people attended the Mapping the Future Workshop to brainstorm where future growth should occur. Breakout groups also addressed critical questions such as housing choice and affordability, agriculture, transportation and land use, congestion, parks/recreation/open space, protection of the environment, hazard mitigation, protection of ancestral and historic sites, community character, retail and tourism.

There were two charrettes, the first held in March 2006 and the other in June 2006. In the first charrette, the public identified alternative growth scenarios and selected a preferred scenario. In the second charrette, the public articulated desired principles to provide details for a preferred scenario.

Eleven working groups made up of citizens and community stakeholders met monthly, from May 2006 – September 2006, to focus in more detail on specific issue areas. Finally, the draft plan was recommended for approval by the Steering Committee, and then it was approved by the County Council and signed into law by the Mayor.

The Kona CDP is the first community development plan to commence under the framework of the February 2005 County of Hawai'i General Plan. The Kona CDP was adopted by County Council via ordinance in September 2008. The purposes of the Kona CDP are:

- Articulate Kona's residents' vision for the planning area;
- Guide regional development in accordance with that vision, accommodating future growth while preserving valued assets;
- Provide a feasible infrastructure financing plan to improve existing deficiencies and proactively support the needs of future growth;
- Direct growth to appropriate areas;
- Create a plan of action where government and the people work in partnership to improve the quality of life in Kona for those who live, work, and visit;

- Provide a framework for monitoring the progress and effectiveness of the plan and to make changes and update it, if necessary.

The General Plan notes, Urban Expansion Areas allow for a mix of high density, medium density, low density, industrial, industrial-commercial and/or open designations in areas where new settlements may be desirable, but where the specific settlement pattern and mix of uses have not yet been determined.

The Kona CDP recognizes that the General Plan LUPAG Urban Area is larger than needed in order to accommodate the projected growth within the planning horizon, so it emphasizes that future growth within the urban area is encouraged in a pattern of compact villages at densities that support public transit.

Transit-Oriented Developments (TODs) and Traditional Neighborhood Developments (TNDs) are identified as the planning tool to manage this anticipated growth within the defined "Kona Urban Area." The Kona CDP defines these as compact mixed-use villages, characterized by a village center within a higher-density urban core, roughly equivalent to a 5-minute walking radius (1/4-mile), surrounded by a secondary mixed-use, mixed-density area with an outer boundary roughly equivalent to a 10-minute walking radius from the village center (1/2-mile).

The distinction between a TOD and TND is that the approximate location of a TOD is currently designated on the Official Kona Land Use Map along the trunk or secondary transit route and contains a transit station, while TND locations have not been designated and may be located off of the trunk or secondary transit route at a location approved by a rezoning action.

According to the Kona-CDP, Transit Oriented Development (TOD) and Traditional Neighborhood Design (TND) Village developments shall exhibit the following characteristics and conform to the following design principles:

a) Commercial Village or Neighborhood Villages with mixed uses. A mixture of non-residential and residential uses of various densities, intensities, and types designed to promote walking between uses and a variety of transportation modes such as bicycles, transit, and automobiles.
b) Functional Villages. Villages are located and designed to embrace a full range of urban facilities including neighborhood retail centers, a variety of housing types, public/civic space and a variety of open space amenities,

c) Walkable streets. Village designs are based on reasonable walking distances, the location of parking, and the design of streetlights, signs and sidewalks.
d) Interconnected circulation network. An interconnected street system that prioritizes pedestrians and bicycle features and links neighborhoods to shopping areas, civic uses, parks and other recreational features.
e) Respect for natural and cultural features. Development activity recognizes the natural and environmental features of the area and incorporates the protection, preservation and enhancement of these features.
f) Public Transit. A major public transit stop shall be located within the Village Center of most Villages.

Transit-Oriented Development (TOD) would integrate housing, employment, shopping and recreation opportunities. Villages would be designed around transit stations/stops which would reduce the need for daily trips and financially support the expanded transit system. TOD Urban Villages are located a minimum of one mile apart, between major transit stations, along Keohokālole Highway trunk route in order to preserve the transit efficiency of this route.

Transect Zones (T-Zones) organize the density, complexity and intensity of the land use within the TOD Village. The operating principle is that there is an urban core with a main center focus such as a transit station and plaza. This urban core area, which is spatially defined based on walkable distances called Pedestrian Sheds, has the highest density, complexity, and intensity of uses. The land uses transition to less dense uses moving away from the center.

The Transect Zones that correspond to the urban core, secondary area and greenbelt referred to in the Kona CDP and Village Design Guidelines are as follows (also noted are the allowable residential densities and building heights in each transect zone):

i. Urban Core
    1. T-5 Urban Center (Maximum density - 30 units per acre)
        i. Mix of residential units, such as townhouses, and apartments mixed with commercial, offices and retail
        ii. Typical Building Height: 2- to 5-Story with some variation (all, excluding attics and raised basements)
    2. T-4 General Urban (Maximum density - 12 units per acre)

        i. Neighborhood commercial uses with single-family and multi-family residential
        ii. Typical Building Height: 2- to 3-Story with a few taller Mixed Use buildings
ii. Secondary Area
    1. T-3 Suburban (Maximum density - 6 units per acre)
        i. Single-family units, with ancillary community and public uses, and neighborhood and convenience-type commercial uses
        ii. Typical Building Height is 1- to 2-Story with some 3-Story
iii. Greenbelt
    1. GB1, GB2 (Maximum density .25 units per acre)
        i. Greenbelt is an undeveloped area and may also serve multi-purpose uses, such as for drainage (e.g., flow ways or retention basins), sensitive resource preserves or wildfire protection buffers
iv. Mixed-Use Industrial
    1. SD1 (Maximum density - 12 units per acre)

The Kaloko Makai project was conceived, planned and designed to be consistent with the Hawaii County General Plan, the Keahole to Kailua Development Plan (K-to-K Plan) and the Kona Community Development Plan (Kona CDP.) Kaloko Makai is situated in the Kona Urban Area of the Kona CDP and Urban Expansion Area in the General Plan and serves to implement these planning documents.

Kaloko Makai is a compact, mixed-use, master-planned community offering a wide range of housing types and affordability, and a variety of businesses and employment opportunities, focused around an initial urgent care medical facility with land available (at no cost) for a new Kona regional hospital.

Kaloko Makai has been designated as a Neighborhood Transit Oriented Development (TOD) in the Official Kona Land Use Map of the Kona Community Development Plan. Kaloko Makai has been planned and designed as a Neighborhood Transit TOD and supports many of the Kona CDP Guiding Principles. Kaloko Makai:

- Directs future growth patterns toward compact centers – Kaloko Makai is planned around a compact urban center within the Kona Urban Area.
- Provides connectivity and transportation choices – Kaloko Makai will be transit-ready and is located along key alignments for regional transportation. Developer SCD will also contribute to the development

of Ane Keohokalole Highway. The Project itself is planned to offer walking and biking trails in addition to vehicular roads.

- Provides housing choices – Kaloko Makai will offer a broad range of housing types including affordable as well as "market-priced" housing units. Offerings will range from traditional single-family homes to mid- and higher-density multifamily homes, and may include live-work and mixed use developments.
- Provides recreation opportunities – Kaloko Makai features a 150-acre dryland forest preserve, as well as numerous community parks, a district-scale park and trails.
- Provides infrastructure and essential facilities concurrent with growth – In addition to the recreational and transportation contributions noted above, Kaloko Makai is planned to include a Hospital and medical complex, Lodge and Business Center, two Elementary Schools and a Middle School.

Kaloko Makai is situated in a region that is rapidly developing, with immediate access to Kona International Airport and is adjacent to the well established commercial and light industrial-service centers of North Kona and Kailua Kona which serve the needs of the visitor, agriculture, ranching, and technology industries, among others, which populate the western half of the island.

As indicated in the Market Study prepared for the project (Appendix A in the DEIS) Kaloko Makai is planned to respond to the market and demographic trends, as well as community needs. The project will serve a County population that is changing in terms of size, geographic dispersion, age profile and lifestyle. Over the course of approximately 30-years Kaloko Makai will deliver the anticipated needed homes in a diverse, planned community.

The target market is the local, rather than the offshore, buyer. Overall, the project is intended to respond to already-anticipated economic growth, rather than to generate more of it. The project's inventory could represent a significant solution for the anticipated future unmet demand for some 9,400-new housing units through 2040, based on currently entitled projects and their plan maximums.

As noted, the maximum densities for the three primary transects of the Kona CDP are as follows: T3 - Sub-Urban Zone, 6-units/acre; T4 - General Urban Zone, 12-units/acre; T5 - Urban Center Zone, 30-units per acre. Given the proposed Kaloko Makai layout, this equates to approximately 11,400-

allowable residential units (however, Kaloko Makai is proposing a total of 5,000-units, less than half the total allowable unit count.)

Kaloko Makai proposes up to 500,000-square feet of gross leasable area of various commercial uses, including retail and office. The market analysis supported development of previously proposed 1.1-million square feet (more than double the presently-proposed commercial space.)

In addition, as supported by the market analysis and consistent with the Kona CDP, a hospital site, 120-room Lodge and Business Center, 75-acres of SD-1 and 150-acre dryland forest preserve will make up the balance of the development.

Who are the communities members? They are a mixed and interesting breed. If they are like myself, I would say more reserved; while others are more vocal. I am not comfortable having to defend an issue such as this in the public eye. For whatever this is worth I will convey what countless other community members may want to say.

Response: Chapter 9 of the DEIS summarizes the consultation process to date for the Kaloko Makai project. The Petitioner's representatives have met with numerous groups and community members regarding the project.

Additionally, with regard to the Kona CDP, as noted in our response to your previous question, the Hawai'i County Planning Department recognized that only with broad public input can the Kona residents take ownership of the Kona Community Development Plan (Kona CDP,) by which they may embrace the vision and commit to a better future. Initiated in September 2005, this plan is the result of an extensive public process.

The Hawaii County Mayor and the Hawaii County Council appointed 15 citizens to serve on the Kona CDP Steering Committee, representing a cross-section of the Kona community. Several large community meetings were held. In recognition that the process needed to go to the people, meetings were held at people's homes, churches, and community centers.

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critical questions such as housing choice and affordability, agriculture, transportation and land use, congestion, parks/recreation/open space, protection of the environment, hazard mitigation, protection of ancestral and historic sites, community character, retail and tourism.

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Eleven working groups made up of citizens and community stakeholders met monthly, from May 2006 – September 2006, to focus in more detail on specific issue areas. Finally, the draft plan was recommended for approval by the Steering Committee, and then it was approved by the County Council and signed into law by the Mayor.

Roadside Hinalani Street, as it stands now, is naturally appealing as it ascends skyward from the sea. It is one of few dry land forest reserves in close proximity to town and the people who live and visit here. What a rare opportunity to use this area to educate the public and visitors on how a dry land forest ecosystem works in a natural park-like setting. The community would much favor working in natural "green space" than buildings and infrastructure that go with heavy development. Treading lightly on the land suits this area best. Highlight the existing historic features of trails, plants, and cultural sites.

Response: Recognizing the importance of this dryland forest, the Petitioner incorporated a large portion (150-acres) of the dryland forest into their preliminary design as the Kaloko Makai Dryland Forest Preserve. By preserving these 150-acres, the Petitioner is ensuring that the Kaloko dryland forest is preserved for generations to come.

Planners and decision makers should work around the scenic beauty and cultural resources that already exists. Failure to do so should not allow development to proceed. Mandatory guidelines for development lack strong cultural context. Which should include seeking out community members associations and documentations to an area to be included in the EIS not only what is physically "on the ground." Our education system will thank you, our communities will love you.

Response: The purpose of the CIA is to consider the effects that the proposed project may have on the culture of Hawaii, and traditional and customary rights. The assessment also considers cultural resources, practices and beliefs

within the broader context of Kaloko Ahupuaa and Kohanaiki Ahupuaa that are relevant to assessing the role of the project area.

The scope of work of the CIA also included conducting oral interviews with persons knowledgeable about the historic and traditional practices in the project area and region. This information is recorded and summarized within the CIA document.

Your letter, along with this response, will be reproduced and included in the forthcoming Second DEIS. We appreciate your participation in the EIS review process.

Sincerely,

Earl Matsukawa, AICP
Project Manager

cc: Mr. Jay Nakamura, Stanford Carr Development
Mr. Daniel Orodenker, State Land Use Commission

September 21, 2011

Michelle Tomas

P O Box 337

Kailua Kona, HI 96745

Response to Kaloko Makai DEIS

RECEIVED
SEP 22 2011

Aloha,

I would like to take the time to comment on the DEIS prepared by Wilson Okamoto Corp on behalf of TSA Kaloko Makai, LLC

In going over the very lengthy document I found many inconsistencies within the document that needs clarification. Chapter 4 page 86 states there will be " ...279 acres of open space, 58 acres of parks, and preservation of 150-acre Dryland Forest." Then on chapter 5 page 8 it says "There will be approximately 297 acres of parks and open space consisting of 89 acres of open space, 58 acres of parks, and preservation of 150-acre Kaloko Makal Dryland Forest." Also on Chapter 5 page 64 under the heading Cultural Resources, Objective CR-3 Preservation of Kanaka Maoli Culture and Island Values. Ensure that our Kanaka Maoli and island values and cultures are preserved and perpetuated.

Policy CR-3.1: Honor Kanaka Maoli culture and heritage. The Kanaka Maoli culture is the foundation of Hawaii's living culture. We must ensure that the Kanaka Maoli people are supported and that this part of our culture is perpetuated. The success of this endeavor will ensure that the way of the Kanaka Maoli will guide our actions and behaviors in the years ahead.

The contradiction is that how can Kaloko Makai preach preservation of the Kanaka Maoli when they specifically say that "Of the 341 sites in the project area, ...a total of seventy two (72) sites be preserved." KM (Kaloko Makai) will in effect destroy trails. On paper when you read "trails" that can evoke a thought of perhaps overgrown grass, but in actuality its water worn stones placed carefully one after the other for miles on a'a lava that once upon a time enabled the Kanaka Maoli of time gone by to walk from their homes in the mountain down to the shore to gather from the shoreline then back home again. These trails, once bulldozed, realigned,

and then "changed" to reflect a sidewalk on the side of Hina Lani road is no longer an ancient trail but a very poor substitute for it. In living celebration of the Kanaka Maoli do not destroy which we hold dear and that is our living culture. Do not bulldoze the trail or the endangered plants. Also on the chopping block is the native and endangered Halapepe, the favorite plant of the Goddess Laka (hula). Also the endangered plant Aiea. While KM says they will "take" the plants Halapepe and Aiea, but plant three each in its place, where is the data suggesting that this out planting will be successful? The importance of preserving an endangered plant in-situ outweighs the out planting of a dozen endangered replacements. The out planted plant may only survive a year or so, and then die, whereas the endangered plant in-situ is already established and with the proper "non disturbance" there is a possibility the plant may provide seeds and data for repopulation.

Also, chapter 2 page 18 states the "Objectives of KM are to .....Cultivate intrinsic respect for the land and natural surroundings, develop an inherent Hawaiian sense of place and nourish a sustaining living environment." Once again bulldozing the Ko'oko'olau (which many of us use for medicinal purposes- as a tea) and the many plants, and sites will not promote or help anyone "cultivate intrinsic respect for the land and natural surroundings, or help us develop an inherent Hawaiian sense of place."

Another contradiction is on Chapter 2 page 39 it states "....the estimated overall cost for a new regional hospital is approximately $300 to $500 million." Then again on Chapter 2 page it states "...costs for the construction and development of the hospital will be in the range of $152 million."

Aside from those concerns another major concern is Density. The picture KM paints is one that Kona will have a housing shortage. Chapter 2 page 19-20 states "...current & competitive housing opportunities with the market do not satisfy forecasted demands." I sense an "If you build it, they will come" mentality. Do we really want this high density development here? Do we really want a community that reflects one that is similar to Waikiki, right when people fly into Kona? Is KM trying to fulfill the so-called future housing shortage by building all the necessary housing for the forecasted shortfall in this one development? KM describes the development area as being 1,138.866 acres (chapter 1 page 1), then on Chapter 5 page 8 it says that there will be ..."297 acres of parks and open space, 150 acres of Dry land Forest", the DEIS also states they will donate 40 acres to the Hospital, 43 acres for three Schools, 10 acres for the Judiciary Complex, 1 million square feet of various commercial uses, additional acreage for a desalinization plant, a wastewater treatment plant, a Fire station, a Police sub-station (chpt 4 pg. 87), in addition to the buffer areas. Will this leave suitable acreage for the building of 5,000 homes? Unrealistic, high density development is the picture that is being painted here.

An area of concern is the "affordable housing" claim. Chapter 1 page 11 "...traffic-generated noise to the community will be mitigated by adequate setbacks from the highway, in conformance with federal highway standards, sound attenuating walls, total closure and air-conditioning, in addition to the utilization of sound attenuating windows and window fixtures." Then on Chapter 2 page 20 KM states "Pricing of affordable units at the project will be set in accordance with County or State guidelines to be determined in consultation with government agencies. For illustrative purposes, according to county guidelines in effect as of September 1, 2010, conforming affordable housing prices will include:

- For-sale units priced from $202,500 to $366,200 for those offered to families of two to four persons earning 110% to 120% of the median income; and
- One- to two bedroom rental units priced from $1,307 to $1,500 per month, including utilities, and offered to households earning 80% to 100% of the median income. "

Can this price range of homes be realistic in view of the homes being totally enclosed with air conditioning, and the utilization of sound attenuating windows and window fixtures, and also the utilization of LEED concepts (Chapter 2 page 60) during the development of KM?

Another area of high importance is of the potential impact of water runoff. We (my family) fish off the shores of Honokohau, Kaloko, as well as O'oma and surrounding areas of Kona. Numerous local families pole fish, spear fish as well as throw net as a means of providing dinner off these shorelines. I am deeply concerned the runoff from this high density development will have on the fish that we consume. How many times have you washed your car in your driveway, now multiply this by the thousands. 5,000 units will have at least 2 cars per household. Runoff from parks maintenance, home landscaping, and other personal uses will not doubt affect the sea life makai of the development.

The development of Kaloko Makai as written in their DEIS is shortsighted and not culturally sensitive. Its calls for the desecration of culturally sensitive areas, the eradication of endangered plants with no data suggesting successful replacement, the relocation of an ancient (chicken skin kine) and very treasured trail. It doesn't have enough input from members of the community that will be directly affected by this development. The density is too high, scale back.

In closing I would like to go back to my opening paragraph and reference Chapter 5 page 64 under the heading "Cultural Resources, Objective CR-3 Preservation of Kanaka Maoli culture and Island Values. Ensure that our Kanaka Maoli and island values and cultures are preserved and perpetuated." Why can't we co-exist with our iwi kupuna...why does one have to exist with the desecration of another? Why can't we give the iwi kupuna the respect of not disturbing them? Let them rest in peace. Let them rest in peace. Preserve ALL burials. Once upon a time the feet of our ancestors walked on the water worn stones in the a'a lava fields. The trails are a treasure, a testament of where we came from and how we can teach all the children of Hawaii about how this beautiful culture survived, and how we can allwork together for a greater good. The trail can be a focal point for schools to work on maintaining it. It can be a part of a living classroom. This can be a first of its kind development within Kona that incorporates the historic environment within its master plan. ... With the community's support.

Mahalo Nui for your consideration.

Aloha,

Michelle Tomas

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7469-01
July 25, 2013

Ms. Michelle Tomas
P.O. Box 337
Kailua Kona, HI 96745

Subject: Draft Environmental Impact Statement (DEIS)
Kaloko Makai
Kaloko and Kohanaiki, North Kona, Hawaii
Tax Map Key: (3) 7-3-09: 017, 025, 026, and 028

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In going over the very lengthy document I found many inconsistencies within the document that needs clarification. Chapter 4 page 86 states there will be "...279 acres of open space, 58 acres of parks, and preservation of 150-acre Dryland Forest." Then on chapter 5 page 8 it says "There will be approximately 297 acres of parks and open space consisting of 89 acres of open space, 58 acres of parks, and preservation of 150-acre Kaloko Makai Dryland Forest."

Response: The above referenced inconsistencies have been corrected in the forthcoming Second DEIS.

Also on Chapter 5 page 64 under the heading Cultural Resources, Objective CR-3 Preservation of Kanaka Maoli Culture and Island Values. Ensure that our Kanaka Maoli and island values and cultures are preserved and perpetuated. Policy CR-3.1: Honor Kanaka Maoli culture and heritage. The Kanaka Maoli culture is the foundation of Hawaii's living culture. We must ensure that the Kanaka Maoli people are supported and that this part of our culture is perpetuated. The success of this endeavor will ensure that the way of the Kanaka Maoli will guide our actions and behaviors in the years ahead.

The contradiction is that how can Kaloko Makai preach preservation of the Kanaka Maoli when they specifically say that "Of the 341 sites in the project area, a total of

seventy two (72) sites be preserved." KM (Kaloko Makai) will in effect destroy trails. On paper when you read "trails" that can evoke a thought of perhaps overgrown grass, but in actuality its water worn stones placed carefully one after the other for miles on a'a lava that once upon a time enabled the Kanaka Maoli of time gone by to walk from their homes in the mountain down to the shore to gather from the shoreline then back home again. These trails, once bulldozed, realigned, and then "changed" to reflect a sidewalk on the side of Hina Lani road is no longer an ancient trail but a very poor substitute for it. In living celebration of the Kanaka Maoli do not destroy which we hold dear and that is our living culture. Do not bulldoze the trail or the endangered plants. Also on the chopping block is the native and endangered Halapepe, the favorite plant of the Goddess Laka (hula). Also the endangered plant Aiea. While KM says they will "take" the plants Halapepe and Aiea, but plant three each in its place, where is the data suggesting that this out planting will be successful? The importance of preserving an endangered plant in-situ outweighs the out planting of a dozen endangered replacements. The out planted plant may only survive a year or so, and then die, whereas the endangered plant in-situ is already established and with the proper "non disturbance" there is a possibility the plant may provide seeds and data for repopulation.

Response: The project area is indeed rich in archaeological resources. However, because it is well away from the coast and poorly watered, the project site has always been somewhat "rural", with few sites that can be associated with events or broad patterns of history (Criterion A), nor can they be associated with specific persons (Criterion B), or show distinctive characteristics or represent the work of a master (Criterion C).

Seventy two of the sites surveyed are presently recommended to be preserved. While many of these sites-to-be-preserved do have a burial function, many of them have other functions as well. Other types of sites recommended for preservation include trails, ahupuaa walls, ceremonial enclosures and platforms (possible heiau), excellent examples of temporary and permanent habitation complexes, animal husbandry walls, activity areas, water collection features, and petroglyphs. Preservation plans will be developed in consultation with community participants and lineal and cultural descendants.

It should be understood that all discussion of site types, functions, and mitigations should not be considered finalized until the AIS is approved by SHPD. A total of 57 trail remnants are described. While many of these are recommended for preservation, many are also recommended for no further work. Notably, many of the trail remnants are relatively short, on the order of 10 m. long. The SHPD has always supported judicious consideration of site preservation, typically on a case-by-case basis.

The Kaloko Makai development is consistent with the Kona CDP including Policy CR-3.1 Honor Kanaka Maoli Cultural and Heritage.

The Kohanaiki Trail ("Road to the Sea" Trail) bisects the project site and is well defined for most of its alignment until the trail reaches the TMK 7-3-009:017. SCD, with their sub-consultant Cultural Surveys Hawai'i, has been consulting with Na Ala Hele to determine the location of the remaining alignment. The alignment shown in Figure 2-11 is the alignment determined based on consultation with Na Ala Hele.

Treatment of Kohanaiki Trail will follow the agreement established after extensive discussions with the interested community at Kaloko Heights. This is represented by a 10' wide trail pathway (meandering mauka to makai on what is believed to be the historic alignment) with a 10' wide buffer on each side of the trail (30' wide in total). In places where cut and fill are necessary, the elevation of the trail may change, but the general alignment will not be disturbed.

As noted in the DEIS and the forthcoming Second DEIS, "Where the Trail intersects with Hina Lani Drive, Kaloko Makai will realign the remaining lower portion of the Trail from that point to run parallel with and adjoining the Hina Lani Street right-of way down to Queen Ka'ahumanu Highway. Since the integrity of the historic trail is lost at that point, due to the construction of Hina Lani Street, the adjoining industrial subdivision and the water tank, Kaloko Makai will realign the trail and have it run down the southern boundary of the property (fronting Hina Lani,) from the point of intersection with Hina Lani down to Queen Kaahumanu Highway. This alignment gives the users of the trail easy access to cross Queen Kaahumanu or Hina Lani Street at the bottom, as there are crosswalks with crossing signals at that point." This is also noted on the Site Plan map of the project.

Additionally, there are two trails that start at the same point on Hina Lani; one is an old stepping stone trail that leads mauka and the other runs across the dryland forest. These trails are intended to be open for public use. The land use plan for Kaloko Makai includes a school and park at the end of one of the trails so residents within the project will be able to walk to and from school via the trail. The other trail will connect to a public street and will allow people easy access to the trail.

The trail system within the dryland forest will allow it to be accessed by residents and visitors and afford opportunities to educational programs as well.

As described within the Kaloko Makai Dryland Forest Habitat Conservation Plan (HCP), appropriate signage will be developed to encourage public cooperation and discourage trespassing, vandalism or arson within the Kaloko Makai Dryland Forest Preserve

All archaeological sites that were discovered by Kaloko Makai's archaeologists, CSH, were recorded in Kaloko Makai's AIS and were given a recommendation by CSH ranging from preservation to no further work.

The AIS was submitted to SHPD on October 30, 2008; to date the SHPD has not accepted nor rejected Kaloko Makai's AIS or archaeologists' recommendations.

In regards to the plant species, in the anticipated development discussed in the Draft EIS, only one 'aiea and two hala pepe plants are found outside the dryland forest preserve; the action, then, proposed removal of these plants due to the proposed development. Based on comments during the DEIS process and further evaluation of the project layout, under the development proposal described in the Second Draft EIS, none of the listed endangered plants situated outside the dryland forest preserve will be "taken" in the development and construction of the Kaloko Makai project. It is not anticipated that a Habitat Conservation Plan (HCP) will be prepared.

Instead, Kaloko Makai will leave those plants in place and incorporate a 50-foot buffer around the one 'aiea and two hala pepe and any structure within the project. The plants will be incorporated into landscaping within the 50-foot buffers.

Kaloko Makai will set aside 150-acres in the Kaloko Makai Dryland Forest. Within this preserve, a variety of endangered species will have continued protection and their habitats set aside in perpetuity, enhancing their prospects for survival.

Also, chapter 2 page 18 states the "Objectives of KM are to .....Cultivate intrinsic respect for the land and natural surroundings, develop an inherent Hawaiian sense of place and nourish a sustaining living environment." Once again bulldozing the Ko'oko'olau (which many of us use for medicinal purposes- as a tea) and the many plants, and sites will not promote or help anyone "cultivate intrinsic respect for the land and natural surroundings, or help us develop an inherent Hawaiian sense of place."

Response: Preservation of the natural and archaeological resources (i.e. native dryland forest, ahupua'a wall, historic trails, activity areas, burials, habitation sites, markers, petroglyphs etc as noted in the AIS) found within the project site will be incorporated into the development of the proposed project.

Further discussion is included in the forthcoming Second DEIS.

Existing ko'oko'olau within the Preserve will be managed through the designation of the 150-acre Kaloko Makai Dryland Forest Preserve.

Another contradiction is on Chapter 2 page 39 it states " ....the estimated overall cost for a new regional hospital is approximately $300 to $500 million." Then again on Chapter 2 page it states "...costs for the construction and development of the hospital will be in the range of $152 million."

Response: Theses inconsistencies have been corrected in the forthcoming Second DEIS.

Aside from those concerns another major concern is Density. The picture KM paints is one that Kona will have a housing shortage. Chapter 2 page 19-20 states " ...current & competitive housing opportunities with the market do not satisfy forecasted demands." I sense an "If you build it, they will come" mentality. Do we really want this high density development here? Do we really want a community that reflects one that is similar to Waikiki, right when people fly into Kona? Is KM trying to fulfill the so-called future housing shortage by building all the necessary housing for the forecasted shortfall in this one development? KM describes the development area as being 1,138.866 acres (chapter 1 page 1), then on Chapter 5 page 8 it says that there will be ..."297 acres of parks and open space, 150 acres of Dry land Forest", the DEIS also states they will donate 40 acres to the Hospital, 43 acres for three Schools, 10 acres for the Judiciary Complex, 1 million square feet of various commercial uses, additional acreage for a desalinization plant, a wastewater treatment plant, a Fire station, a Police sub-station (chapter 4 pg. 87), in addition to the buffer areas. Will this leave suitable acreage for the building of 5,000 homes? Unrealistic, high density development is the picture that is being painted here.

Response: As stated in the DEIS, Mikiko Corporation prepared a Market Assessment for Kaloko Makai. The report is included in its entirety as Appendix A. The report states, "Kaloko Makai is located within proximity to regions that will continue to be the focus of further development as the Island's population grows, and has the potential to be a major cornerstone of residential, commercial, and light industrial growth as a center of community, commercial, and economic activity." An updated Market Assessment by

Mikiko Corporation will be include and referenced in the forthcoming Second DEIS.

Kaloko Makai is planned to respond to the market and demographic trends as well as the community needs. The Kaloko Makai development is consistent with the Kona CDP which calls for a range of densities.

The Kona CDP allows Kaloko Makai to be designated a Regional Center TOD, since the proposal includes land reserved for a regional hospital. Nevertheless, heeding the community's desire for a lower density development, the Petitioner has decided to develop a Neighborhood TOD, (which it is designated on the Official Kona Land Use Map of the Kona CDP.) This change is reflected in the forthcoming Second DEIS.

Please note that one of the alternatives described in Chapter 7 of the DEIS and forthcoming Second DEIS is the development of a "Maximum Density TOD." This alternative assumes the existing Kaloko Makai layout (Figure 2-11,) including the GB, T3, T4, T5 and SD1 transects, and the Traditional Neighborhood Design component in the mauka-south portion of the property, are allocated units to each "T" transect according to the maximum allowable density permitted in the Kona CDP.

The maximum densities for the three primary development transects of the Kona CDP are as follows: T3 - Sub-Urban Zone, 6-units/acre; T4 - General Urban Zone, 12-units/acre; T5 - Urban Center Zone, 30-units per acre. This equates to approximately 11,400 residential units (however, Kaloko Makai is proposing a total of 5,000-units, less than half the total allowable unit count).

In addition, as supported by the market analysis and consistent with the Kona CDP, 600,000 square feet of Commercial (Office/Retail); 120-room Lodge and Business Center; 75-acres of SD-1 and 150-acre Dryland Forest Preserve will make up the balance of the development.

Thus, the current proposed development is far below the Maximum Density TOD alternative that allows approximately 11,400 residential units.

An area of concern is the "affordable housing" claim. Chapter 1 page 11 "...traffic-generated noise to the community will be mitigated by adequate setbacks from the highway, in conformance with federal highway standards, sound attenuating walls, total closure and air conditioning, in addition to the utilization of sound attenuating windows and window fixtures." Then on Chapter 2 page 20 KM states "Pricing of affordable units at the project will be set in accordance with County or State

guidelines to be determined in consultation with government agencies. For illustrative purposes, according to county guidelines in effect as of September 1, 2010, conforming affordable housing prices will include:

- *For-sale units priced from $202,500 to $366,200 for those offered to families of two to four persons earning 110% to 120% of the median income; and*
- *One- to two bedroom rental units priced from $1,307 to $1,500 per month, including utilities, and offered to households earning 80% to 100% of the median income. "*

Can this price range of homes be realistic in view of the homes being totally enclosed with air conditioning, and the utilization of sound attenuating windows and window fixtures, and also the utilization of LEED concepts (Chapter 2 page 60) during the development of KM?

Response: As stated in the DEIS and forthcoming Second DEIS, Kaloko Makai would consist of homes ranging from traditional single-family residences to mixed-use, mid- and higher-density multifamily units. The exact mix of units by type will be determined upon finalizing agreements with government agencies and during the years of build-out, as market conditions and preferences are determined.

The County sets the guidelines for affordable housing prices and the Petitioner will follow these guidelines as required by law. The prices reflected in the DEIS and the forthcoming Second DEIS are for illustrative purposes. Pricing of affordable units at the project will be set in accordance with County or State guidelines to be determined in consultation with government agencies.

Another area of high importance is of the potential impact of water runoff. We (my family) fish off the shores of Honokohau, Kaloko, as well as O'oma and surrounding areas of Kona. Numerous local families pole fish, spear fish as well as throw net as a means of providing dinner off these shorelines. I am deeply concerned the runoff from this high density development will have on the fish that we consume. How many times have you washed your car in your driveway, now multiply this by the thousands. 5,000 units will have at least 2 cars per household. Runoff from parks maintenance, home landscaping, and other personal uses will not doubt affect the sea life makai of the development.

Response: The design concept for the drainage system is to eliminate surface runoff from leaving the site. Natural areas, pits, and dry wells will collect runoff and allow it to infiltrate rather than leave the site as surface water. The passage of such runoff from the ground surface to the groundwater below, though the unsaturated (vadose) zone, provides natural filtration and

adsorption. Surface runoff from most of the developed areas in Kailua-Kona is handled in a similar manner without identifiable adverse impacts to groundwater or the Makai environment.

The development of Kaloko Makai as written in their DEIS is shortsighted and not culturally sensitive. Its calls for the desecration of culturally sensitive areas, the eradication of endangered plants with no data suggesting successful replacement, the relocation of an ancient (chicken skin kine) and very treasured trail. It doesn't have enough input from members of the community that will be directly affected by this development. The density is too high, scale back.

Response: Please see previous responses related to cultural sites, endangered plants, trails and density.

In closing I would like to go back to my opening paragraph and reference Chapter 5 page 64 under the heading "Cultural Resources, Objective CR-3 Preservation of Kanaka Maoli culture and Island Values. Ensure that our Kanaka Maoli and island values and cultures are preserved and perpetuated." Why can't we co-exist with our iwi kupuna...why does one have to exist with the desecration of another? Why can't we give the iwi kupuna the respect of not disturbing them? Let them rest in peace. Let them rest in peace. Preserve ALL burials. Once upon a time the feet of our ancestors walked on the water worn stones in the a'a lava fields. The trails are a treasure, a testament of where we came from and how we can teach all the children of Hawaii about how this beautiful culture survived, and how we can all work together for a greater good. The trail can be a focal point for schools to work on maintaining it. It can be a part of a living classroom. This can be a first of its kind development within Kona that incorporates the historic environment within its master plan....With the community's support.

Response: As stated in the DEIS and forthcoming Second DEIS, there are a total of sixty-five (65) confirmed burials at more than thirty sites (55% of these are located in parcel 26.) All of the confirmed and suspected burials will be preserved in perpetuity pursuant to a burial treatment plan prepared in consultation with recognized descendants and the Hawai'i Island Burial Council. The other preservation sites will be treated in accordance with a preservation plan submitted to and approved by State Historic Preservation Division (SHPD) prior to final subdivision approval.

Treatment of Kohanaiki Trail will follow the agreement established after extensive discussions with the interested community at Kaloko Heights. Additionally, the trail system within the dryland forest will allow it to be

accessed by residents and visitors and afford the opportunity to conduct educational programs, as well.

Your letter, along with this response, will be reproduced and included in the forthcoming Second DEIS. We appreciate your participation in the EIS review process.

Sincerely,

Earl Matsukawa, AICP
Project Manager

cc: Mr. Jay Nakamura, Stanford Carr Development
Mr. Daniel Orodenker, State Land Use Commission

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